Introduction

NCEPOD operates under the umbrella of the National Patient Safety Agency (NPSA) as an independent confidential enquiry, whose main aim is to improve the quality and safety of patient care. Evidence is drawn from all sections of hospital activity in England, Wales, Northern Ireland, Guernsey, the Isle of Man and the Defence Sector, both NHS and private. We are very grateful to all those who take part as advisors, local reporters and as recipients of individual case reporting forms. I would also like to express my sincere thanks to our clinical co-ordinators and all the permanent staff of NCEPOD for the enormous amount of work and enthusiasm which they have put into the production of this report and without which we could not hope to perform such detailed analysis of, and comment upon, clinically-related hospital activity.

Once again we have produced a summary report to accompany distribution of the detailed data both on CD ROM and also on the NCEPOD website, both of which allow major advances in the presentation of our data. Unlike traditional NCEPOD studies and in keeping with our new title of National Confidential Enquiry into Patient Outcome and Death, this is a cohort study looking at a specific area of clinical activity, namely, the management of abdominal aortic aneurysm (AAA). This was a fully representative sample of all patients admitted to hospital with an AAA during the study period, not just of those who died after operation, and thus provided us with good denominator data.

There were 844 patients included in the study, 752 of which involved open operations, 53 of which involved endovascular repairs and 79 of which were patients who did not undergo operation but received palliative care. It had been hoped to carry out case-mix adjustment for the different groups, but this was not possible because the risk data for those patients admitted as emergencies were missing more often than for those admitted for elective treatment. The overall mortality for open elective operation was 6.2% and for emergency operations it was six times higher at 36%.

Abdominal aortic aneurysm is a life threatening condition and once a decision has been made to operate, this should be carried out as expeditiously as possible. In patients scheduled for elective major vascular surgery, numerous factors contribute to delays, not least of which is the availability of high dependency and intensive care facilities. Operations are frequently cancelled due to lack of an available critical care bed and the patients in this study were no exception; one in six elective cases having their operation postponed. Not infrequently, the lack of a critical care bed only becomes apparent at the last minute and because AAA repairs are major procedures which occupy several hours operating, large amounts of theatre, surgical and anaesthetic time are wasted with the inevitable knock-on effect on waiting lists. For patients presenting as an emergency, where surgical repair of a ruptured aneurysm is considered life saving, critical care bed availability may be a secondary consideration, but in busy units on major vascular take, for what may be a large catchment area, patients not infrequently spend several hours in the immediate postoperative period waiting for a bed to become free. During this critical time when cardiovascular stability, respiratory function, fluid management, analgesia and temperature control require constant monitoring by experienced staff, such situations are far from ideal. Of those patients undergoing elective surgical or endovascular repair, 56% went to ICU after treatment and 34% went to HDU. The remaining 9% of elective patients were nursed in a dedicated theatre recovery area for an extended period after surgery, though whether this was normal practice in those hospitals, by offering 24 hour recovery facilities or as a result of a shortage of critical care beds is uncertain.

Many of these patients have significant comorbidities, which inevitably require preoperative

assessment and treatment, but nevertheless, of those scheduled for elective admission 21% spent more than 12 weeks on the waiting list and 18 patients admitted as an emergency had been on the waiting list for elective repair. Since morbidity increases with increasing aneurysm size and still further with intraluminal leaking or rupture, there is often a fine line to be drawn between optimising a patient's clinical condition in terms of cardiorespiratory system and delaying surgery beyond a certain time.

Vascular surgery is a sub-specialty in which close co-operation and team work between surgeon and anaesthetist is essential to ensure optimal management and patient outcome and this was certainly confirmed by this study. There was excellent consultant involvement in both elective and emergency cases (97% for both anaesthetists and surgeons in elective cases), which is undoubtedly a key factor in the high quality of care delivered to these patients.

Inevitably, a number of hospitals and clinicians were performing very small numbers of AAA repairs, particularly as emergencies, with only 57% of hospitals having an on-call rota for vascular surgery and only 3% reporting an on-call rota for vascular anaesthesia. While the published evidence shows that the outcome of elective AAA repair is better when hospitals and surgeons are performing large numbers of cases and therefore, ideally, this is not the operation for the occasional practitioner, the situation, particularly for emergency cases, is far from satisfactory in many parts of England, Wales and Northern Ireland. This is often simply related to isolated hospitals, where the risks of transferring an acutely ill patient (and usually the only method of transport is by road) with a leaking or ruptured aneurysm are considered greater than operative treatment by a general surgeon in the isolated hospital. The situation is changing nationally, in that, while many of the more senior general surgeons based in district general hospitals certainly have had vascular surgical training and therefore possess the necessary skills and experience, younger surgeons are frequently highly specialised in more limited surgical areas. Few of us would wish to be the isolated surgeon confronted by a major vascular problem which in his and the anaesthetist's view, is unfit for transfer.

Encouragingly, the patients in this study who were transferred did not do worse than patients directly admitted to the operating hospital. However, they are a selected group considered fit for transfer and who survived that transfer. It is difficult to be sure for an individual patient that transfer produces better results than staying put, since considerable additional risk and morbidity can result from delay and transfer, before the benefits of treatment in a specialised unit are realised. Every case is different and factors to be considered include comorbidity, the transfer distance and time and the mode of transport. Equally the benefit of the unit in which surgery will be undertaken is as much about supporting facilities such as critical care provision, haemodialysis etc., as about surgery. Although a surgeon may be geographically isolated, many of the other available facilities may be as good as or better than those available at a tertiary centre, particularly if postoperative critical care facilities in the receiving hospital are severely stretched or unavailable. Many small hospitals still undertake significant numbers of similar cases involving substantial blood loss and rapid transfusion in seriously ill patients. Some tertiary units now run a dedicated on-call outreach service; this team may prefer to travel to the isolated hospital rather than subject a critically ill and cardiovascularly unstable patient to a prolonged transfer in far from optimal conditions. Solutions for improving the service for patients with AAA may therefore differ between geographical areas.

In the case of elective AAA treatment, the well-recognised problem of low case numbers is more relevant and referral or transfer is normally in the patient's best interests. There is little to support surgeons continuing to treat single figure numbers of elective cases on a regular annual basis.

Although the diagnosis and monitoring of abdominal aortic aneurysm by CT scan is widely available and routinely used for elective cases, the availability of specialised imaging services

outside normal working hours in many units was considered poor. Whilst in four out of five hospitals that had a CT scanner it was possible to have a CT scan out of hours, only half of all hospitals could organise out of hours angiography or interventional radiography and in only one third was MRI scanning available out of hours. Painful and leaking AAAs are often difficult to confirm in the face of alternative differential diagnoses and this study emphasises that Trusts should ensure the availability of diagnostic radiology services including CT scanners outside normal working hours, for all seriously ill patients. Failure to do so will allow the acute aneurysm to progress to frank leakage or rupture before the diagnosis is apparent, when the outcome for the patient may be considerably worse as a result.

Although a total of 79 patients received palliative care, the question of when not to operate is a very difficult one and a greater proportion of emergency patients were operated on rather than received palliative care in large vascular units, compared to intermediate sized or remote units. This may of course reflect the greater experience and skill of specialist vascular surgeons in large units, but advanced aortic vascular disease is a malignant condition in all but name, rendering the patient terminally ill and this should always be borne in mind. In emergency cases in particular, and in patients with significant cardiorespiratory comorbidity, the decision not to operate, linked to properly considered and administered palliative care, should be considered positively and in full consultation with the patient or his or her advocate.

Although only a small number (53) of patients in this study underwent endovascular repair (EVAR), their good outcome is in accordance with published trials. Of these, only one was ruptured and treated as an emergency, the vast majority were unruptured and asymptomatic. Since successful endovascular stenting requires that the patient is cardiovascularly stable, this method of treatment is limited at present, but increased diagnosis and endovascular treatment of asymptomatic aneurysms will undoubtedly reduce the number which eventually leak or rupture. The results of the recent UK EVAR trials show that in low risk patients (those fit for open repair), endovascular repair is significantly more efficacious in preventing aneurysm-related death than operative repair for four years after operation and therefore should be offered to all patients in this category. In contrast, no survival benefit was demonstrated for EVAR over best medical therapy in patients unfit for EVAR. While this does not mean that no unfit patient should ever be offered EVAR, it does mean that every effort should be made to render unfit patients as fit as possible.

There are many recommendations arising from this report, a number of which are as much about organisation of existing facilities as about transferring or centralising services. Major elective surgery should not be considered or take place unless all essential elements of perioperative care are available. Trusts should take action to improve access to Level 2 beds for patients undergoing elective aortic aneurysm repair so as to reduce the number of operations cancelled and inappropriate use of either recovery area beds or Level 3 beds. In addition, in those units where vascular surgery patients routinely receive postoperative mechanical ventilation, anaesthetic departments and critical care units should review together whether those patients could be managed in a Level 2 high dependency unit.

Clinicians, commissioners and Trusts are encouraged to review whether elective aortic aneurysm surgery should be concentrated in fewer hospitals and to take measures to ensure that surgeons, who do not routinely perform elective vascular surgery, only operate on emergency aortic aneurysms in exceptional circumstances. Equally, isolated surgeons should not be put in the impossible position of receiving a critically ill patient through the A&E department with no support from an outreach or transfer service and no alternative but to operate. Anaesthetic departments are urged to review the allocation of vascular lists so as to reduce the number of anaesthetists caring for very small volumes of aortic surgery cases.

The perioperative diagnosis and management of AAA and in particular symptomatic and emergency

cases, is a major consumer of surgical, anaesthetic, radiological and critical care resources. Inevitably these cases compete with other patients for such facilities and significant advances in the treatment of AAA will have a major impact in this area. While it is vital to ensure optimal care for such severely ill patients, it is also important to try to produce good evidence based data to inform the decision-making process in key areas such as the transfer of a critically ill patient with a ruptured aneurysm to a tertiary centre and also to ensure that the decision of whether to opt for surgical, endovascular or palliative care is taken in the best interest of the patient.

Dr. Peter Simpson
Chairman - NCEPOD

Acknowledgements

This is the eighteenth report published by NCEPOD and, as always, could not have been achieved without the support and co-operation of a wide range of individuals and organisations. Our particular thanks go to the following:

- The expert group and advisors who worked with NCEPOD staff to understand the findings of this study and who are listed here:

Mr S Ashley	Consultant Vascular Surgeon, Plymouth Hospitals NHS Trust
Dr P Bayly	Consultant Anaesthetist, Newcastle upon Tyne Hospitals NHS Trust
Mr J M F Clarke	Consultant General and Vascular Surgeon, Norfolk and Norwich University Hospital NHS Trust
Professor S Gallivan	Clinical Operational Research Unit, University College London
Miss M Harvey	General Manager, Critical Care, Mayday University Hospital NHS Trust
Mrs M Ibbetson	Lay representative
Mr R M Kirby	Consultant Surgeon, University Hospital of North Staffordshire NHS Trust
Mr G T Layer	Consultant Surgeon, Royal Surrey County Hospital NHS Trust and NCEPOD Trustee
Dr J Mayet	Consultant Cardiologist, St Mary's NHS Trust and Imperial College London
Dr R More	Consultant Cardiologist, Blackpool Fylde and Wyre Hospitals NHS Trust
Dr A Nicholson	Consultant Radiologist, Leeds Teaching Hospitals NHS Trust and NCEPOD steering group member
Dr D Prytherch	Senior Research Fellow, University of Portsmouth and Portsmouth Hospitals NHS Trust
Dr A Taylor	Consultant in Anaesthesia and Intensive Care, City Hospitals Sunderland NHS Trust
Dr D Thomas	Consultant Anaesthetist, University Hospital of North Durham
Dr S Thomas	Consultant Radiologist, Sheffield Teaching Hospitals NHS Trust
Dr M Utley	Clinical Operational Research Unit, University College London
Mrs M Wang	Lay representative
Dr D Whitaker	Consultant Anaesthetist, Central Manchester and Manchester Children's University Hospitals NHS Trust and NCEPOD steering group member

- The local reporters in each hospital who work tirelessly to ensure full participation by their organisation
- All those clinicians who contributed to the study by completing questionnaires
- The organisations who provided funding to cover the cost of this study and who are listed here:

National Patient Safety Agency
Department of Health, Social Services and Public Safety (Northern Ireland)
Aspen Healthcare
Benenden Hospital
BUPA
Capio Group
Covenant Healthcare Ltd

Cromwell Hospital
Department of Health and Social Security, Isle of Man Government
Fairfield Independent Hospital
HCA International Ltd
Horder Centre
Hospital Management Trust
Hospital of St John & St Elizabeth
King Edward VII Hospital
King Edward VIIs Hospital Sister Agnes
London Clinic
McIndoe Surgical Centre
Mount Alvernia Hospital
Netcare Healthcare
New Victoria Hospital
North Wales Medical Centre
Nuffield Hospitals
Orchard Hospital
St Anthony's Hospital
St Joseph's Hospital
Spencer Wing, Queen Elizabeth the Queen Mother
Hospital States of Guernsey Board of Health
Ulster Independent Clinic

- The professional organisations that support our work and who constitute our Steering Group:

Association of Anaesthetists of Great Britain and Ireland
Association of Surgeons of Great Britain and Ireland
Coroners' Society of England and Wales
Faculty of Dental Surgery of the Royal College of Surgeons of England
Faculty of Public Health of the Royal Colleges of Physicians of the UK
Institute of Healthcare Management
Royal College of Anaesthetists
Royal College of General Practitioners
Royal College of Nursing
Royal College of Obstetricians & Gynaecologists
Royal College of Ophthalmologists
Royal College of Pathologists
Royal College of Physicians of London
Royal College of Radiologists
Royal College of Surgeons of England

- The Steering Group, clinical co-ordinators and chief executive would like to record their appreciation of the hard work of the NCEPOD staff: Philip Brown, Heather Cooper, Marisa Cullinane, Steven Dowling, Stacey Emmett, Dolores Jarman, Deon Palmer, Neil Smith, Carmen Tsang and Donna Weyman.

Disclaimer

This work was undertaken by NCEPOD, which received funding for this report from the National Patient Safety Agency. The views expressed in this publication are those of the authors and not necessarily those of the Agency.

Recommendations

Recommendations are listed by chapter.

3. Organisation of vascular services

Trusts should ensure the availability outside normal working hours of radiology services including CT scanners.

Clinicians, purchasers, Trusts and Strategic Health Authorities should review whether elective aortic aneurysm surgery should be concentrated in fewer hospitals.

Major elective surgery should not take place unless all essential elements of the care package are available.

4. Surgery

Patients with an aortic aneurysm requiring surgery must have equal priority with all other patients with serious clinical conditions for diagnosis, investigation and treatment.

Trusts should take action to improve access to Level 2 beds for patients undergoing elective aortic aneurysm repair so as to reduce the number of operations cancelled and inappropriate use of Level 3 beds.

Trusts should ensure that clinicians of the appropriate grade are available to staff preoperative assessment clinics for aortic surgery patients.

Strategic Health Authorities and Trusts should co-operate to ensure that only surgeons with vascular expertise operate on emergency aortic aneurysm patients, apart from exceptional geographical circumstances.

5. Anaesthesia

Trusts should ensure that anaesthetists can identify the major cases that they have managed in order to support audit and appraisal.

Anaesthetic departments should review the allocation of vascular cases so as to reduce the number of anaesthetists caring for very small volumes of elective and emergency aortic surgery cases.

Trusts should ensure they that they have robust systems for the postoperative care of epidural catheters with accompanying appropriate documentation.

Anaesthetic departments and critical care units should review together whether vascular surgery patients who routinely receive postoperative mechanical ventilation could be managed in a Level 2 High Dependency Unit breathing spontaneously.

1. Method

Introduction

Recent studies in the detection[1] and management[2] of Abdominal Aortic Aneurysms (AAA) have focused on screening programmes and clinical interventions to reduce mortality in this group of patients. Further studies have addressed the cost and outcome implications of providing care for patients with AAAs[3] and the organisation of vascular services[4].

This report describes the process of care of elective (surgical and endovascular repair) and emergency patients in relation to outcome and also describes the process of care of emergency patients when a decision was made not to operate.

This work was supported by the Vascular Society of Great Britain and Ireland (VSGBI), the Vascular Anaesthetic Society of Great Britain and Ireland (VASGBI) and the Royal College of Radiologists.

1. Method

Sample size & data collection

1,129 operated cases and 106 non-operated cases were expected during the study period. These figures were based on a percentage of the data from Hospital Episode Statistics (HES) in England, Wales and Northern Ireland for the year 2002/03. An estimate was made for cases from the independent sector.

Retrospective data collection took place for two months from 1st February until 31st March 2004.

1. Method

Hospital participation

All relevant National Health Service hospitals in England, Wales and Northern Ireland were expected to participate, as well as relevant hospitals in the independent sector, public hospitals in the Isle of Man and Guernsey and the Defence Secondary Care Agency.

1. Method

Population

Data were collected from two groups of patients:

- Adults (≥16 years of age) that underwent surgery for the first time repair of an AAA; both elective and emergency procedures were included, as well as endovascular repair.
- Adults who were diagnosed with an AAA but did not undergo surgery and subsequently died in hospital during the same hospital episode.

Patients undergoing a repeat repair of an AAA or surgery that was for complications arising from the initial repair of the AAA were excluded.

1. Method

Identification of sample cases

Sample cases were identified by NCEPOD local reporters. This was done either at the end of each month or at the end of the two month period. Cases were identified as samples if they were coded with one of the Office of Population Census and Surveys' (OPCS) procedure codes or International Classification of Diseases' (ICD) diagnosis codes which are listed in Table 1.

Table 1. OPCS and ICD codes used to identify sample cases	
OPCS Procedure codes (4th Revision)	
L18.3	Emergency replacement of aneurysmal segment of suprarenal abdominal aorta by anastomosis of aorta to aorta
L18.4	Emergency replacement of aneurysmal segment of infrarenal abdominal aorta by anastomosis of aorta to aorta
L18.5	Emergency replacement of aneurysmal segment of abdominal aorta by anastomosis of aorta to aorta nec
L18.6	Emergency replacement of aneurysmal bifurcation of aorta by anastomosis of aorta to iliac artery
L18.8	Emergency replacement of aneurysmal segment of aorta - other specified
L18.9	Emergency replacement of aneurysmal segment of aorta - other unspecified
L19.3	Replacement of aneurysmal segment of suprarenal abdominal aorta by anastomosis of aorta to aorta nec
L19.4	Replacement of aneurysmal segment of infrarenal abdominal aorta by anastomosis of aorta to aorta nec
L19.5	Replacement of aneurysmal segment of abdominal aorta by anastomosis of aorta to aorta nec
L19.6	Replacement of aneurysmal bifurcation of aorta by anastomosis of aorta to iliac artery nec
L19.8	Replacement of aneurysmal segment of aorta - other specified
L19.9	Replacement of aneurysmal segment of aorta - other unspecified
ICD Diagnosis codes (10th Revision)	
I71.0	Dissecting aneurysm of aorta (ruptured) [any part]
I71.3	Abdominal aortic aneurysm, ruptured
I71.4	Abdominal aortic aneurysm, without mention of rupture
I71.8	Aortic aneurysm of unspecified site, ruptured (Rupture of aorta NOS)
I71.9	Aortic aneurysm of unspecified site, without mention of rupture: aneurysm, hyaline necrosis, dilatation of aorta

1. Method

Questionnaires

For each patient a maximum of three clinical questionnaires were to be completed. The questionnaires were either sent to the NCEPOD local reporter to disseminate or directly to the clinician involved, depending upon the choice of the hospital.

A questionnaire was completed by the surgeon that performed the aneurysm repair or made the decision not to operate if the patient did not undergo surgery. In cases where surgery was not performed and the patient died before being seen by a surgeon, the admitting consultant was asked to complete the questionnaire. This questionnaire covered aspects such as comorbidities, preoperative assessment and details of the operation.

A separate questionnaire was also completed by the senior anaesthetist involved in the repair or decision not to operate and covered details about preoperative investigations and the anaesthetic.

If endovascular repair of the aneurysm was performed, a supplementary questionnaire was sent to the radiologist involved in the case.

Hospitals were also asked to complete an organisational questionnaire relating to the facilities at the hospital.

1. Method

Quality and confidentiality

A number of predetermined key fields on each questionnaire had been set to ensure that data analysis could be performed effectively. If these key fields were not completed on receipt of the questionnaire by NCEPOD, the NCEPOD local reporter or clinician was contacted to see if the data could be obtained.

Once the questionnaire was as complete as possible, the identifying casenote number on each questionnaire was entered into an encryption programme that generated a new unique number for each patient that was not linked to a hospital. The original casenote number was then removed from the questionnaire, along with any identifiable information relevant to the patient or clinician.

The data from all questionnaires received were electronically scanned into a preset database. Prior to any analysis taking place, the data were cleaned to ensure that there were no duplicate records and that erroneous data had not been entered during scanning. Any fields that contained spurious data that could not be validated were removed.

1. Method

Data analysis

All data were analysed using Microsoft Access and Excel by the staff at NCEPOD. The data were aggregated before review by the NCEPOD clinical co-ordinators and advisors.

During the course of the study, large amounts of data were collected about many different aspects of the management of AAA. Analysis of these data has focused on providing descriptive statistical analyses. No attempt has been made to carry out formal statistical hypothesis testing and hence no p-values are presented. This is because the study was not designed with a priori hypotheses in mind. Also if significance testing were to be carried out for every analysis provided, then correcting for multiple comparison on such a large scale would render all results insignificant. On the other hand, retrospectively to choose a small number of analyses to subject to hypothesis testing would not be scientifically valid.

1. Method

Risk-stratified models of clinical outcome

Prytherch et al[5] have shown that it is possible to develop models that accurately predict the risk of adverse outcome (mortality in this case) following admission for general surgery, using data that is routinely collected in hospitals. Models have been developed for both patients undergoing operation and those not undergoing operation. Data items required were: urea, sodium, potassium, haemoglobin, white cell count, age on admission, sex, mode of admission and classification of operation. Subsequent work shows that inclusion of albumin and creatinine levels may improve the models. These models were applied to the totality of general surgical admissions
– no attempt was made to model separate sub-specialties. However, this model has been successfully applied to the analysis of the VSGBI National Vascular Database[6] using the same limited data items which has generated the Vascular Biochemical and Haematological Outcome Modelling (V-BHOM) model[7].

It had been originally hoped to carry out case-mix correction using V-BHOM, to examine if for example, there was a systematic difference in the risk profiles of patients treated at large centres compared to others. Unfortunately, it was found that there was an imbalance in the availability of the data that such risk adjustment depends on. Risk data concerning emergency admissions were more frequently missing than for elective cases. In view of this, risk adjustment using only the risk data that are available might well give a very distorted representation of actuality and so risk adjustment has been omitted.

1. Method

Advisor group

A multidisciplinary group of advisors reviewed the aggregated data. The group comprised of vascular surgeons, general surgeons who took part in on-call rotas, anaesthetists, intensivists, cardiologists, vascular radiologists, a theatre manager and two lay representatives. The aim of this group was to discuss and comment on the findings and to suggest any further analysis that should be performed.

1. Method

References

1 Multicentre aneurysm screening study (MASS): cost effectiveness analysis of screening for abdominal aortic aneurysms based on four year results from randomised controlled trial. BMJ. Nov 2002; **325**: 1135.

2 Rose DF, Davidson IR, Hinchliffe RJ, Whitaker SC, Gregson RH, MacSweeney ST, Hopkinson BR. Anatomical suitability of ruptured abdominal aortic aneurysms for endovascular repair. J Endovasc Ther. 2003; **10(3)**: 453-7.

3 Michaels J, Brazier J, Palfreyman S, Shackley P, Slack R. Cost and outcome implications of the organisation of vascular services. Health Technology Assessment 2000; 4(11).

4 Vascular Surgical Society of Great Britain and Ireland. The Provision of Emergency Vascular Services. 2001.

5 Prytherch DR, Sirl JS, Weaver PC, Schmidt P, Higgins B, Sutton GL. Towards a national clinical minimum data set for general surgery. Br J Surg 2003; **90(10)**: 1300 – 1305.

6 Vascular Society of Great Britain and Ireland. Fourth National Vascular Database Report. 2004. http://www.vascularsociety.org.uk/docs/nvdr2004.pdf

7 Vascular Surgical Society of Great Britain and Ireland. National Vascular Database Report. 2002.

2. Overview of data collected

Introduction

This section provides a general overview of the data received and the study population.

2. Overview of data collected

Hospital participation

226 hospitals, identified as possibly performing surgical or endovascular repair of an abdominal aortic aneurysm (AAA), were sent an organisational questionnaire. 188 of these hospitals returned a questionnaire, whilst 38 hospitals did not and gave us no reason as to why they should not participate in the study. Four of these 38 hospitals contributed to the National Vascular Database operated by the VSGBI [1]. Seven of the 188 hospitals that returned organisational questionnaires were excluded, based on answers in their questionnaires, leaving 181 hospitals to take part in the study. Of these, 163 were NHS hospitals and 18 were independent hospitals.

Of the 181 hospitals identified by returned organisational questionnaires, 137 hospitals completed at least one clinical questionnaire, 21 reported no cases for either month and 23 returned no questionnaires and did not tell us that there were no cases. Of the 23 hospitals that returned no questionnaires, one hospital said they were too understaffed and did not have time to participate and two hospitals returned questionnaires after the deadline.

2. Overview of data collected

Population

Figure 1 demonstrates how the sample population was divided between procedure and admission type. It can be seen that in this study the majority of cases underwent a repair of their aneurysm; in only 9% (79/884) was a decision made not to operate or the patient died before receiving surgery. Of the repairs performed, 93% (752/805) were done by an open surgical procedure and more commonly as an elective procedure.

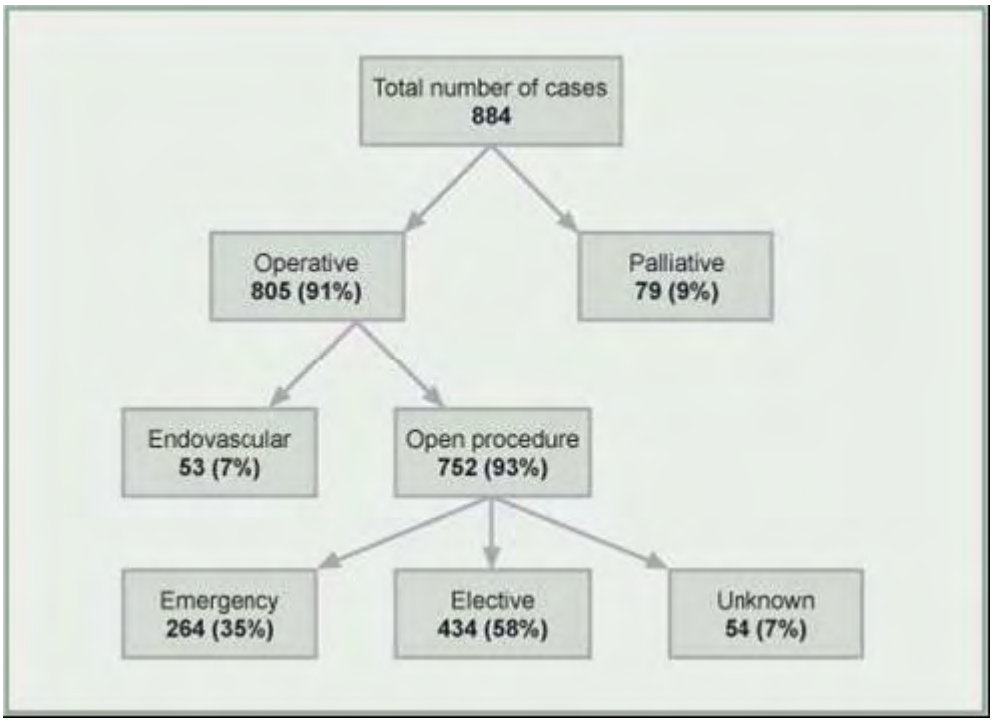


Figure 1. An overview of the study sample cases

2. Overview of data collected

Data received

Figure 2 provides an overview of the number of clinical questionnaires returned. More surgical questionnaires were returned as some of these would have been completed by the admitting consultant when a patient died before being seen by the surgeon and anaesthetist.

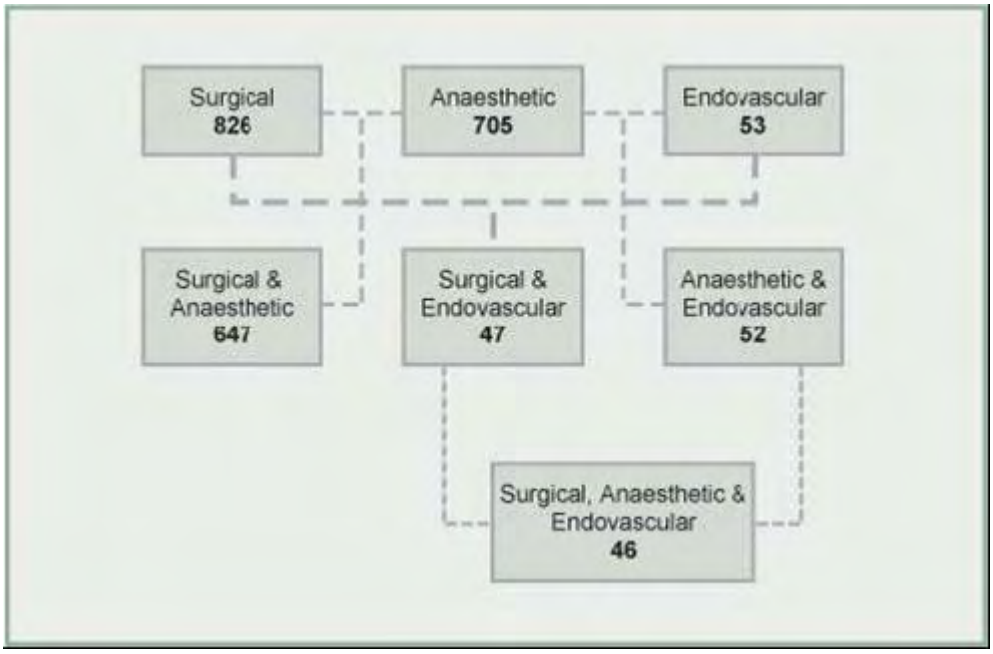


Figure 2. Overview of questionnaires returned

2. Overview of data collected

Denominator data

Information on 805 of the expected 1,129 operated cases were received and on 79 of the expected 106 non-operated cases. This represents 71% and 75% respectively. The hospitals that did not return questionnaires could account for some of this missing data.

2. Overview of data collected

Age and Sex

Figure 3 demonstrates the distribution of age of all the patients included in this study.

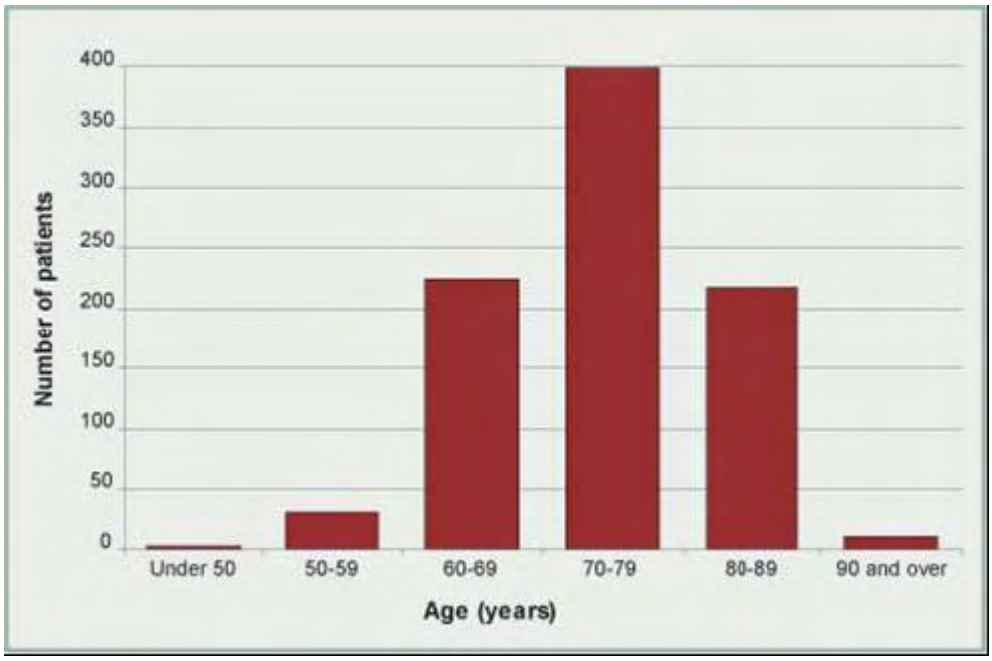


Figure 3. Distribution of age of study population

The mean (SD) age of this group of patients was 74.0 (7.7) years and 83.5% were male. This is consistent with the fact that AAAs are more common in males over the age of 65 [2]. The mean (SD) age of patients operated on was 73.0 (7.3) compared with a mean (SD) age of 82.6 (6.8) in those patients where surgery was not performed.

2. Overview of data collected

References

1 The Vascular Society of Great Britain and Ireland. National Vascular Database Report. 2004.

2 Lederle FA, Johnson GR, Wilson SE, et al. The aneurysm detection and management study screening program: validation cohort and final results. Aneurysm Detection and Management Veterans Affairs Cooperative Study Investigators. Arch Intern Med 2000; **160**: 1425-30.

3. Organisation of vascular services

Introduction

Patients with an abdominal aortic aneurysm should expect to be cared for in a setting with the appropriate facilities available, and treated by staff of the right expertise. These criteria should apply whether the patient is undergoing elective or emergency aortic aneurysm repair. This chapter will examine how well hospitals met these requirements.

3. Organisation of vascular services

Size of vascular unit

Hospital staff completing the organisational questionnaire were asked to classify the size of the vascular unit at their hospital as large, intermediate or remote:

Large vascular unit: Hospital with sufficiently large catchment population (at least 500,000) to employ at least four vascular surgeons and the potential for an on-site vascular rota.

Intermediate vascular unit: Hospital with catchment population of less than 500,000, fully equipped for vascular surgery but with insufficient vascular surgeons for an on-site emergency rota.

Remote vascular unit: Separated by long distances from other hospitals, and usually serving small catchment population.

Figure 1 shows how hospitals classified themselves. 47 hospitals were classified as large units, 106 as intermediate and 16 as remote. For 12 hospitals the question was not answered. Of the 884 patients in this study, 411 were cared for in larger vascular units, 411 in intermediate units and 19 in remote vascular units. The size of unit was not given for 43 patients.

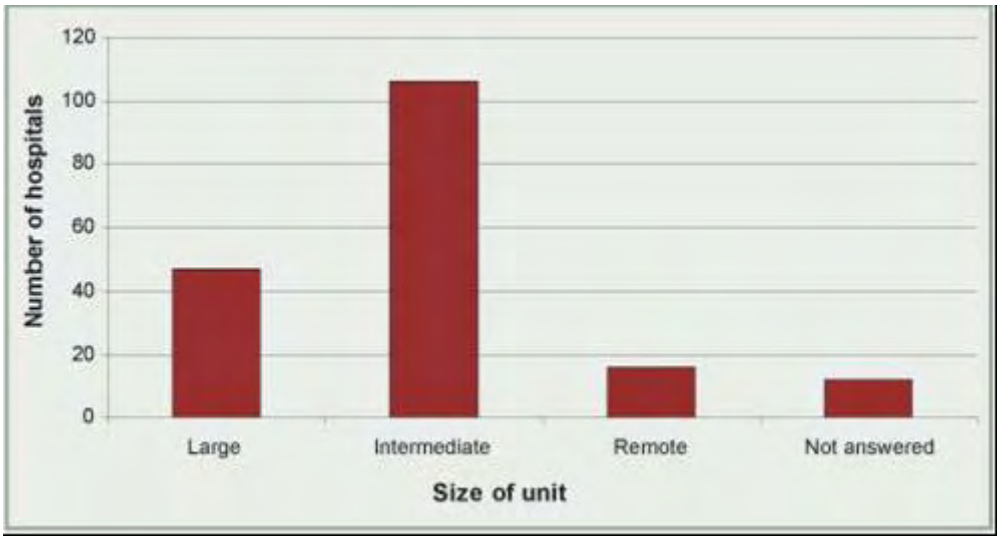


Figure 1 . Size of vascular unit n=181

3. Organisation of vascular services

Imaging facilities >> Elective patients

Poor availability of radiology services out of hours was common.

Imaging is crucial to the successful care of patients with aortic aneurysms. Proper imaging before elective repair will establish the true size of the aneurysm and thus whether the patient should be advised to undergo operation, or whether it might be better to continue with observation only. Imaging will establish the precise anatomy of the aneurysm, information necessary to decide on the operation required. Furthermore, the operation indicated may require particular facilities that need to be planned in advance. Full knowledge of the patient's particular anatomy and the procedure required is essential before the surgeon can properly inform the patient of the risks and benefits of AAA repair when seeking consent for the operation.

Table 1. General availability of different imaging facilities according to size of vascular unit

	Angiography	%	CT scanner	%	Interventional radiology	%	MRI scanner	%	Ultrasound	%
Large	45	100	46	100	44	98	44	96	47	100
Intermediate	100	96	104	99	98	94	95	91	106	100
Remote	13	81	16	100	12	75	14	88	16	100
Total	**158**	**96**	**166**	**99**	**154**	**93**	**153**	**92**	**169**	**100**

Percentages refer to the number of hospitals with the facilities available as a proportion of the total number of hospitals that replied to that particular question.

There was little difference in provision of services between different sized units (Table 1). Provision was less good in remote units but the numbers of such units was small. One should note that respondents may have interpreted the question regarding availability of 'Interventional radiology' as including procedures such as biliary stenting, and may not have restricted an affirmative answer to vascular procedures only. Similarly, the affirmative answers as to the availability of ultrasound may refer to ultrasound in general; hospitals that answered "Yes" may not necessarily have access to **vascular** ultrasound services.

Table 1 shows that nearly all hospitals performing aortic aneurysm repair have the imaging modalities required to care for such patients. Superficially this is reassuring. However, NCEPOD's advisors were strongly of the opinion that these services are not necessarily readily accessible to vascular surgery patients. Department of Health targets specified that by 2001 there should be a maximum two month wait from GP referral to treatment for breast cancer and that this standard should be rolled out to other cancer sites so that by 2005 all cancers would be treated within two months of referral by their GP. In order to meet these targets, patients with cancer are given a high priority for radiological investigations. In contrast, the advisors reported that patients who do not have cancer, for example those with aortic aneurysms who need a CT examination before surgery, can wait several months before the appointment for their CT examination. Although not malignant, large AAAs (greater than 6 cms diameter) pose a threat to life and require urgent treatment. Is it acceptable that patients with an AAA should carry a 85% risk of dying [1,2] should their aneurysm rupture while they wait for their appointment, whilst other patients receive greater priority?

3. Organisation of vascular services

Imaging facilities >> Emergency patients

Many patients admitted as an emergency with a diagnosis of ruptured aortic aneurysm do not need any imaging before being transferred to the operating theatre. In fact when the diagnosis of a ruptured aneurysm is obvious from the clinical history and examination, any delay for further investigation may compromise the chances of a successful outcome. However, in other cases where the patient's haemodynamic status is acceptable and the diagnosis of ruptured aortic aneurysm is in doubt, imaging may be required. Clearly it is essential that facilities for radiological investigations are available 24 hours a day.

Table 2 shows the proportion of facilities that were available out of hours using data from all hospitals.

Table 2. Out of hours availability of different imaging facilities according to size of vascular unit

	Angiography	%	CT scanner	%	Interventional radiology	%	MRI scanner	%	Ultrasound	%
Large	29	64	36	78	27	61	15	34	29	62
Intermediate	46	46	85	82	41	42	25	26	74	70
Remote	5	38	11	69	6	50	5	36	11	69
Total	**80**	**51**	**132**	**80**	**74**	**48**	**45**	**29**	**114**	**67**

Percentages refer to the number of hospitals with the facilities available as a proportion of the total number of hospitals that replied to that particular question.

Whilst in four out of five hospitals that had a CT scanner it was possible to have a CT scan out of hours, only half of hospitals could organise out of hours angiography or interventional radiography, and in only one third was MRI scanning available out of hours. It is surprising how many hospitals are unable to provide a comprehensive range of imaging facilities out of hours. This obviously has implications for all patients admitted as emergencies. Given that a CT scan is usually the most important investigation for patients with an aortic aneurysm [3] it is disappointing that the proportion of CT scanners available 24 hours a day is not 100%. Some CT scanners are initially funded via cancer initiatives, but all hospitals admitting patients with aortic aneurysms should provide the resources for 24 hour working for all patients. Are patients told if the hospital to which they are being admitted does not provide a full range of imaging for emergency patients?

One reason for the poor provision of out of hours services in interventional radiology is the shortage of consultants. A survey was carried out by the Royal College of Radiologists Audit Office on behalf of the British Society of Interventional Radiologists in 1999 and 2000, covering the whole of the United Kingdom [4]. This identified 165 hospitals with surgical vascular services. At that time there were only 87 specialist vascular radiologists. Approximately half were single handed. Returns for this study showed that 33% of hospitals had an on-call rota for interventional radiology. In many hospitals interventional radiologists will participate in the general radiology on-call rota. If a patient requires an emergency interventional radiology procedure on a day when the on-call radiologist does not have interventional skills, the hospital depends on the goodwill of an interventional radiologist to come back into the hospital to provide the service.

The ability to provide out of hours imaging facilities depends on the size of the hospital. Table 2 shows that angiography, interventional radiology and MRI scanning were more likely to be available in large vascular units compared to intermediate or small units. However, even in large vascular units, many hospitals were unable to provide a satisfactory imaging service out of hours.

NCEPOD has no information as to why most hospitals could provide a satisfactory service to meet clinical need whereas others of a similar size could not.

3. Organisation of vascular services

Hospital workload

Hospitals were asked to supply the number of elective and emergency aneurysm repairs performed in the financial year 2002/03. The data for endovascular procedures are considered in a separate chapter.

>> Numbers of elective open operations

49 hospitals performed 10 or fewer elective aortic aneurysm repairs in 2002/03.

The figures for elective surgery for different sized units are shown in Figure 2.

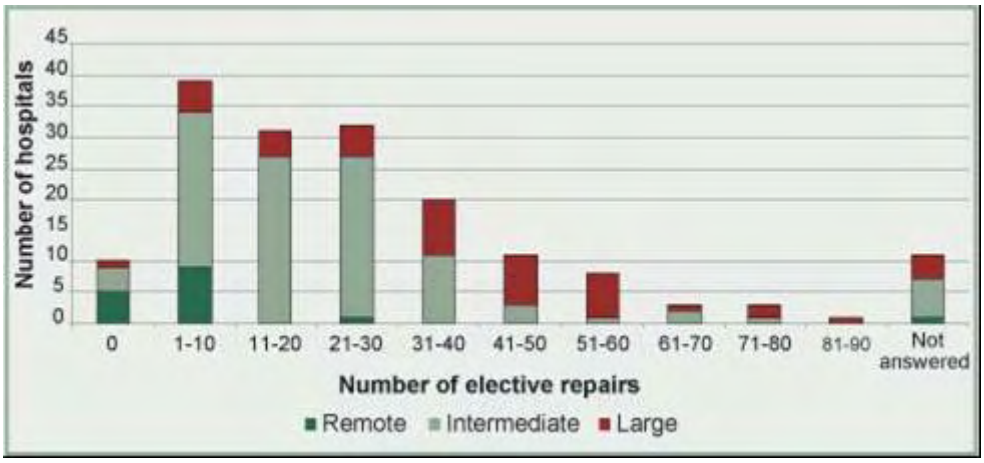


Figure 2. Number of elective open repairs performed in year 2002/03 by size of unit n=181

As expected, larger units had a bigger workload. However the numbers of operations performed at some hospitals appears remarkably small. Six large units reported performing 10 or fewer elective AAA repairs in 2002/03, and 29 intermediate hospitals reported performing 10 or fewer (fewer than one a month). All but one of 15 remote units reported performing 10 or fewer procedures. In total 31% (49/158) of hospitals performed 10 or fewer elective open AAA repairs in the 12 month period. It must be remembered that this is the total for the whole institution. Individual surgeons and anaesthetists will have done fewer cases in the year than this.

3. Organisation of vascular services

Hospital workload >> Emergency open repairs

87 hospitals performed 10 or fewer emergency aortic aneurysm repairs in 2002/03.

The pattern is repeated for emergency open repairs (Figure 3).

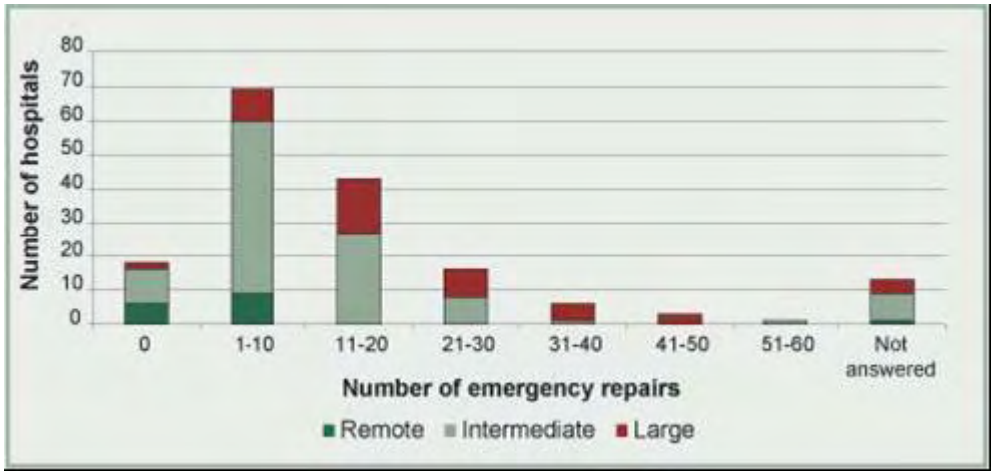


Figure 3. Number of emergency open repairs performed in year 2002/03 by size of unit n=181

Again, some hospitals report performing small numbers of open emergency AAA repairs. 11 large units and 61 intermediate sized units reported doing 10 or less emergency repairs in 2002/03. In total 56% (87/156) of hospitals performed 10 or fewer open AAA repairs on patients admitted as an emergency in the 12 month period.

3. Organisation of vascular services

Hospital workload >> Elective versus emergency repairs

There was a great variation between hospitals in the number of elective operations performed compared to the number of emergency operations. Figure 4 plots the elective to emergency ratio for all hospitals that did at least one elective and one emergency aortic aneurysm repair in 2002/03. Three hospitals carried out no elective repairs in 2002/03 but at least one emergency repair.

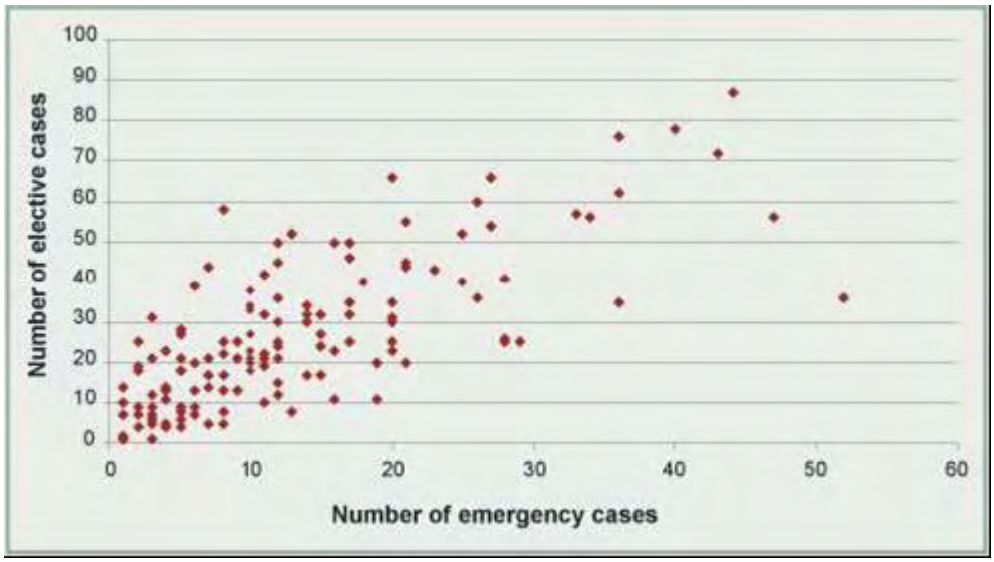


Figure 4. Number of emergency open repairs by number of elective open repairs n=137/181

It is remarkable that there should be such a variation in the pattern of work. Some hospitals had a ratio of two elective operations to one emergency operation, whilst in others the ratio was reversed. NCEPOD has no data that would explain why there should be such variations in the pattern of work, even between hospitals that were performing substantial numbers of procedures. Nor does NCEPOD have the data to analyse whether there is a difference in outcome between hospitals that correlates with the difference in the proportion of elective to emergency operations performed.

3. Organisation of vascular services

Hospital workload >> Volume of procedures versus outcome for open operation

Many people feel intuitively that it is better for major procedures to be performed by staff who do such operations regularly, but is this true, and if so, what number of procedures is it necessary to perform to confer competency and good outcomes? The numbers of procedures done by individual hospitals were too small for meaningful examination of whether there was an association between volume of work and outcome by individual hospital. Therefore, hospitals were grouped according to whether they performed fewer elective open AAA repairs (low volume group) or more elective repairs (high volume group) than the median value for the number of elective repairs reported for 2002/03. For each group NCEPOD has calculated the number of patients who died within 30 days of operation and the number who were alive at 30 days. The results are shown in Table 3.

Table 3. Outcome of elective cases by number of elective open procedures performed in hospital in the previous year

Outcome	Volume of cases						
	Low	%	High	%	Sub-total	Not answered	Total
Died within 30 days	11	6	14	7	25	2	**27**
Alive at 30 days	185	94	173	93	358	47	**405**
Sub-total	**196**		**187**		**383**	**49**	**432**
Not answered	1		1		2	0	**2**
Total	**197**		**188**		**385**	**49**	**434**

There does not appear to be a pattern to suggest that there is a reduced proportion of deaths associated with hospitals that perform a greater number of operations. A similar representation of the outcome of emergency operations is shown in Table 4.

Table 4. Outcome of emergency cases by number of elective open procedures performed in hospital in the previous year

Outcome	Volume of cases						
	Low	%	High	%	Sub-total	Not answered	Total
Died within 30 days	45	40	32	29	77	17	**94**
Alive at 30 days	68	60	77	71	145	25	**170**
Total	**113**		**109**		**222**	**42**	**264**

There do appear to have been proportionately fewer deaths in the hospitals performing a greater volume of operations, but the total number of operations is not large. The relationship of outcome and the size of vascular unit is considered later in this chapter.

If it is not possible to draw firm conclusions from these data, is there other evidence from published sources that could help interpret the findings of this study that many hospitals are performing small numbers of procedures?

3. Organisation of vascular services

Hospital workload >> Published evidence

Numerous studies of surgical practice in recent years have examined the relationship between the volume of procedures performed and outcome. Birkmeyer[5] used Medicare data from the United States to look at the effect of the number of operations performed by a hospital on the outcome of mortality, for 14 procedures. Mortality decreased as volume increased for all 14 procedures, although the strength of the effect varied between different types of procedure.

One of the procedures examined was elective repair of unruptured aortic aneurysm. There were over 140,000 such operations in the Medicare population in the study period. Figures were adjusted for a number of risk factors including mode of admission. Taking the risk adjusted odds ratio for hospitals performing less than 17 cases a year as one, the ratio for hospitals doing 31-49 cases a year was 0.70 (confidence intervals [CI] 0.64-0.76), and for hospitals doing greater than 79 cases a year the odds ratio was 0.58 (0.53-0.65).

A second paper by Birkmeyer[6] used two years' data from the United States from Medicare patients to examine the interaction of a surgeon's volume of cases with the hospital workload. Surgeons working at a large hospital will probably do a large number of procedures, but some individual surgeons working in high volume hospitals may do a low number of procedures. This may or may not affect outcome. The paper examined how much of the observed phenomenon of reduced mortality at high volume hospitals should be ascribed to the volume of work performed by the surgeon, for a number of procedures. For repair of non-ruptured abdominal aortic aneurysm, surgeons were divided into low, medium and high volume surgeons on the basis of performing less than eight, eight to 17.5, and greater than 17.5 aneurysm repairs annually. The adjusted odds ratio for operation in a low volume hospital (as defined for this study) compared to a high volume hospital was 1.4. Of this variation 57% could be ascribed to variations in the volume of operations performed by the surgeon. (As a comparison, 100% of the variation in aortic valve surgery outcome could be ascribed to the effect of the volume of work of the surgeon.)

A paper by Urbach[7] examined data for five complex procedures from Canadian hospitals. This paper showed an adjusted odds ratio of 0.62 (CI 0.46-0.83) for repair of unruptured AAAs at high volume hospitals compared to low volume hospitals (number of aneurysm repairs 6,279). This study also found that for some combinations of procedures, improved outcome in one procedure was associated with high volumes of another procedure.

These results from studies with much greater numbers than the number of unruptured AAAs in this study (434 elective AAA repairs, 86 emergency unruptured repairs) show that outcome is better when both surgeon and hospital undertake greater rather than smaller volumes. Presumably the effect of hospital volume reflects expertise and resources in anaesthesia, intensive care, nursing care, laboratory and imaging services and so forth.

The definitions of low volume and high volume used in these studies were constructed for the purpose of analysis and cannot be used to set levels of work to define good practice. The Leapfrog Group[8] is an American collaboration of 170 organisations that purchase healthcare. The Group's aims are to improve the safety, quality and affordability of healthcare. It has suggested that hospitals should perform a minimum volume of 50 elective AAA repairs a year. Only 19 hospitals in this study achieved this level of work.

3. Organisation of vascular services

Hospital workload >> Implications

These large scale studies do not mean that individual surgeons and hospitals performing small numbers of procedures cannot have excellent results. Nevertheless, it is of concern that so many hospitals are carrying out small numbers of procedures. Clinicians, Trust managers and purchasers should examine whether existing referral and work patterns are in the best interests of patients. The centralisation of such surgical services as cardiac surgery, neurosurgery and some cancer surgery is well established, as are networks for the management of cancer. The data from this study together with the published evidence suggest that serious consideration should be given to restricting elective open aortic aneurysm surgery to many fewer hospitals than are presently carrying out the procedure.

There will be an inevitable impact on the provision of emergency aortic surgery if elective surgery is restricted to fewer hospitals. Patients admitted to hospitals that have increased their aortic vascular workload will be treated by a surgical team that has the possibility of increasing its expertise. Patients admitted to a hospital that has faced a reduction in its vascular workload, or that now does no elective aortic cases at all, will be treated by a surgical team that only performs an occasional case. This is bound to lead to apprehension on the part of the patient and the surgical team, and may result in a worse outcome.

Screening programmes to identify asymptomatic aortic aneurysms before they rupture, and to offer elective surgery when appropriate, have been debated for some years. There appears now to be sufficient evidence to show that screening programmes for aortic aneurysm are beneficial[9,10] and screening may be implemented. The National Screening Committee has stated that randomised controlled trials have demonstrated a reduction in mortality from ruptured abdominal aortic aneurysm and that a working group set up to appraise the policy implications will report by the end of 2005[11].

At present, some patients with a ruptured AAA present to hospitals that undertake very few or no emergency aneurysm repairs. Although the numbers of such patients would be reduced with the implementation of a screening programme, some patients will not be picked up by a screening programme and will continue to present with a ruptured AAA. Possible options are that a surgeon without any regular vascular experience may step into the breach to do the best they can; a vascular surgeon may travel from another hospital to operate in the admitting hospital (this solution will provide surgical expertise but the patient will not have access to anaesthetic, nursing and ICU expertise); or the patient may be transferred from the admitting hospital to a vascular unit in another hospital. Several recent publications explore the various models of care that are potentially available[12,13,14].

There is evidence that patients with a ruptured aortic aneurysm can be transferred safely for journeys of more than an hour by road or over 25 miles[15]. Some areas within the United Kingdom have already instituted schemes for the transfer of patients from a particular catchment area into a central vascular unit. It will be necessary to consider similar schemes whenever planning to withdraw vascular services from hospitals with small workloads.

3. Organisation of vascular services

Specialist on-call rotas >> Vascular surgical on-call

Only 57% of hospitals reported that there was a separate on-call rota for vascular surgery.

Vascular surgery is a specialised branch of surgery; trainees are expected to spend at least two years in a vascular surgical training post before gaining accreditation. A ruptured aortic aneurysm is a major surgical crisis. It is logical that such patients should be cared for by vascular surgeons. However, not all hospitals were organised so that a vascular surgeon was always available out of hours.

Hospitals were asked whether there was a separate vascular on-call rota for vascular surgery. Overall 57% (103/181) of hospitals had a separate rota, 43% did not. The proportion varied between units of different size (Figure 5).

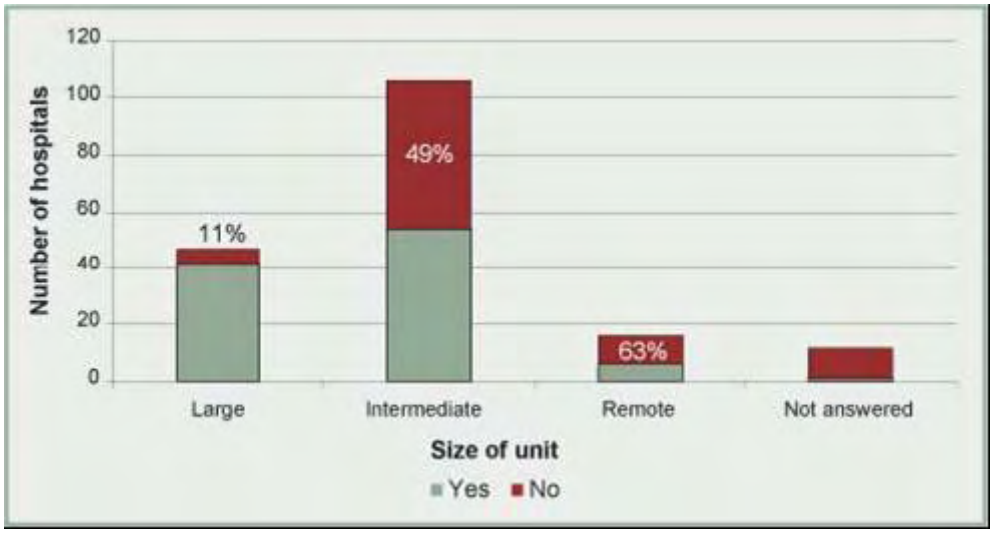


Figure 5. Separate surgical on-call rota for vascular surgery by size of vascular unit n=181. Percentages refer to hospitals without a separate rota.

The definitions provided by NCEPOD suggested that large vascular units would have the potential for a vascular surgical rota whereas an intermediate unit would have insufficient vascular surgeons to form an on-site emergency rota. It is notable that despite this, 51% of intermediate units had managed to organise such a rota. It is unclear as to why all large units did not have a rota. It is likely that surgeons on a vascular rota will have a more onerous on-call commitment than their consultant colleagues on a general surgical rota, both in terms of frequency of on-call and attendance required when on duty. Consultants will be deterred from establishing vascular rotas if this extra commitment is not recognised in consultant job plans. It may also be that Trust managers may be reluctant to appoint sufficient vascular consultants to form an acceptable specialist rota because there may be insufficient elective work during the working day to occupy the increased surgical capacity.

63% (64/102) of the on-call rotas were shared with another hospital or Trust. Shared rotas are obviously a common way of organising a specialist vascular rota when a hospital has limited resources to organise an on-call rota on its own. Hospitals should explore the potential for collaborating with neighbouring Trusts, so as to provide specialist on-call rotas. Financial arrangements for the payment of hospitals should be set up in such a way that there are no perverse incentives to arrange clinical services so as to maximise income for the hospital rather than promote patient care. Trusts must accept that work should be shared with other Trusts if this will promote patient care, even if the result is a loss of income to the Trust.

It is unsatisfactory for hospitals that are able to organise vascular on-call emergency rotas, either within

their own hospital or in partnership with neighbouring hospitals, not to do so. When there is not a vascular on-call rota, vascular surgeons or older general surgeons with vascular expertise will often come in to their hospital at night when they are not on-call to assist a colleague who is struggling with a ruptured aortic aneurysm. Such surgeons are to be applauded for their commitment to patient care, but Trusts should not depend on ad hoc arrangements and the goodwill of clinicians. Patients requiring emergency aneurysm repair should be treated by a surgeon who is practised in the management of this condition, working to a properly established emergency on-call rota. It is wrong to expect surgeons to carry the burden of responsibility of performing major emergency surgery outside their regular area of competence.

It should be noted that this issue is in a state of flux. On the one hand, the number of older general surgeons who had some vascular experience in their training and exposure to aortic surgery on-call is declining, and their place is being taken by newly appointed consultants in colorectal surgery and other disciplines who may have never seen a ruptured aortic aneurysm; these consultants may refuse to treat vascular emergency patients. On the other hand, these pressures may have accelerated the move to forming vascular surgical on-call rotas since NCEPOD collected its data in April 2004. A survey by the Association of Surgeons of Great Britain and Ireland in 2004 reported that 72% of Trusts (not hospitals) had a vascular on-call rota, and that 64% of vascular surgeons also participated in the general surgical on-call work[16].

There have been suggestions that despite the intuitive feeling that outcome following emergency AAA repair should be better when care is delivered by a specialist vascular surgeon, results are actually no different. NCEPOD examined the outcome of the patients in this study. The data for patients admitted as an emergency with unruptured and ruptured AAAs are analysed separately (Figures 6 and 7) because overall outcomes for the two groups are different; emergency unruptured AAAs have a mortality higher than AAAs admitted electively but lower than ruptured AAAs.

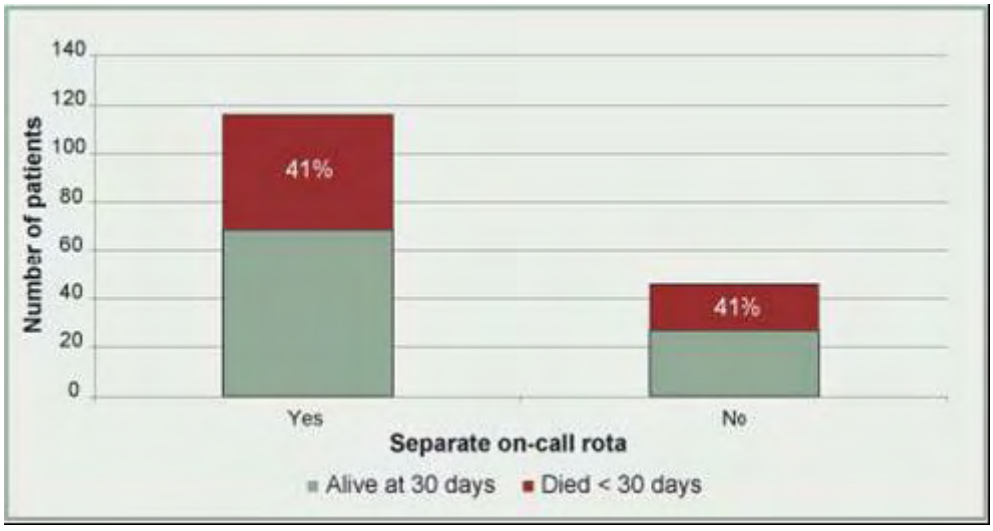


Figure 6. Outcome in ruptured emergency open procedure cases by whether or not there is a separate on-call rota for vascular surgery n=162/168. Percentages refer to patients who died in hospital within 30 days.

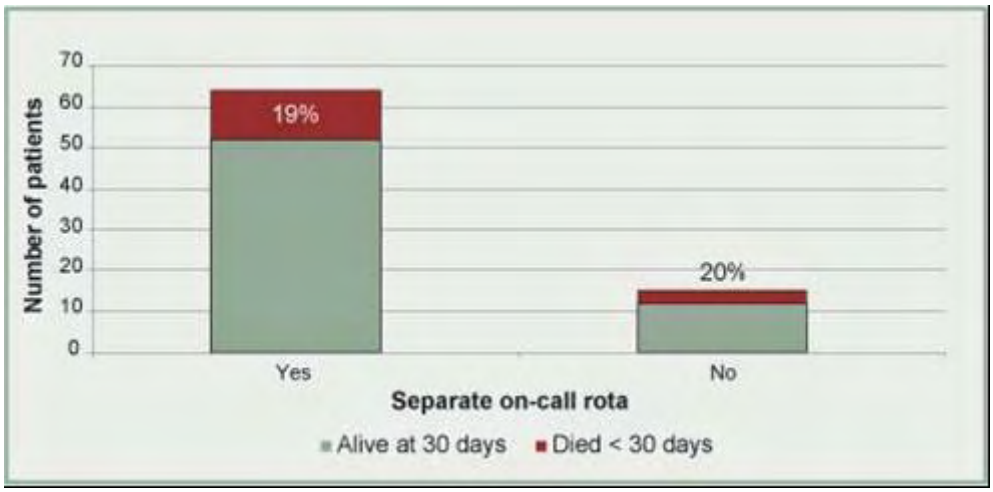


Figure 7 . Outcome in unruptured emergency open repairs by separate on-call rota for vascular surgery n=79/81. Percentages refer to patients who died in hospital within 30 days.

There was no difference in the outcome of surgery for ruptured or unruptured AAA between those hospitals where there was a surgical on-call rota and where there was not. Overall numbers are not large. Patients in hospitals without a formal vascular surgery on-call rota may have been operated on by vascular surgeons who attended the hospital despite being off duty. NCEPOD is unable to make a judgement as to whether or not the case-mix of the patient populations were the same.

3. Organisation of vascular services

Specialist on-call rotas >> Anaesthetic on-call rotas for vascular surgery

Anaesthetic on-call rotas for vascular surgery were very uncommon. Only 3% (5/178) of hospitals responded that they had a vascular anaesthetic rota. It appears to be accepted practice that whilst individual anaesthetists will develop expertise in anaesthesia for elective vascular surgery, any anaesthetist should be prepared to anaesthetise a patient for surgery for an emergency AAA repair. This seems illogical. The NCEPOD advisors commented that now that anaesthetic training has been shortened, new anaesthetic consultants may have seen very few operations for ruptured aortic aneurysm before appointment. It is not possible from the data collected for this study to make any observation as to whether better outcome for emergency AAA surgery is associated with the presence of a vascular anaesthetic rota. However, is it not time for at least large vascular units to implement vascular anaesthetic on-call rotas so that the sickest vascular patients are cared for by the most experienced practitioners?

3. Organisation of vascular services

Specialist on-call rotas >> On-call rota for interventional radiology

Overall, 24% (41/173) of hospitals reported that they had an on-call rota for interventional radiology. These rotas were chiefly found in large vascular units (Figure 8).

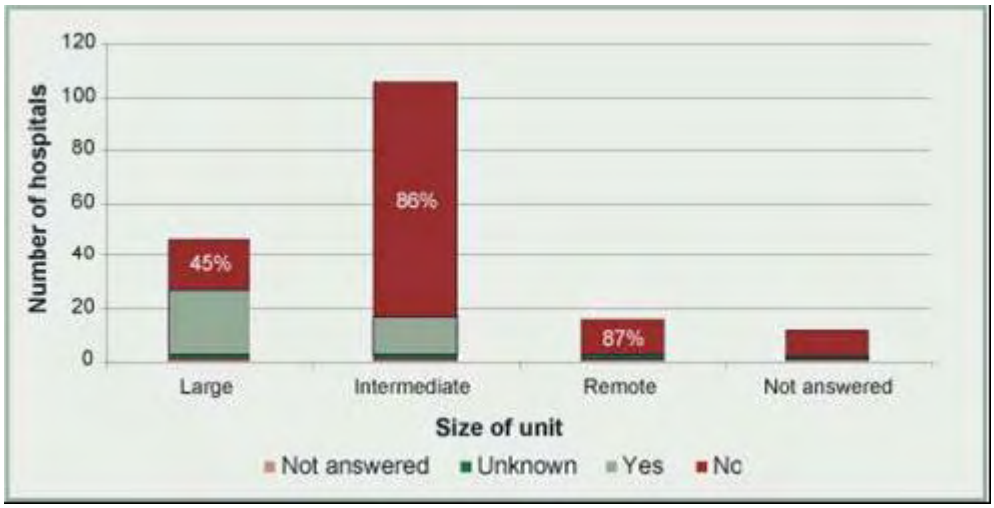


Figure 8. Separate on-call interventional rota in hospitals by size of vascular unit n=181. Percentages refer to hospitals without a separate on-call rota.

The problems of providing out of hours imaging have already been discussed earlier in this chapter.

3. Organisation of vascular services

Provision of theatre sessions for vascular surgery

20% of hospitals did not have dedicated daytime general surgical theatre sessions (NCEPOD lists).

>> Elective dedicated vascular sessions

Hospitals were asked whether there were dedicated elective theatre sessions for vascular surgery, and if so, how many. 80% (144/180) had dedicated elective sessions. Figure 9 shows the relationship between the number of elective AAA repairs reported for the year 2002/03 and the number of elective vascular sessions reported.

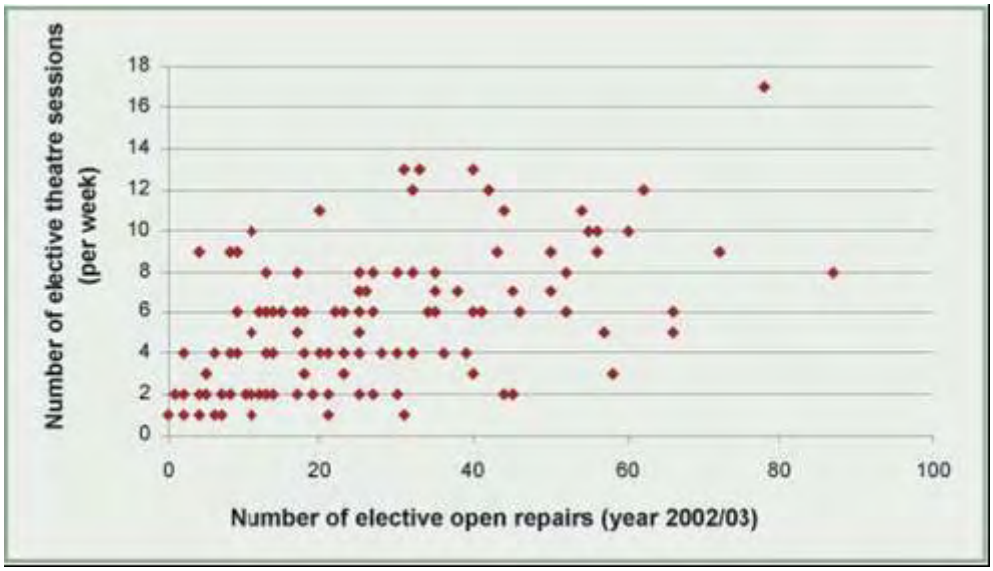


Figure 9. Number of elective theatre sessions by number of elective open repairs n=128

As expected, the greater the number of repairs done in a hospital the more likely it was that there would be a greater number of elective vascular sessions. However, it is striking that for hospitals carrying out the same number of AAA repairs, e.g. approximately 60, the number of sessions could vary from three to 12. Hospitals may wish to compare their own provision of services with the data presented here.

3. Organisation of vascular services

Provision of theatre sessions for vascular surgery

>> Emergency dedicated vascular sessions

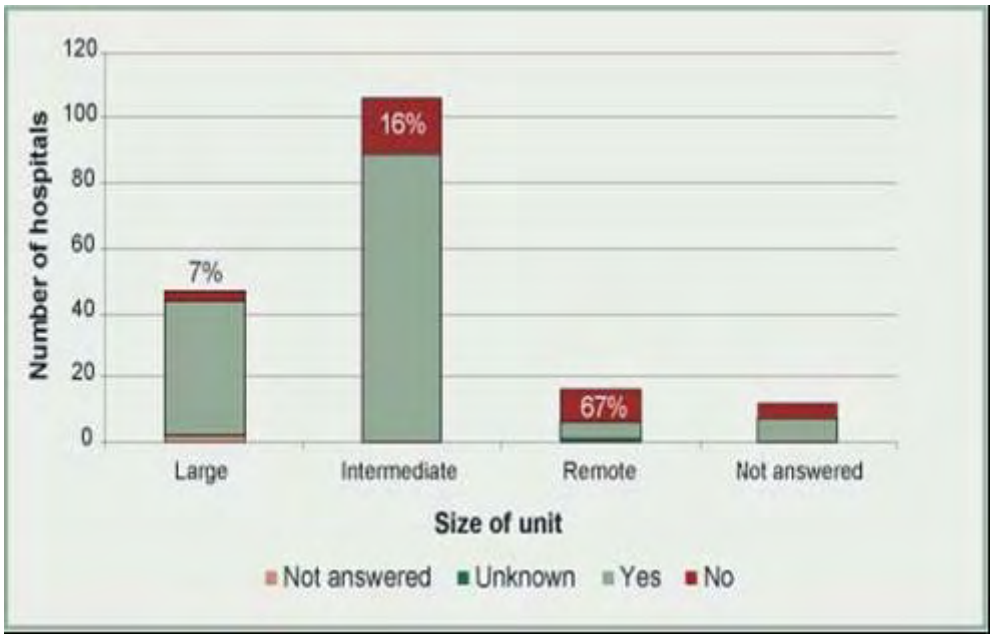
Only 2% (4/181) of hospitals made provision for dedicated emergency vascular theatre sessions. Three of these were hospitals with large vascular units and one a hospital with an intermediate sized unit.

3. Organisation of vascular services

Provision of theatre sessions for vascular surgery

>> Daytime general emergency theatre sessions

If it was unlikely that a hospital had provision for dedicated vascular emergency theatre sessions, did hospitals at least have daytime theatre sessions allocated for surgical emergency cases of all sorts?



It is very disappointing that 18% of hospitals (30/166) did not have theatres immediately available (NCEPOD theatres) for emergency surgery during the daytime (Figure 10). Larger units were more likely to have NCEPOD theatres, but provision was not universal even in this group of institutions. These facilities were first recommended by NCEPOD in 1990. If a patient presents with a ruptured aortic aneurysm and the hospital does not have an emergency theatre, the patient will have to wait until an ongoing operation is finished and the theatre is cleared before surgery can commence. Any delay in operating on a ruptured aneurysm has the potential to affect adversely the patient's outcome. It is hard to understand the clinical priorities in hospitals that do not provide daytime emergency theatres when so many hospitals have managed to establish this facility. Trusts should give serious consideration to this issue in the interests of patient safety.

3. Organisation of vascular services

Use of blood products

Only 55% of hospitals routinely provided a cell salvage machine for aortic surgery.

Repair of AAA is inevitably associated with blood loss, sometimes small, sometimes considerable. Despite substantial investment in improving the safety of donated blood, the administration of donor blood is still associated with risks [17]. The introduction of extra safety checks has resulted in an increase in the cost of donor blood and restricted its supply. “Better Blood Transfusion” [18] set the objectives of exploring the use of pre-donation of autologous blood and perioperative blood salvage.

3. Organisation of vascular services

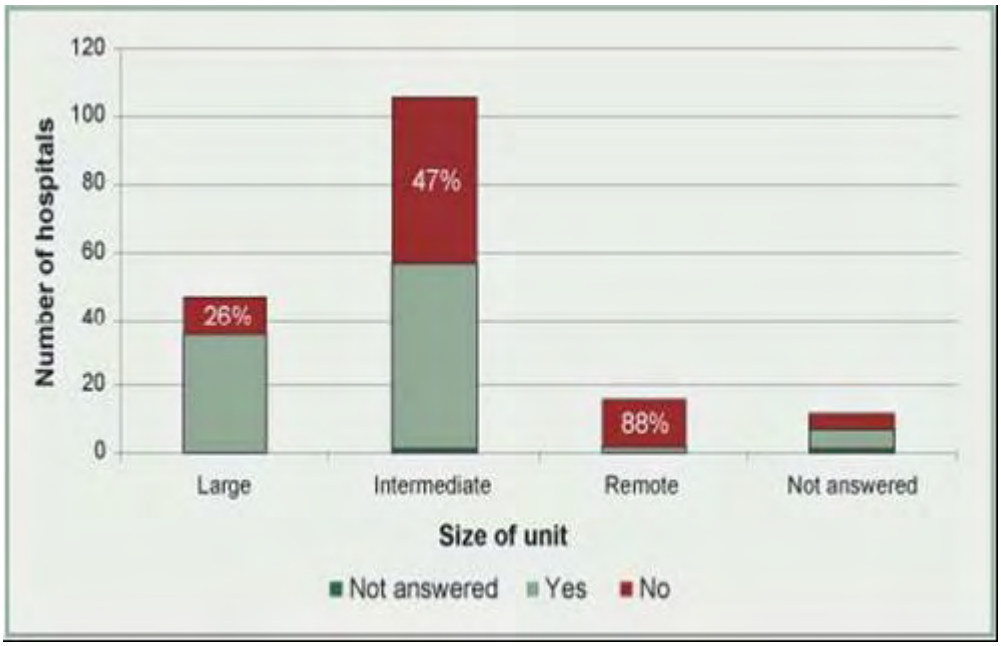
Use of blood products >> Preoperative autologous blood donation

20% (34/173) of hospitals provided a service whereby patients could donate blood in the weeks preceding elective AAA repair. It is disappointing that this figure was so low. One reason suggested by the advisors was that it is unrealistic to try to organise blood donation for an operation booked for a particular date, only to find that the operation is frequently cancelled because other resources such as an HDU bed are unavailable (see the chapter on Surgery); the donated blood is then wasted. Reducing the rate of cancellations might allow greater use of this valuable technique.

3. Organisation of vascular services

Use of blood products >> Perioperative cell salvage

55% (93/168) of hospitals responded that cell savers for intraoperative cell salvage were routinely available in theatre (Figure 11). Cell savers were more likely to be available in large vascular units.



The technology for intraoperative cell salvage has been available for some years. The capital cost of the machines is substantial but with the rise in the cost to Trusts of donor blood, the cost of the disposable equipment required for each operation now equates to the cost of one donated unit of blood. If use of the machine results in averting the use of two units of donated blood then there is the potential for a net saving to the hospital. In addition, the patient is protected from the risks of donated blood. The introduction of cell saving equipment requires that sufficient theatre staff are trained in its operation so that someone competent is always available when the equipment is needed.

"Better Blood Transfusion" was circulated in July 2002 [18]. By Spring 2004 when this data was collected only 55% of hospitals in the study had managed to introduce this technology.

3. Organisation of vascular services

Destination after AAA repair >> Elective AAA repair

There was a extensive use of Level 3 ICU care after elective open AAA repair.

9% of patients were reported to have been nursed in recovery areas for a substantial period after surgery.

Hospitals were asked to specify their recommended immediate destination after an elective AAA repair. There were differences in the answers from different sized units. Respondents were specifically directed not to mark “recovery area” if the patient only received immediate post-anaesthetic care before transfer to one of the other destinations listed in Table 5.

Table 5. Size of vascular unit by recommended immediate destination for elective AAA repair n=181. Answers may be multiple.

Size of unit	Recovery area	ICU	HDU	Combined ICU/HDU	Vascular ward	General ward	Not answered
Large	2	15	20	10	1	0	0
Intermediate	1	46	31	29	0	0	3
Remote	1	7	2	3	0	1	2
Sub-total	**4**	**68**	**53**	**42**	**1**	**1**	**5**
Not answered	0	2	2	1	0	0	7
Total	**4**	**70**	**55**	**43**	**1**	**1**	**12**

The replies that gave “Combined ICU/HDU” as the patient’s destination after elective surgery make it difficult to assess the level of care given at those hospitals. It appears that overall, patients in large vascular units were more likely to go to HDU after elective AAA, whereas patients at intermediate and small units were more likely to go to ICU. Assuming that there is no difference in the case-mix between the various size units, this finding implies a misuse of resources by the smaller units. With modern anaesthesia and analgesia it is possible for patients to be warm, in a stable cardiovascular status and breathing spontaneously at the end of elective AAA repair, and therefore not to require Level 3 support. It is well recognised that the demand for Level 3 beds exceeds the supply so that patients should not be sent to ICUs when the resources of ICUs are not required. Anaesthetists, surgeons and intensivists should examine the destination of patients after elective AAA repair. If patients commonly are admitted to ICU Level 3 care they should investigate what is preventing these patients being cared for in Level 2 beds.

One possible reason for the use of Level 3 beds may be the quality of Level 2 care. There was anecdotal evidence from advisors that some hospitals with beds designated as being Level 2 standard find it difficult to provide nursing staff who are actually able to deliver Level 2 care on a consistent basis. In such circumstances, clinicians may feel that the only way to ensure safe care for patients after complex surgery is to admit them to Level 3 beds. “Comprehensive Critical Care” [19] recommends that Level 2 and Level 3 beds should be adjacent so that skills may be used flexibly to prevent such situations arising. Investment following the publication of “Comprehensive Critical Care” has resulted in a larger increase in HDU than ICU beds, so cancellations will be less likely if AAA patients are scheduled for HDU care after surgery.

From the organisational questionnaire, 2% (4/169, no answer on 12 questionnaires) of hospitals specified that the recovery area was the intended destination after elective surgery. These recovery areas may have been specifically equipped and staffed to manage high level postoperative care. From the anaesthetic questionnaire, 9% (35/373) of elective patients were reported to have gone to the recovery area as a primary destination (57 questionnaires were unanswered). Presumably staff were forced to keep patients in recovery areas because a staffed bed in HDU or ICU was not available when needed. Most recovery areas are not equipped to the standard required to care for patients after major surgery for substantial periods of time nor do they have adequate arrangements for medical cover. Despite the stress

and upset to the patient, major surgery should not proceed unless all the essential elements of the care package (surgeon, anaesthetist, critical care facilities etc) are available.

If the provision of care for aortic surgery, elective or emergency, is changed so that surgery is transferred to another hospital, the resources for critical care must be transferred as well, otherwise the critical care facilities at the receiving hospital will be unable to cope with the extra workload.

3. Organisation of vascular services

Destination after AAA repair >> Emergency AAA repair

Four hospitals usually admitted emergency AAA repair patients to HDU after surgery. All other hospitals admitted patients to either an ICU or a combined ICU/HDU. This is appropriate and would be expected for patients after surgery that is complex and carries a very high mortality.

No hospital specified the recovery area as the intended destination after emergency aortic aneurysm repair. Nevertheless the data from the anaesthetic questionnaire were that 6% of patients went to the recovery area after surgery. This may be further evidence of inadequate critical care resources.

Anaesthetic and critical care staff should ensure that all instances when patients cannot get access to critical care beds after aortic surgery are documented so that pressure can be placed on purchasers and Trust management to provide the facilities required for this major surgery.

3. Organisation of vascular services

Outcome of surgery >> Elective open AAA repair

Overall mortality for elective open aortic aneurysm repair was 6.2%.

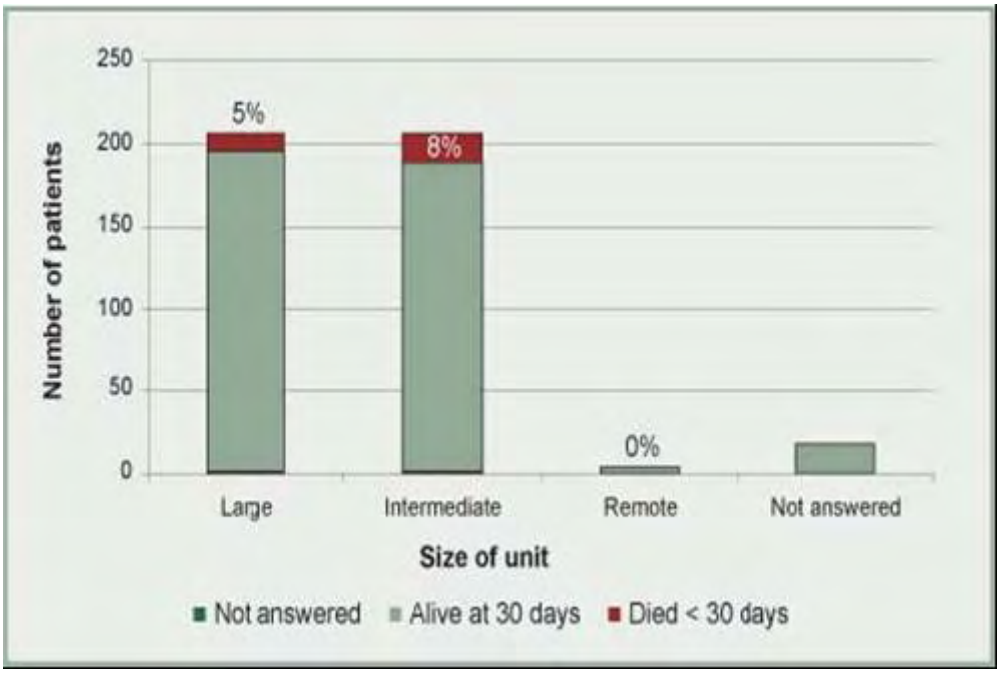


Figure 12. Outcome in elective open repairs by size of vascular unit n=434. Percentages refer to patients who died in hospital within 30 days.

3. Organisation of vascular services

Outcome of surgery >> Open repair after emergency admission

Overall mortality for open AAA repair after emergency admission was 36%.

Patients admitted as an emergency with an aortic aneurysm were more likely to receive palliative, non-operative treatment in an intermediate sized vascular unit than in a large unit.

The overall mortality for patients who underwent open AAA repair after emergency admission was 36% (94/264). There was little difference between the operative outcome between large and intermediate units (Table 6).

Table 6. Outcome after emergency open repair by size of vascular unit

	Large unit	%	Intermediate unit	%	Remote unit	%	Not answered	Total
Died within 30 days	35	29	44	35	6	75	9	**94**
Alive at 30 days	86		80		2		2	**170**
Total	**121**		**124**		**8**		**11**	**264**

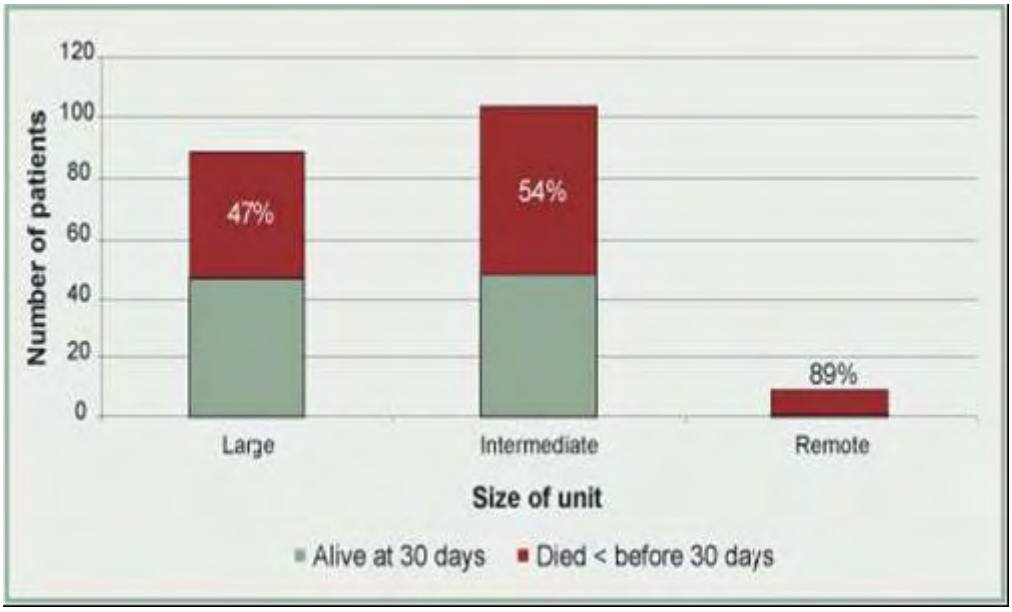
It is known that there is a difference in operative mortality for emergency patients depending on whether the aneurysm is ruptured or not, so the outcome of patients has been considered separately for patients with ruptured and unruptured aneurysms.

3. Organisation of vascular services

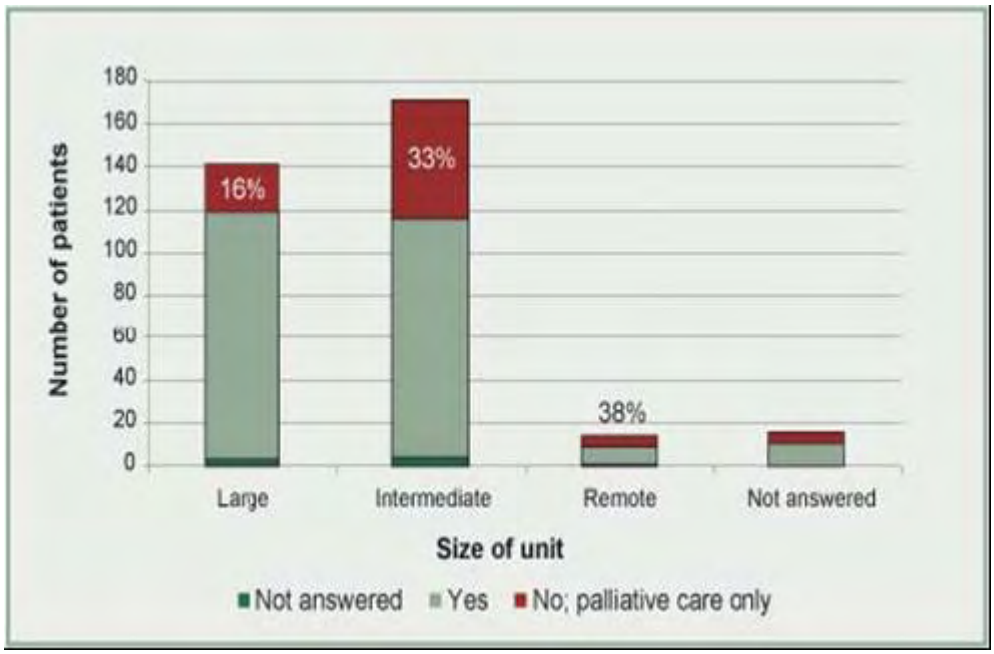
Outcome of surgery >> Ruptured aneurysms

Outcome after operation for ruptured AAA is strongly influenced by how many patients who present with a ruptured aneurysm actually proceed to operation. It is reasonable to assume that a decision not to operate, whether made by the patient, the family, or the surgeon, is more likely when the outcome is thought to be particularly hopeless; therefore a hospital that has a greater propensity to recommend non-operative, palliative treatment will tend to have a better outcome for those patients who do undergo surgery.

Figure 13 presents the outcome for patients in this study admitted with a ruptured AAA, whether or not the patient went for surgery; that is, the figures for the patients who died include the patients who received palliative care as well as those who died within 30 days of surgery.



According to these data a greater proportion of patients died in intermediate sized units. This was associated with a greater reluctance by intermediate sized units to operate on patients admitted as an emergency with an aortic aneurysm (Figure 14).



3. Organisation of vascular services

Outcome of surgery >> Unruptured aneurysms

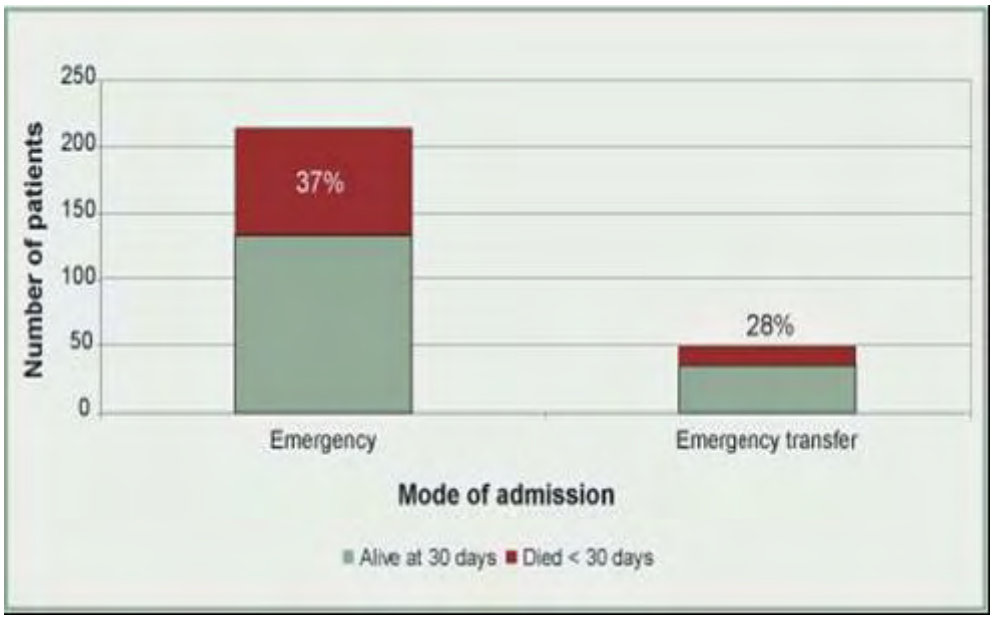
There was a difference in outcome associated with undergoing surgery at a large vascular unit compared with an intermediate vascular unit (Figure 15). This is an unexpected finding. The numbers were small. Further investigations of the management of unruptured AAAs admitted as emergencies would be helpful to determine if this phenomenon is sustained in other studies, and if so, the cause.

Transfer policies may also have an influence on figures for the survival of emergency AAA patients.

3. Organisation of vascular services

Transfer of patients

There were 50 patients who were transferred as emergencies from one hospital to another. There have been concerns that in some circumstances the outcome for such patients could be worse, either because of adverse effects of the transfer process itself or because of the extra delay that is likely to accompany transfer. NCEPOD examined the outcome associated with patients that were transferred as opposed to those who were admitted directly to the hospital where the operation took place.



There did not appear to be an adverse effect on outcome for patients who were admitted as an emergency transfer (Figure 16). NCEPOD collected information from the hospital where the operation took place, so has no data on whether any patients died during the transfer, nor whether the population of patients chosen to be transferred differed from the patients whom hospitals chose not to transfer out.

Variations in transfer policies may affect the survival of patients in different sized units. It is possible that smaller units may transfer the relatively stable patients to tertiary centres. Patients judged too unfit to be transferred would be managed in the smaller unit and would be likely to have a poor outcome with or without surgery.

3. Organisation of vascular services

Audit /clinical governance meetings

Hospitals were asked whether the surgical department held regular audit/clinical governance meetings. 97% (173/178) held such meetings. This figure is commendable.

At those hospitals that held audit meetings the numbers of health professionals that were involved are detailed in Table 7.

Table 7. Health professionals involved in audit/clinical governance meetings

Health professional	Number of hospitals
Surgeons	173
Nurses	125
Anaesthetists	76
Radiologists	66
ICU consultants	52
Operating department practitioners	37
Pathologists	27
Pharmacists	25
Microbiologists	24
Physiotherapists	21
Nutritionists	8
Other	50

Hospitals were also asked whether there were separate multidisciplinary meetings specifically for vascular surgery. At those hospitals that held separate vascular surgery meetings the numbers of health professionals that were involved are detailed in Table 8.

Table 8. Health professionals involved in vascular surgery meetings

Health professional	Number of hospitals
Surgeons	98
Nurses	59
Anaesthetists	23
Radiologists	105
ICU consultants	15
Operating department practitioners	10
Pathologists	4
Pharmacists	6
Microbiologists	3
Physiotherapists	15
Nutritionists	2
Other	37

All hospitals should have meetings to discuss and reflect on the process and outcome of surgical

services, especially vascular surgical services which will have a higher associated mortality for both elective and emergency operations than almost all other areas of surgery. It is unimportant whether the meetings are termed audit, governance, morbidity and mortality or some other title so long as there is a structured process to assess and improve practice. Hospitals should consider if the needs of vascular surgery can be met within a general forum or whether they are best served by meetings devoted to vascular surgery alone. It is not acceptable that even a small minority of hospitals do not have governance meetings of any sort.

It is praiseworthy that such a wide range of clinical specialties contribute to these meetings. These data should lead clinicians to consider whether all the necessary people attend their local meetings. The high number of radiologists attending specific vascular meetings may reflect their part in assessing patients for interventional procedures and in performing these procedures. NCEPOD did not ask specifically whether cardiologists attended audit/governance meetings. This was unfortunate given the involvement of cardiologists in the preoperative assessment of vascular surgery patients. Attendance by cardiologists may have contributed to those marked ‘Other’.

There is little point in organising multidisciplinary meetings if people are unable to attend because of the timing of the meeting or other clinical commitments. Audit/governance is a proper and essential part of patient care. Meetings should be held during the working day, not in the early morning or evening. The time required should be reflected in consultant job plans.

3. Organisation of vascular services

Patient information

The data above indicate that there are substantial differences between hospitals in the range of services they are able to provide for elective and emergency aortic surgery patients and in the expertise of their staff. Patients should always have as much information as possible so that their decisions about their care are fully informed. The ‘Choose and Book’ initiative reinforces the need for patients to receive information to help them make choices. Hospitals, general practitioners and patients should consider how best to present all the information patients need for them to make a proper decision about the quality of care that a hospital provides.

3. Organisation of vascular services

Recommendations

Trusts should ensure the availability outside normal working hours of radiology services including CT scanners.

Clinicians, purchasers, Trusts and Strategic Health Authorities should review whether elective aortic aneurysm surgery should be concentrated in fewer hospitals.

Major elective surgery should not take place unless all essential elements of the care package are available.

3. Organisation of vascular services

References

[1] Budd JS, Finch DRA, Carter PG. *A study of the mortality from ruptured abdominal aortic aneurysms in a district community.* Eur. J. Vasc. Surg. 1989; **3**: 351-4.

[2] Bengtsson H, Bergqvist D. *Ruptured abdominal aortic aneurysm: a population-based study.* J.Vasc.Surg. 1993; **18**: 74-80.

[3] *Making the Best Use of a Department of Clinical Radiology* (5th edition). 2003. Royal College of Radiologists.

[4] Dr A Nicholson. Royal College of Radiologists. Personal communication.

[5] Birkmeyer JD, Siewers AE, Finlayson EVA *et al*. *Hospital volume and surgical mortality in the United States.* N.Engl.J.Med. 2002; **346**: 1128-37.

[6] Birkmeyer JD, Stukel TA, Siewers AE *et al.Surgical mortality and operative mortality in the United States.* N.Engl.J.Med. 2003; **349**: 2117-27.

[7] Urbach RD, Baxter NN. *Does it matter what a hospital is high volume for? Specificity of hospital volume-outcome associations for surgical procedures: analysis of administrative data.* BMJ 2004; **328**: 737-40.

[8] Leapfrog Group
http://www.leapfroggroup.org/media/file/Leapfrog-Evidence-based_Hospital_Referral_Fact_Sheet.pdf

[9] Earnshaw JJ, Shaw E, Whyman MR *et al.Screening for abdominal aortic aneurysms in men.* BMJ 2004; **328**: 1122-4.

[10] Lindholt JS, Juul S, Fastig H, Henneberg EW. *Screening for abdominal aortic aneurysms; single centre randomised controlled trial.* BMJ 2005; **330**: 750-2.

[11] National Screening Committee – abdominal aortic aneurysm
http://libraries.nelh.nhs.uk/screening/viewResource.asp?mr=10&offset=40&dg=&searchText=&attributeText=&categoryID=1331&attributeOptionID=&keywordID=&uri=http%3A//libraries.nelh.nhs.uk/common/resources/%3Fid%3D60457
accessed 07/07/2005.

[12] Michaels J, Brazier J, Palfreyman S, Shackley P, Slack R. *Cost and outcome implications of the organisation of vascular services.* Health Technology Assessment 2000; 4(11).

[13] Vascular Surgical Society of Great Britain and Ireland. *The provision of emergency vascular services*. 2001.
http://www.vascularsociety.org.uk/docs/Provision_Emergency.pdf
accessed 05/08/05.

[14] Vascular Surgical Society of Great Britain and Ireland. *The provision of vascular services 2004*. 2003.
http://www.vascularsociety.org.uk/Docs/Provision%20of%20Vascular%20Services.pdf
accessed 05/08/05.

[15] Adam DJ, Mohan IV, Stuart WP *et al. Community and hospital outcome from ruptured abdominal aortic aneurysm within the catchment area of a regional vascular service* J.Vasc.Surg. 1999; **30**: 922-8.

[16] Association of Surgeons of Great Britain and Ireland.

[17] *SHOT Annual Report 2003.* Serious Hazards of Transfusion Steering Group. 2004.

[18] *Better blood transfusion.* HSC 2002/009. 2002. Department of Health. [19] *Comprehensive Critical Care*. Department of Health. 2000.

4. Surgery

Introduction

This chapter examines the characteristics of the patient, the role of the surgeon and aspects of the surgical procedure for patients who were admitted for open repair. NCEPOD did not attempt to collect data on patients known to have an abdominal aortic aneurysm who may have died outside hospital whilst awaiting investigation, or during transfer between hospitals.

4. Surgery

Mode of admission

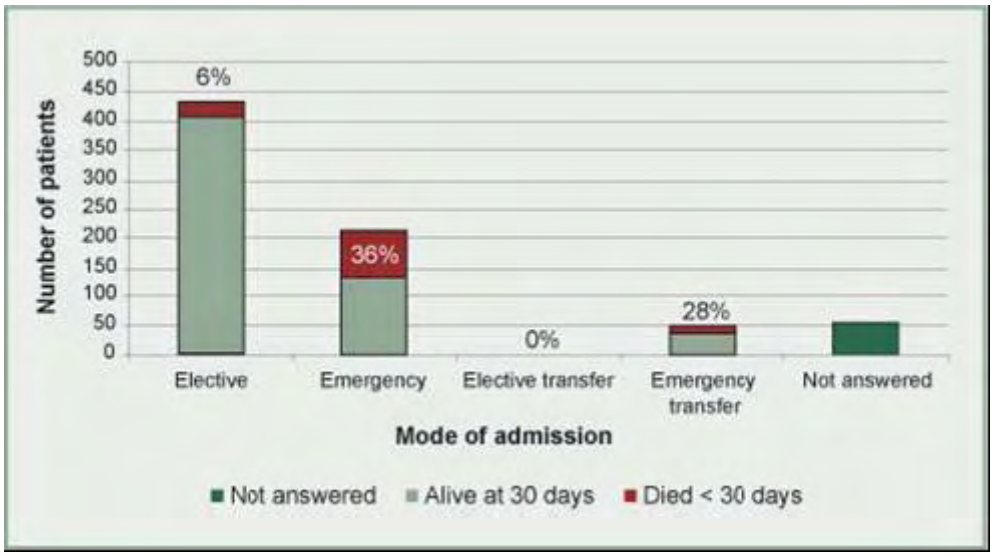


Figure 1. Mode of admission by outcome n=752. Percentages refer to patients who died in hospital within 30 days.

Data on mode of admission and 30 day mortality were examined for 752 patients who had an open AAA repair (Figure 1). These data exclude patients who did not undergo operation but received palliative care only (79) and patients who had an endovascular repair (53). These two groups of patients are considered separately. Just under a third (31%, 214/698) were direct emergency admissions and a further 50 patients were emergency transfers (admissions that had been transferred in from another hospital). Compared to the mortality rate for elective admission for AAA repair of 6.2% (27/434), the mortality rate after an emergency admission was six times higher at 36% (94/264). Because of the expected but dramatic difference in outcome between these two groups they have been analysed separately.

Denominator data may differ between sections according to the completeness of data returned.

4. Surgery

Elective surgery >> Demographics

AAA is well documented as a condition affecting men much more commonly than women. Only 13% (57/434) of repairs were performed on women. The gender distribution in the present report is similar to that recorded in recent HES data [1].

Age distribution was also as expected. The median age for men was 72 years and for women 73. The incidence of AAA increases with age but so does the incidence of significant comorbidity. The data for elective patients have been analysed to examine whether mortality increases with age. Figure 2 shows the age and sex distribution. Figure 3 shows the total numbers of patients in each age cohort who were alive 30 days after surgery or had died.

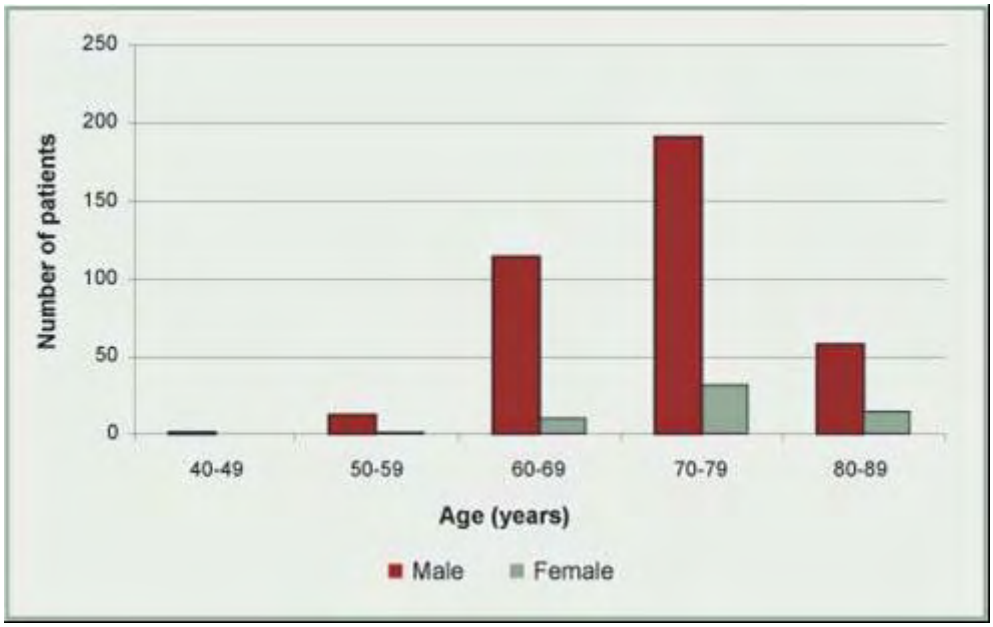


Figure 2. The distribution of age and sex *n* =434

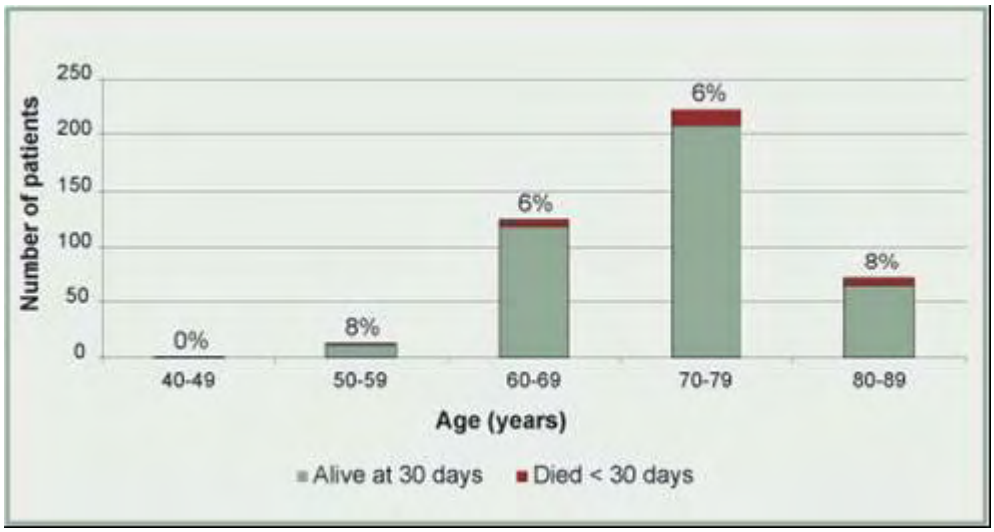


Figure 3. Age by mortality *n* =432/434. *Percentages refer to patients who died in hospital within 30 days.*

The oldest elective patient in this study was 88 years. Of 71 patients aged 80 and over, only six died. Age alone should not be the only reason to turn down a patient for elective AAA repair.

4. Surgery

Elective surgery >> Delays to operation

Waiting times

21% of patients spent more than 12 weeks on the waiting list for elective AAA repair.

18 patients admitted as an emergency, had been on the waiting list for either open or endovascular repair.

Figure 4 shows the time between the patient being placed on the waiting list and the date of their operation for the 382 patients for whom these data were available.

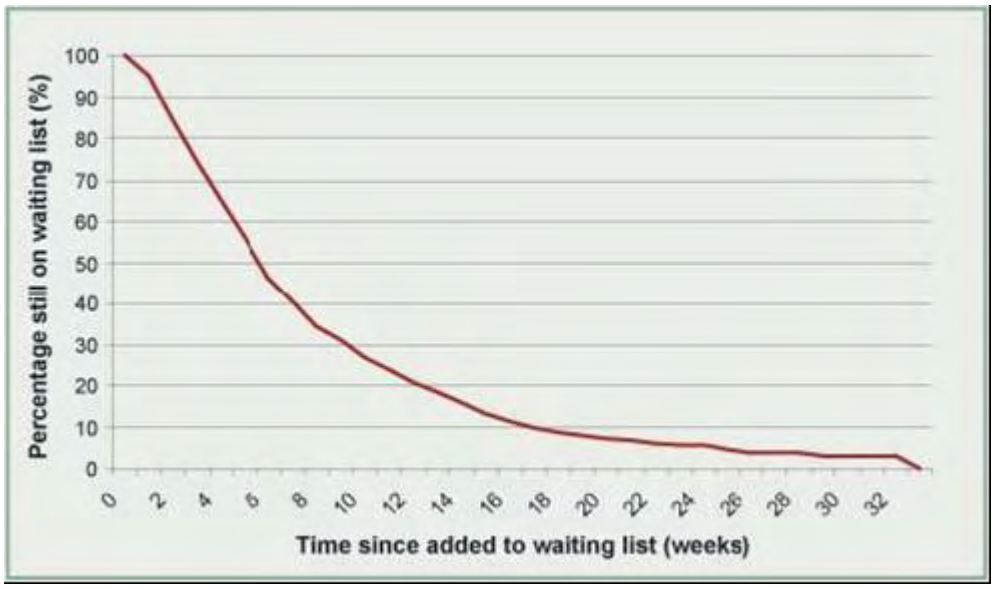


Figure 4. Time between patients being placed on the surgical waiting list and the date of their surgery n=382/434

Once on a waiting list, the median wait to surgery was five weeks. However, 141 patients waited longer than five weeks and 21% (80/382) of patients on whom NCEPOD had data waited more than 12 weeks. This is far too long. In contrast, the majority of women with breast cancer can expect their operation within 31 days of receiving the diagnosis[2] and Trusts are judged on their ability to meet this target. If the target for treatment of a cancer patient is four weeks from diagnosis then all necessary investigations must be done within this timeframe. NHS guidelines for how quickly a non-cancer patient should be seen in clinic or how soon after diagnosis they should be treated have progressively improved but lag behind guidelines for treating patients with cancer. Furthermore, when Trusts insist that patients cannot be put on a waiting list until all necessary preoperative investigations have been performed, the true time a patient has to wait for their surgery is hidden.

For patients with an AAA the true time from diagnosis to treatment includes: the time between the first appointment in the consultant's clinic and the completion of any referrals to other consultants; the time taken for all necessary investigations to be performed and reported; and the time between going on a waiting list and actually having the AAA repaired. The present study only collected data on the last part of this journey. In meetings with advisors, anecdotal evidence was heard that the need to meet centrally-set cancer targets has disadvantaged patients who do not have cancer but have conditions which are equally, if not more immediately, life threatening. Examples were cited of patients with cancer being given priority for radiological investigations and critical care beds. As a result, patients with aortic aneurysms face great

uncertainty about how soon they will be treated whilst knowing that their condition is life threatening. In addition, they know that they can be cured with surgery but that they have one chance in twenty (or worse) of not surviving the operation. They know that if the aneurysm ruptures before admission the probability of survival is much reduced. One can imagine the state of mind of these patients whilst they wait.

Of patients who were admitted as an emergency with an aortic aneurysm, 13 were on the waiting list for elective open repair and five were on the waiting list for endovascular repair. Three of these patients died giving a mortality rate of 17%; three times the rate for elective open repair. To these numbers must be added an unknown number of patients on the waiting list who died in the community from rupture of their aneurysm without reaching hospital.

It is clear that there are real risks in waiting for elective aortic aneurysm surgery. Policy must be changed so that patients with an aortic aneurysm have equal priority with all other patients with serious clinical conditions for diagnosis, investigation and treatment. The setting of priorities does not seem to have taken into consideration the risk of death while on a waiting list.

Cancellations

One in 25 patients had their original operation cancelled because there was no ward bed available.

One in six patients had their original operation cancelled because there was no critical care bed available.

One of the reasons patients waited so long for their operations was that an earlier date for their operation was arranged and then cancelled.

Bed availability

One in twenty five (4%, 17/410) of patients had their original operation cancelled because there was no ward bed available. NCEPOD did not collect data on the reasons why beds were not available but there is good anecdotal evidence that admissions for elective surgery are commonly cancelled because of pressure on hospital beds, especially from emergency admissions.

One in six (17%, 71/415) of patients had their original operation cancelled because there was no critical care bed available. Cancellation of aortic aneurysm repair for lack of a critical care bed was not an occasional unexpected event but a regular systematic feature of the practice of vascular surgery seen in this study. The study has also highlighted the number of patients going to a Level 3 bed when most patients undergoing an aneurysm repair can be safely managed in a Level 2 bed.

NCEPOD has expressed concern in the past about the inadequate number of staffed critical care beds, and considerable resources have been allocated in recent years to expand the provision of critical care resources, with a subsequent increase in bed numbers. However, it appears that a continuing shortfall of such beds still hampers the admission of many patients requiring elective complex surgery and Trusts must act to ensure that cancellation of major elective surgery for lack of critical care beds becomes a rare event.

4. Surgery

Elective surgery >> Preoperative assessment

Preoperative assessment clinic

Only 79% of elective patients attended a preoperative assessment clinic.

102 patients were seen by a pre-registration house officer alone or a pre-registration house officer and a nurse practitioner.

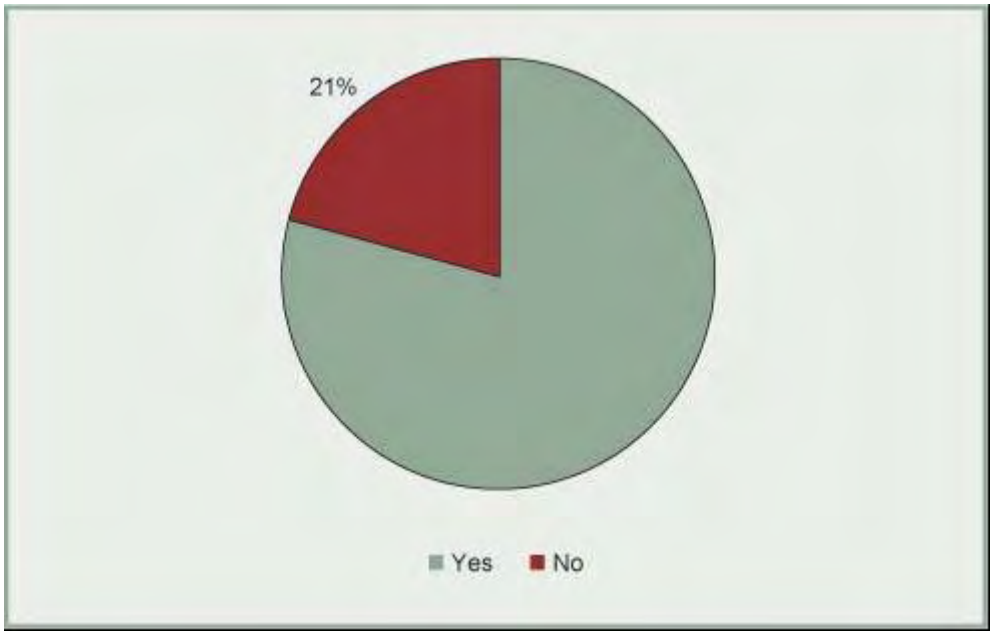


Figure 5. Number of patients who attended a preoperative assessment clinic n=428/434. Percentage refers to patients who did not attend a clinic.

Only 79% (339/428) of elective patients in this study were preoperatively assessed (Figure 5) and we believe that this figure is too low. All patients booked for aortic aneurysm repair should attend a preoperative assessment clinic. Comorbidity is very common among patients with AAA, and demands proper assessment before surgery.

Formal review in a preoperative assessment clinic is useful because it allows the surgeon and anaesthetist to ensure that the patient's condition has been optimised to reduce the risk of perioperative morbidity and mortality. Preoperative assessment clinics help identify previously unrecognised comorbidity and reduce the likelihood that surgery will be cancelled after admission because of the patient's medical condition.

The preoperative assessment clinic is also an opportunity to ensure that patients have been given all the information they need to give informed consent, and to meet the anaesthetist. Patients deserve the opportunity for an unhurried discussion of all the issues involved before their operation.

Staffing of the preoperative assessment clinic

Table 1. Members of the clinical team who assessed the patient at the preoperative assessment clinic n=339. Answers may be multiple.

Clinician	Total
Consultant anaesthetist	129
SpR anaesthetist year 3+	3
SpR anaesthetist year 1/2	1
SHO anaesthetist	2
Consultant surgeon	90
SpR surgeon 3+	18
SpR surgeon 1/2	2
SHO surgeon	24
PRHO surgeon	181
Nurse practitioner	142

Patients should be assessed by experienced and competent staff (Table 1). 102 patients were assessed by a PRHO alone or a PRHO together with a nurse practitioner. This suggests that some assessment clinics merely provide an opportunity for clerking and blood sampling. It is improbable that a PRHO or SHO in surgery would have had the knowledge and experience to properly assess a patient awaiting aortic surgery and to evaluate the risks and benefits of the procedure. Nurse practitioners who had been trained in preoperative assessment would have been able to manage routine patients very satisfactorily, but patients for aortic surgery need special consideration. Trusts should ensure that clinicians of the appropriate grade and experience are available to staff preoperative assessment clinics for aortic surgery patients, or that time is given in another clinical setting for the senior surgical and anaesthetic members of the team to satisfy themselves that the patient is ready for their operation and has given informed consent.

4. Surgery

Elective surgery >> Comorbidities

The large number of patients with cardiac and respiratory symptoms confirms the expectation of finding comorbidity in patients with abdominal aneurysms, especially hypertension and coronary artery disease. A history of heart failure more than one month before surgery was associated with a mortality rate of 21%. Few patients admitted for elective surgery had cardiac signs on admission but the presence of peripheral oedema was associated with a higher mortality. The presence of dyspnoea on exertion (a symptom associated with respiratory and cardiac disease) was also associated with an increase in mortality rate. Interestingly the presence of atrial fibrillation was not associated with increased risk of death although the number of cases was small. A large number of patients were classified as having other unspecified abnormalities on their ECG. However, the responses to this question by the surgeon may have been based on their own interpretation of the ECG or on a computerised analysis.

Table 2. Cardiac history in elective patients and their outcome n=434. Answers may be multiple.

Cardiac history	Total	% that died within 30 days
None	134	7
Angina controlled/on exertion	93	9
Heart failure more than one month ago	14	21
Hypertension	179	6
MI more than two months ago	107	7
Other	68	40
Unknown	1	
Not answered	2	

Table 3. Cardiac signs in elective patients n=434. Answers may be multiple.

Cardiac signs	Total	% that died within 30 days
None	362	6
Peripheral oedema	21	14
Other	49	8
Unknown	7	
Not answered	7	

Table 4. ECG and outcome n=434. Answers may be multiple.

ECG	Total	% that died within 30 days
None	243	5
AF rate >90	20	<1
Other abnormality	145	9
Not answered	2	

Table 5. Respiratory history and outcome n=434. Answers may be multiple.

Respiratory history	Total	% that died within 30 days
None	295	4
Dyspnoea on exertion	113	11
Dyspnoea at rest	2	<1
Other	12	<1
Not answered	4	

9% (39/423) of patients were diabetic which is in line with previous knowledge that diabetes is a common comorbidity in people with vascular disease. However, in this study the presence of diabetes was not associated with an increased mortality. The 30 day mortality for patients considered to have a normal build was 5% (21/382). 28 patients were considered to be morbidly obese (30 day mortality 11%) and five were cachectic (30 day mortality 20%).

4. Surgery

Elective surgery >> Imaging

Table 6. Types of imaging and outcome n=434. Answers may be multiple.

Type of imaging	Total	% died within 30 days
CT	378	7
Ultrasound	286	5
Angiography	30	7
MRI	6	0
None	8	13
Unknown	1	
Not answered	1	

The most common imaging investigation was CT. It also illustrates why delays in obtaining access to CT facilities can slow the patient's journey from first consultation to operation. The next most common investigation was ultrasound. 244 patients were reported as having both ultrasound and CT and 2% (8/432) of patients were reported as having had no preoperative imaging before elective repair.

4. Surgery

Elective surgery >> The operation

Length of operation – surgical time

The length of operation was calculated from the times given for incision and closure (Figure 6). Although not measured it is recognised that a substantial amount of anaesthetic time is required for preparing the patient for surgery and for transfer to their postoperative destination once surgery is complete.

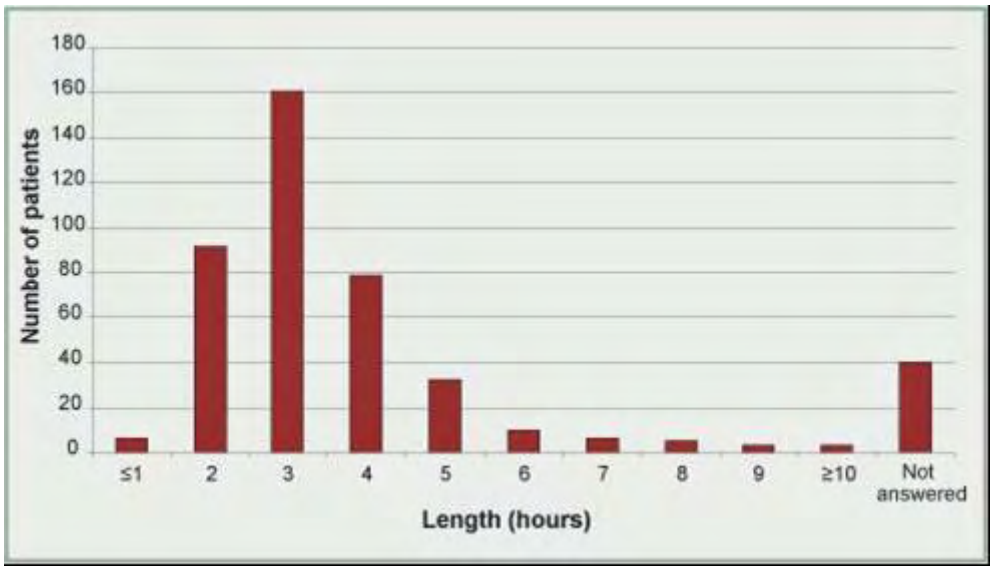


Figure 6. Length of operation n=434

The length of surgery could be calculated in 394 cases (Figure 6). The median time taken was three hours. 27 cases took longer than five hours and 12 of these patients died. Nearly three quarters of repairs (70%, 288/412) were done using a tube graft. Most bifurcated grafts were positioned entirely within the abdomen (i.e. aorto-biiliac grafts). NCEPOD asked whether any other procedures were completed during the same theatre visit (Table 7) and clearly, in some cases, these extra procedures led to longer operating times.

Table 7. Other procedures completed during the same theatre visit n=434. Answers may be multiple.

Procedure	Total	% died within 30 days
Peripheral artery bypass	9	33
Thrombectomy / embolectomy	19	32
Other vascular procedures	21	29
Other non-vascular procedures	17	12
None	327	5
Not answered	47	

Additional vascular procedures were associated with a large increase in mortality and should be avoided unless essential.

Grade of surgeon

In 97% of cases the most senior operating surgeon was a consultant.

Data on the most senior grade of surgeon present were returned for 417 out of 434 elective aneurysm repairs (Table 8).

Table 8. Grade of the most senior operating surgeon

Grade of surgeon	**Total**	%
Consultant	403	97
Staff grade	3	<1
SpR year 3+	4	<1
Other	7	2
Sub-total	**417**	
Not answered	17	
Total	**434**	

A consultant surgeon was present for nearly every case (97%, 403/417). This is excellent practice as long as the degree of involvement of consultants as the most senior operating surgeon does not hinder trainees reaching the level of competency required for consultant practice. As a surgeon develops their skill it is important that they demonstrate the ability to manage and operate on complex cases to the satisfaction of their trainers before they are allowed to enter into independent practice as consultants. Although technical skill is only one of the requirements of a vascular surgeon it is clearly important where the risks of morbidity and death are high. Junior surgeons must receive sufficient training to acquire these skills. It is therefore acceptable for competent specialist registrars and SAS surgeons to undertake AAA repair when a consultant is immediately available for advice and help.

Specialty of surgeon

All but one of the elective operations for which data were available were performed by a vascular surgeon or a general surgeon with a vascular interest.

92% of these surgeons were members of the Vascular Society of Great Britain and Ireland.

Surgeons were asked to report their surgical subspecialty and Figure 7 shows this reported by the most senior operating surgeon.

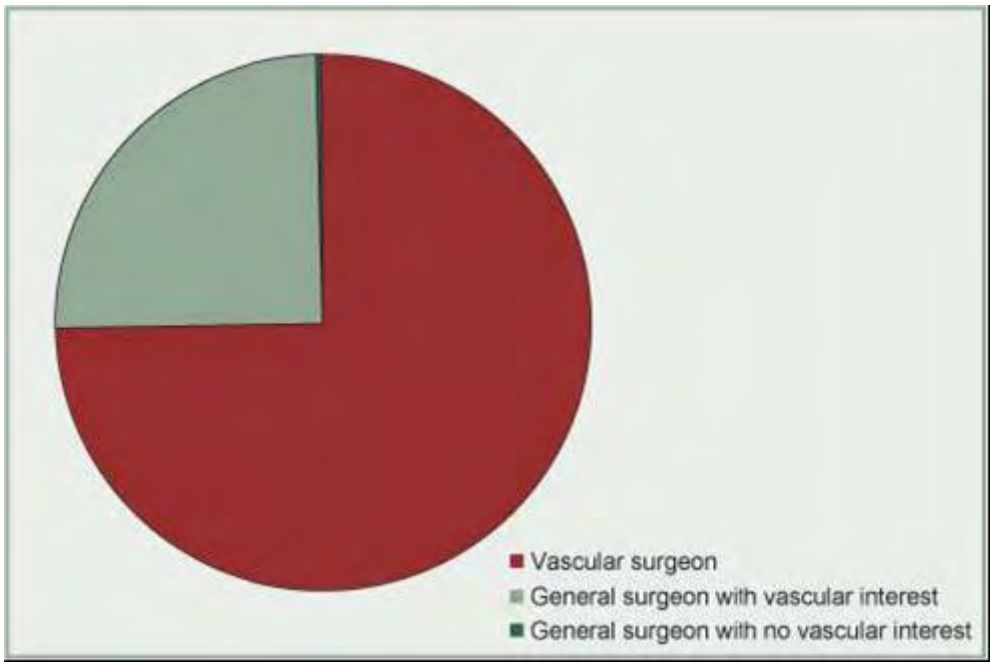


Figure 7. Specialty of the most senior operating surgeon n=416/434

Surgeons performing AAA repair fall into the category of 'General Surgeons' as defined by the Specialist Advisory Committee. This is a transition period as many surgeons are still working who underwent an extended training that allowed them to develop skills in many subspecialties, although they may no longer use all of those skills. In the future, shortened training schemes will only allow surgeons to reach competency in one or occasionally two subspecialties.

NCEPOD asked surgeons to specify their specialty. 75% (311/416) of elective patients were operated on by vascular surgeons. In this study a vascular surgeon was defined as a surgeon with expertise and a regular practice in vascular surgery (at least 70% of elective surgical time devoted to doing vascular cases). 25% (104/416) of patients were operated on by general surgeons with a vascular interest; in this study these were surgeons who spent a substantial proportion of elective surgical time doing vascular cases, but typically less than 70%. One elective patient was operated on by a general surgeon with no special interest in vascular surgery and in 18 cases the question was left unanswered.

Membership of Vascular Society and outcome

Many surgeons with a special interest in a subspecialty of general surgery are members of specialist societies. These societies, such as the Vascular Society of Great Britain and Ireland (VSGBI) are supported by and in turn advise the Association of Surgeons of Great Britain and Ireland (ASGBI) and the Royal Colleges of Surgery. Surgical societies typically organise educational events, help in the setting of standards and increasingly promote comparative audit. However, membership of such a society is not a prerequisite to perform vascular surgery and is not a guarantee of competency, but it might act as a marker of continuing professional development and a willingness to participate in comparative audit. The great majority of surgeons operating on elective cases were members of the VSGBI.

The development of strong surgical societies may be acting as a driver towards increasing subspecialisation and it is likely that in the future some subspecialties will no longer see themselves as a part of 'General Surgery'. This happened with orthopaedics and more recently urology. A further driver of subspecialisation is the need to train consultants in a shorter period. While hospitals with a large staff of consultants may be able to cope with this change it may prove to be a problem in smaller and remote hospitals where newly appointed consultants cannot cover the full range of general surgical emergencies.

The data have been analysed to see whether there was any difference in outcome between operations

performed by surgeons who were and who were not members of the VSGBI (Table 9). These data must be interpreted with caution. Some surgeons may have contributed more than one case and the number of cases done by surgeons who were not members of the VSGBI was small but there appeared to be no difference in outcome associated with membership of the VSGBI.

Table 9. Surgeon's membership of the VSGBI and patient outcome

Member of VSGBI	Alive at 30 days	Died within 30 days	% died within 30 days	Not answered	Total
Yes	313	21	6	1	**335**
No	26	2	7	0	**28**
Sub-total	**339**	**23**		**1**	**363**
Unknown	10	0		0	**10**
Not answered	56	4		1	**61**
Total	**405**	**27**		**2**	**434**

4. Surgery

Elective surgery >> Surgeons' workload

Surgeons' workload

18% of elective patients were operated on by a surgeon who performed fewer than 10 elective AAA repairs a year.

This section must be interpreted with great caution because the denominator data are based on returned surgical questionnaires. Some surgeons may have returned more than one. This is most likely to happen with surgeons who perform many aneurysm repairs but could happen with low volume surgeons by chance.

The most senior operating surgeon was asked to supply the number of AAA repairs performed in 2002/03 and the source of that information. In 122 questionnaires the surgeon chose not to answer the question, 67 answers were "from memory" and 245 from a logbook or information system. NCEPOD believe that clinicians and Trusts should take joint responsibility for collecting high quality data about procedures performed and outcomes. This is recognised as part of good clinical governance.

Number of cases

Figure 8 shows how many patients were operated on by a surgeon performing between one and five elective AAA repairs in 2002/03, the number who reported performing between six and 10 and so on. In all cases the surgeon reporting data had performed at least one elective repair in 2002/03. It must be remembered that some surgeons may have returned more than one questionnaire and many surgeons relied on memory. Since surgeons performing the most AAA repairs are more likely to have contributed more than one case, the right hand side of the chart (which already demonstrates that relatively few surgeons performed more than thirty AAA repairs) may be an overestimate.

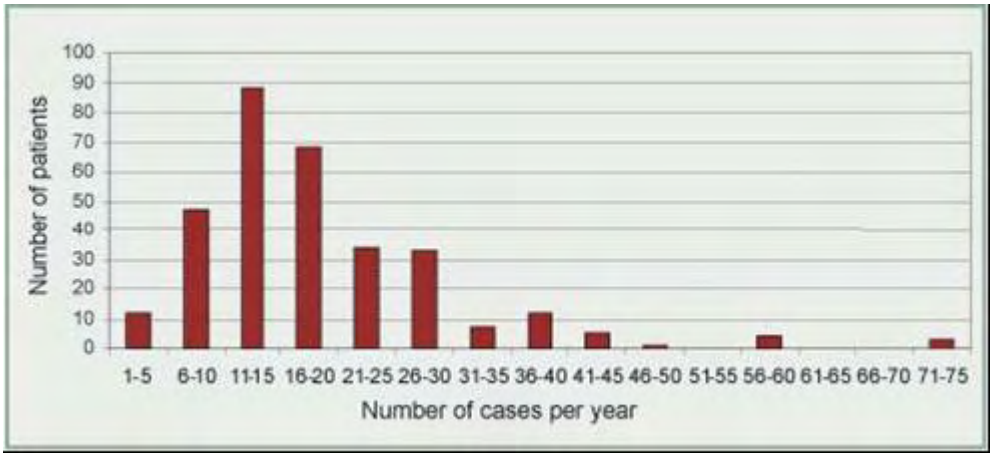


Figure 8. Number of elective repairs performed by the most senior surgeon n=312/434

Only 82% (255/312) of procedures were performed by surgeons who had probably performed more than 10 elective aneurysm repairs in the year 2002/03.

Workload and outcome

NCEPOD has considered whether the data available can be of use in examining the relationship between the outcome of surgery and the number of procedures that a surgeon performed in a year.

While other studies have suggested a relationship between outcomes after AAA repair and the experience of the surgeon, the relationship is not clear in this study. This may reflect small numbers or the fact that the experience of the surgeon is, as seems likely, only a part of the explanation of postoperative mortality. What we do note in the present study however, is that patients operated on by surgeons performing over 30 AAA repairs a year had fewer postoperative deaths than average.

If this is true, it raises questions about subspecialisation and volumes of work necessary for a hospital to offer a vascular service. Could it be that surgeons performing aneurysm repair should be aiming to do one a week? Should aneurysm repair be concentrated in fewer units?

4. Surgery

Elective surgery >> Postoperative complications within 30 days of surgery

21% of elective cases had an infective complication of some sort. 1% of patients developed paraplegia.

6% (25/430) of patients had a graft complication and 14 (3%) returned to theatre. Complications related to limb ischaemia were reported in 5% (23/428) of cases and 12 patients (3%) had to return to theatre, one requiring an amputation.

Infections were common, affecting one in five patients undergoing an elective aneurysm repair. We did not ask specifically about MRSA but as might be expected the most common infections were chest infections (14%, 60/431) and wound infections (4%, 16/431). Only two patients developed graft infections within 30 days of surgery.

7% (31/428) of patients were reported to have had a myocardial infarction. For three patients there was no answer to this question and in another three it was unknown. No specific criteria for diagnosis of infarction were laid down in the questionnaire, so some silent myocardial infarcts may not have been reported. 45% of those who had an infarct died within 30 days of surgery. This is consistent with other reports of the grave prognosis of myocardial infarction in this context.

Table 10. Position of aortic clamp

Position of clamp	Total	%
Sub-diaphragmatic	4	1
Supra-renal	37	9
Infra-renal	352	90
Sub-total	**393**	
Unknown	12	
Not answered	29	
Total	**434**	

The incidence of clamps placed above the renal arteries (9% 37/393) seems quite high (Table 10). The development of renal impairment after elective surgery was divided into those patients showing a rise in urea of greater than five mmol/l above the preoperative level, and those who required renal support. Not surprisingly there was a marked increase in the risk of renal impairment if the clamp was placed above the renal arteries at some point in the operation. Although only 9% of patients had a clamp applied above the renal arteries, the urea rose over 5mmol in 25% of patients, and 41% required renal support.

There were 335 cases when the clamp was applied below the renal arteries and in whom data were supplied for both the preoperative creatinine level and the outcome for renal function.

Table 11. Level of renal impairment in patients with an infra-renal aortic clamp							
Preoperative creatinine level	**No renal impairment**	**%**	**Urea >5mmol above preoperative level**	**%**	**Renal support**	**%**	**Total**
≤125 µmol/L	264	95	10	4	3	1	**277**
>125 µmol/L	46	79	9	16	3	5	**58**
Total	**310**		**19**		**6**		**335**

Despite a preoperative creatinine level of ≤ 125 µmol/L, 5% of patients with an infra-renal aortic clamp developed some degree of renal impairment. This figure rose to 21% for those with a preoperative creatinine level above 125 µmol/L.

Four patients (1%, 4/426) were reported to have suffered a stroke within 30 days of surgery. One of the two patients who had a disabling stroke died.

Two patients (0.5%, 2/427) developed ischaemic bowel, (confirmed either at laparotomy, by mucosal changes at endoscopy or at autopsy). Both patients died.

1% (4/426) of patients developed paraplegia but all survived to 30 days. This would seem to have been a more frequent event than might have been anticipated. It is a catastrophic complication. NCEPOD has no information on the consent process, so cannot comment on whether the possibility of this complication would have been explained to the patient before the operation.

‘Other’ complications were reported for 19% (68/367) of patients.

4. Surgery

Emergency surgery >> Mode of admission

Mode of admission

19% of emergency admission patients were transferred from other hospitals.

The mortality rate for emergency admissions with symptoms related to their AAA is higher than for patients admitted electively even though the AAA may not have ruptured.

264 patients were admitted and underwent emergency AAA repair. Mortality after AAA repair following emergency admission was high with 36% (94/264) dying within 30 days of surgery. This contrasts with elective admissions, with a mortality rate of 6.2% (27/434).

For the 50 patients transferred from another hospital, the mortality was slightly better (28%,14/50) compared to those operated on in the hospital to which they were first admitted, who had a 30 day mortality of 37% (80/214).

Why did transferred patients have a lower mortality? Patients considered for transfer should be sufficiently stable to withstand the journey and there must be a perception that their chance of survival will be increased by transfer to a unit with appropriate staff or other resources. This study did not collect data on how many patients were considered for transfer but did not reach the accepting hospital, either because of deterioration before transfer or death in transfer. Patients who survived transfer were therefore likely to have been subject to a greater degree of selection than those who were not transferred.

As discussed above, 20% (52/264) of the emergency admission patients were known to have an aneurysm before their admission and of these 16 died, 13 were recorded as being on a waiting list for open repair and five for endovascular repair. Since only 20-25% of patients whose aneurysm ruptures in the community will reach hospital alive [3], it is likely that mortality amongst patients on the waiting list is somewhat higher than this.

Patients unsuitable for elective repair

There is always discussion about the proper course of action when a patient is admitted to hospital with an aortic aneurysm as an emergency when they have previously declined, or been turned down for elective repair. Because the relevant hospital notes may not be available in the acute setting, the clinician may not be aware of how and why the previous decision was made. In this study 11 (21%) of the 52 patients admitted with a known aneurysm had been classed as unsuitable for elective repair. NCEPOD did not collect data on what reasons lay behind the original decision to deem the patient as unsuitable for aneurysm repair. In the event, four of the 11 patients, (36%), survived and left hospital within 30 days.

4. Surgery

Emergency surgery >> Demographics

19% (50/264) of emergency admissions were female compared to 13% (57/434) of patients for elective AAA repair. The median ages were 75 years for men and 78 for women, which is older than for patients undergoing elective repair.
The surgeon was asked to classify the status of the aneurysm. From the answers received, 168 were ruptured aneurysms and 81 were classified as unruptured, either symptomatic or asymptomatic.

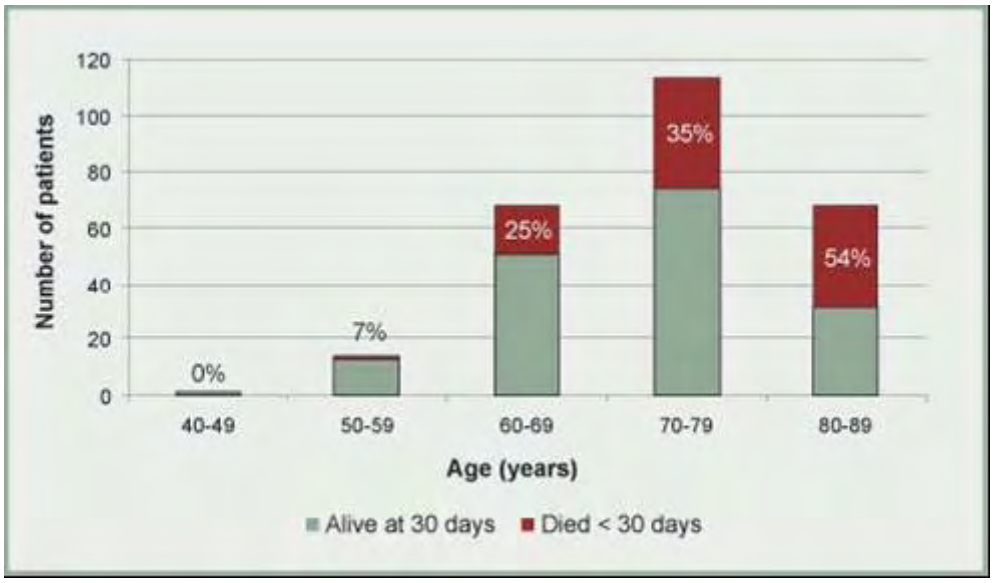


Figure 9. Age by mortality n=264. Percentages refer to patients who died in hospital within 30 days.

4. Surgery

Emergency surgery >> Comorbidities

Cardiac and respiratory comorbidity were common. The numbers are small, but an increased risk of mortality is seen with angina and heart failure. The presence of atrial fibrillation was associated with an increased mortality and this is in contrast to elective patients where atrial fibrillation was not associated with increased mortality, although the numbers are small. The presence of dyspnoea on exertion was associated with an increased mortality rate and it is recognised that in some patients the dyspnoea may have been due to cardiac pathology.

Table 12. Cardiac history and outcome (answers may be multiple)

Cardiac history	Died within 30 days	% who died within 30 days	Alive at 30 days	Total n=264
None	25	27	69	94
Angina controlled	25	42	34	59
Angina uncontrolled	3	75	1	4
Heart failure within one month	5	83	1	6
Heart failure more than one month	7	58	5	12
Hypertension	35	46	61	96
MI/cardiac arrest this admission	2	33	4	6
MI 0-2 months before surgery	0	0	1	1
MI >2 months before surgery	17	45	21	38
Orthopnoea	4	57	3	7
Other	12	46	14	26
Not answered	1		0	1

Table 13. Cardiac signs and outcome (answers may be multiple)

Cardiac signs	Died within 30 days	% who died within 30 days	Alive at 30 days	Total n=264
None	55	29	133	188
Peripheral oedema	9	50	9	18
Pulmonary oedema	2	67	1	3
Raised JVP / high CVP	3	75	1	4
Other	17	63	10	27
Unknown	10		15	25
Not answered	1		1	2

Table 14. ECG and outcome				
ECG	**Died within 30 days**	**% who died within 30 days**	**Alive at 30 days**	**Total**
Normal	28	24	88	**116**
AF rate >90	8	50	8	**16**
Other abnormality	32	45	39	**71**
Sub-total	**68**		**135**	**203**
Unknown	25		32	**57**
Not answered	1		3	**4**
Total	**94**		**170**	**264**

Table 15. Respiratory history and outcome				
Respiratory history	**Died within 30 days**	**% died within 30 days**	**Alive at 30 days**	**Total**
None	47	29	114	**161**
Dyspnoea on exertion	26	43	35	**61**
Dyspnoea at rest	1	25	3	**4**
Other	3	33	6	**9**
Sub-total	**77**		**158**	**235**
Unknown	16		10	**26**
Not answered	1		2	**3**
Total	**94**		**170**	**264**

Mortality was higher among morbidly obese patients (47%, 9/19) than patients of normal build (32%, 68/214) and all three cachectic patients died.

Only 6% (14/251) of emergency admissions were diabetic, lower than elective admissions (9%) but unlike the data from elective patients, diabetes was associated with an increased mortality (50%). However, the numbers are small and there was no information about diabetic status in 13 patients, making it impossible to draw any conclusion about the impact of diabetes on survival in this study.

There was an increased mortality rate among patients who were not fully conscious when assessed before operation. However, being comatose with a Glasgow Coma Score (GCS) of less than nine was not on its own a certain predictor of an adverse outcome. Two out of the seven patients with a GCS less than nine survived their operation and were discharged (Table 16).

Table 16. Glasgow Coma Score and outcome				
Glasgow Coma Score	**Died within 30 days**	**% died within 30 days**	**Alive at 30 days**	**Total**
Fully conscious (15)	54	27	143	**197**
Intermediate (9-14)	32	60	21	**53**
Unconscious (3-8)	5	71	2	**7**
Sub-total	**91**		**166**	**257**
Unknown	3		3	**6**
Not answered	0		1	**1**
Total	**94**		**170**	**264**

4. Surgery

Emergency surgery >> Imaging

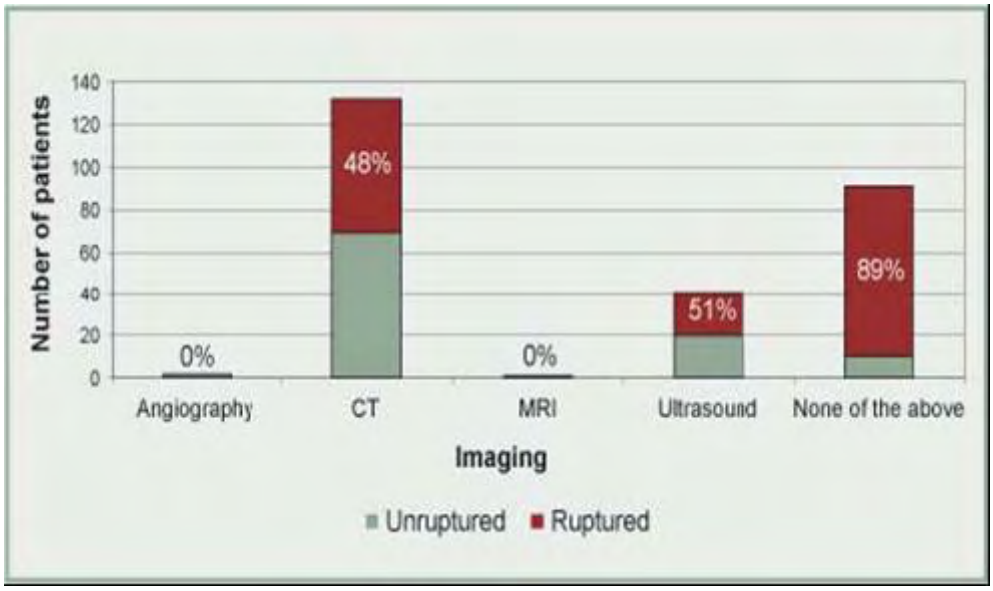


Figure 10 shows the imaging modalities used, divided into whether the aneurysm was ruptured or unruptured. Clearly, there are many patients who are stable enough for imaging even when the AAA has ruptured. Only three patients (unruptured) had any imaging additional to CT or ultrasound. As expected, the great majority of patients in whom no imaging was performed had ruptured aneurysms; presumably the diagnosis was not in doubt and the patient's condition required immediate operation without delay.

4. Surgery

Emergency Surgery >> The operation

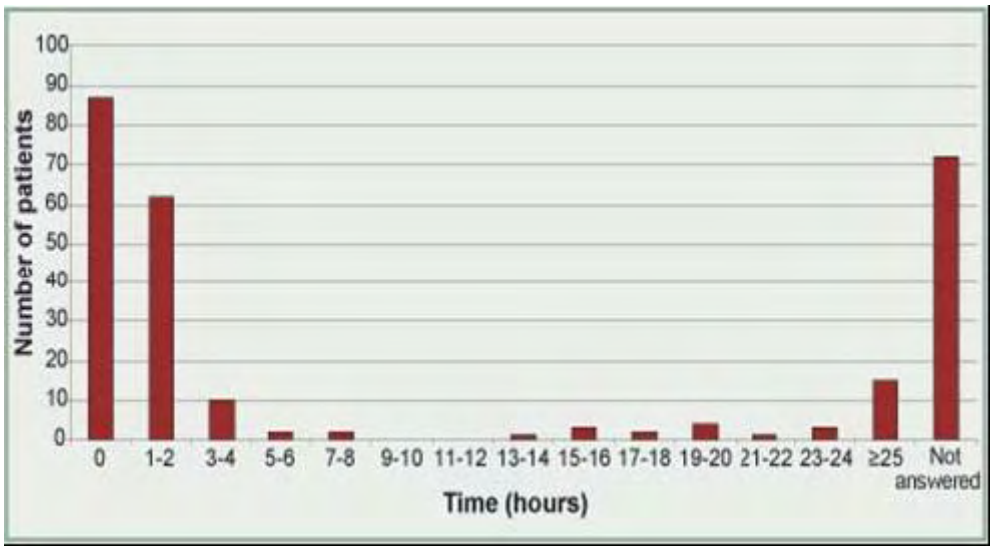
Time of day

Figure 11. Time of day when operation started by outcome n=264. Percentages refer to patients who died within 30 days.

Emergency AAA is a procedure that must be done as soon as reasonably possible especially when patients are cardiovascularly unstable. The procedure may have to be undertaken at night which may cause a deleterious delay if senior staff have to come into the hospital. The differences were not great but there is an impression that the outcome was better when emergency AAA repair was carried out in the daytime. There may be a number of reasons for this but it is possible that patients admitted as an emergency at night with an unruptured aneurysm (with a lower risk of mortality than a ruptured AAA) may have been operated on the next morning, a possibility explored further in the next section.

Time to operation

Figure 12 shows the interval between the time when the decision to operate was taken and the time of incision.

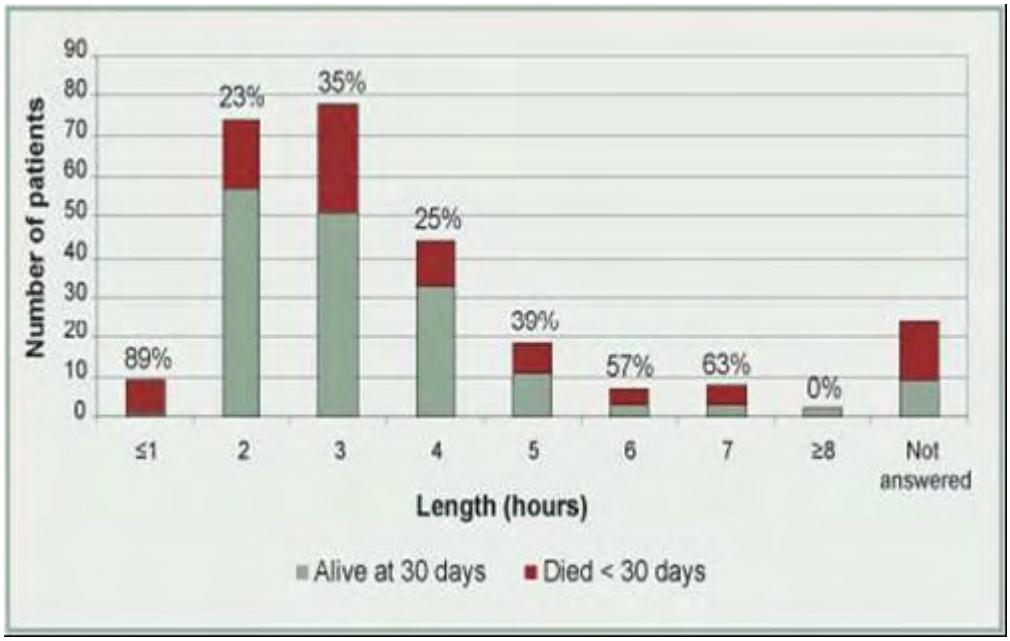


Some cases were delayed for many hours, indeed there appears to be a second cohort after a 12 hour interval. This may represent patients admitted in the evening or night with unruptured aneurysms whose operation was planned for the next day. Data from 192 cases were available to calculate the interval to operation. In 78% (149/192) of cases the incision time was less than two hours after the decision to operate. The interval was over 25 hours in 15 cases.

Delays that prevented surgery at the time it was clinically indicated were reported in 8% (19/244) of cases. The cause of the delay was only supplied in three cases; in two cases the delay was due to lack of theatre resources and in one it was due to lack of critical care resources.

Length of operation - surgical time

The length of operation was calculated from the times given for incision and for closure. Figure 13 gives the range of surgical time, and the number of patients who died or were alive at 30 days. Overall, emergency cases were likely to take a shorter time than elective operations. Operations that were very short or very long often had an adverse outcome.



Nearly three quarters of repairs (73%, 182/249) were done using a tube graft. This is a similar proportion to that for elective repairs. 23 patients also underwent a thrombectomy/embolectomy and four a peripheral

artery bypass.

Grade of surgeon

15 emergency operations were performed without a consultant surgeon present.

Data on the grade of the most senior operating surgeon present were returned for 254 out of the 264 emergency aneurysm repairs (Table 17).

Table 17. Grade of the most senior operating surgeon

Grade of surgeon	Total	%
Consultant	239	94
SpR year 3+	8	3
Other	7	3
Sub-total	**254**	
Not answered	10	
Total	**264**	

The data collected in this study did not include any information about how many emergency cases were started by a junior waiting for a consultant to arrive.

Fifteen AAA repairs were performed without a consultant present. Given the high mortality of this operation in the emergency setting it is surprising that even this small number were performed unsupervised. While the elective setting is an ideal opportunity for training, it is only the highly competent junior who could be left to do an emergency repair and it would seem reasonable to have a consultant nearby for advice and help. However, it is possible that a specialist registrar training in vascular surgery may be more competent than a consultant on-call who does no elective vascular surgery. To ensure availability of adequately trained surgeons to treat patients admitted as emergencies with AAA, Trusts may need to develop networks to provide this service and the number of Trusts admitting surgical emergencies may need to be reviewed. Models for delivering emergency vascular services have been proposed by the VSGBI[4].

Specialty of surgeon

16 emergency operations were performed by a surgeon without an elective vascular workload.

Surgeons were asked to report their surgical subspecialty. We received information for all but 12 cases (Table 18).

Table 18. Specialty of the most senior operating surgeon		
Specialty of surgeon	**Total**	**%**
Vascular surgeon	179	71
General surgeon with vascular interest	57	23
General surgeon with no vascular interest	8	3
Specialist surgeon	8	3
Sub-total	**252**	
Unknown	2	
Not answered	10	
Total	**264**	

94% (236/252) of patients were treated by surgeons with expertise in vascular surgery. Many of the operations must have been done in hospitals without a separate vascular on call rota, so the commitment by these surgeons is commendable. However, 6% (16/252) of AAA repairs were performed by surgeons who had no special interest in vascular surgery or specifically had a special interest in another branch of surgery, for example, colorectal surgery. The mortality rate for vascular surgeons and surgeons with a vascular interest was 32% (76/236) and for general surgeons and surgeons with another specialist interest it was 50% (8/16).

It is highly unsatisfactory that patients presenting with a major vascular emergency received their treatment from a consultant surgeon who did not do vascular surgery as a regular part of their elective work. NCEPOD has no information as to what information patients were given as part of the consent process before operation. One should also understand the anxieties of the surgeons involved, who recognise the limitations of their expertise in vascular surgery, yet have to do the best they can for the patient because those are the circumstances in which they find themselves. This is increasingly a problem for other subspecialties of general surgery in the emergency setting.

The situation regarding availability of vascular surgeons is constantly changing and it should be borne in mind that these data were collected in the spring of 2004, 18 months before the publication of this report. Yet, at the time of writing there were insufficient vascular surgeons nationally to provide specialist care for all emergency admissions. Even with the planned expansion of consultant numbers there will be too few vascular specialists for all hospitals accepting surgical emergencies to provide a specialist vascular service. The question remains; how best can we provide care for a patient admitted as an emergency with an AAA? Solutions may include the transfer of patients to nearby units with vascular surgeons available; directing admissions to appropriate units in the first place; and surgeons who can travel and cover additional hospital sites. There will be exceptional geographical circumstances where it may be very difficult to ensure timely access to a surgeon with vascular expertise. In all other areas, Strategic Health Authorities and Trusts should co-operate to provide a service for patients such that only surgeons with vascular expertise operate on emergency aortic aneurysm patients.

Membership of the Vascular Society and outcome

The data have been analysed as to whether there was any difference in outcome between operations performed by surgeons who were and who were not members of the VSGBI. Because so many surgeons chose not to answer this question one must be cautious about the significance of the better survival associated with operation by a member of the VSGBI.

Table 19. Surgeon's membership of the VSGBI and outcome				
Member of VSGBI	**Died within 30 days**	**% died within 30 days**	**Alive at 30 days**	**Total**
Yes	26	35	49	**75**
No	9	45	11	**20**
Sub-total	**35**		**60**	**95**
Unknown	2		0	**2**
Not answered	57		110	**167**
Total	**94**		**170**	**264**

4. Surgery

Emergency Surgery >> Surgeons' workload

Surgeons' workload

69% of emergency operations were performed by surgeons who had done five or more emergency AAA repairs in 2002/03.

As discussed in the section on elective admissions, these data must be interpreted with great caution.

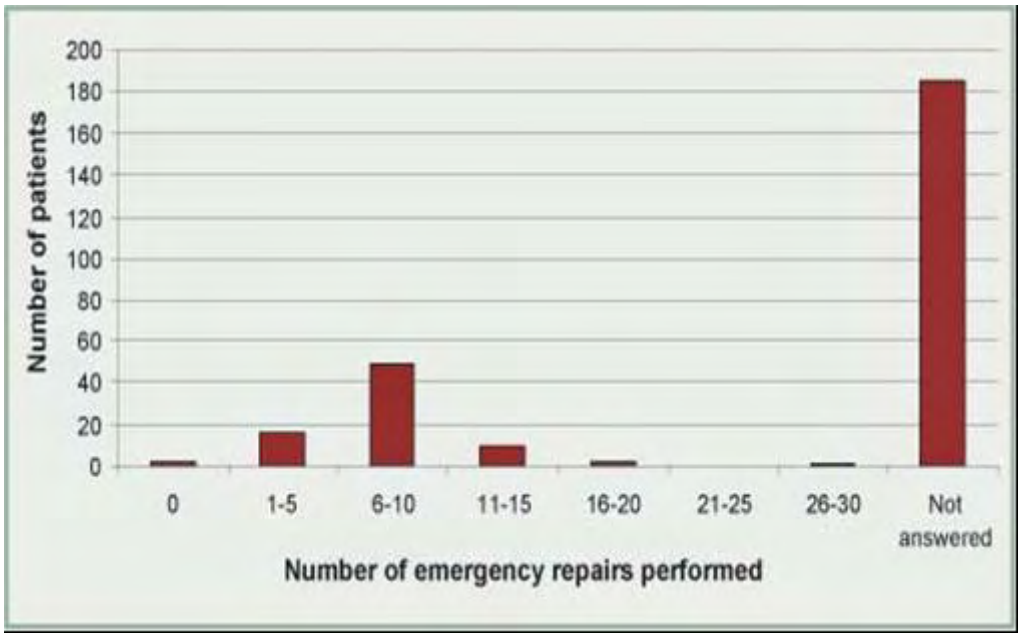


Figure 14. Number of emergency repairs performed by the most senior surgeon n=264

There were 185 blank responses to this question. In two cases the surgeon reported that they had performed no emergency AAA repairs in 2002/03 and in 77% (61/79) of cases, the surgeon had performed more than five emergency AAA repairs in the year.

Workload and outcome

NCEPOD has examined whether the data available to NCEPOD can be of use in examining whether the outcome of emergency surgery was related to the number of procedures that a surgeon performed in a year.

As with elective surgery, because of the small numbers it is hard to draw conclusions about the relationship between the number of AAA repairs a surgeon performed and the likely outcome of patients admitted as an emergency who required an AAA repair. Once again however, the best results were amongst patients operated on by surgeons with the greatest experience of elective AAA repairs in the previous year.

4. Surgery

Emergency Surgery >> Postoperative complications within 30 days of surgery

Graft complications were reported in 14% (33/242) of cases, double the incidence in the elective setting (6%). 14 patients (6%, 14/242) were returned to theatre and three of these required an amputation.

There were few complications reported related to limb ischaemia. Three patients out of the 239 (1%) required amputation and three had to return to theatre for other reasons.

28% (66/238) had a postoperative infection and for 26 patients it was unknown whether there had been any infections. The most common infections were chest infections (20%, 46/238) and no patient developed a graft infection within 30 days of surgery.

17% (37/223) of patients were reported to have had a myocardial infarction. 15 questionnaires were marked unknown and 26 questions were left unanswered. No specific criteria for diagnosis of infarction were laid down in the questionnaire, so in addition some silent myocardial infarcts may have not been reported. 57% (21/37) of those who had an infarct died within 30 days of surgery compared with 18% of those who did not.

Table 20 shows the emergency operations grouped according to the highest position at which the clamp was placed.

Table 20. Position of aortic clamp

Position of clamp	Total	%
Sub-diaphragmatic	13	5
Supra-renal	19	8
Infra-renal	211	87
Sub-total	**243**	
Unknown	10	
Not answered	11	
Total	**264**	

The development of renal impairment after elective surgery was divided into those patients showing a rise in urea > 5 mmol/l above preoperative level and those who required renal support (Table 21).

Table 21. Number of cases with postoperative renal impairment

Renal impairment	Total	%
None	141	64
Urea > 5 mmol above preoperative level	49	22
Requiring haemofiltration / dialysis	30	14
Sub-total	**220**	
Unknown	12	
Not answered	32	
Total	**264**	

Renal failure was commonly associated with mortality. 39% (19/49) of patients who developed a raised urea died, and 60% (18/30) of patients who required renal support died.

Eight patients (3%, 8/236) were reported to have suffered a stroke within 30 days of surgery; three disabling and two non-disabling. The three remaining patients were reported to have had an ‘other’ type of stroke. Three of the eight patients reported as having strokes died.

Five patients (2%, 5/230) developed ischaemic bowel, (confirmed either at laparotomy, by mucosal changes at endoscopy or at autopsy). One patient survived.

One patient developed paraplegia and died. ‘Other’ complications were reported for 35% (64/184) of patients.

4. Surgery

Recommendations

Patients with an aortic aneurysm requiring surgery must have equal priority with all other patients with serious clinical conditions for diagnosis, investigation and treatment.

Trusts should take action to improve access to Level 2 beds for patients undergoing elective aortic aneurysm repair so as to reduce the number of operations cancelled and inappropriate use of Level 3 beds.

Trusts should ensure that clinicians of the appropriate grade are available to staff preoperative assessment clinics for aortic surgery patients.

Strategic Health Authorities and Trusts should co-operate to ensure that only surgeons with vascular expertise operate on emergency aortic aneurysm patients, apart from exceptional geographical circumstances.

4. Surgery

References

[1] http://www.dh.gov.uk/PublicationsAndStatistics/Statistics/HospitalEpisodeStatistics/fs/en

[2] Achieving the NHS Cancer Plan waiting times targets. HSC 2001/012. Department of Health.

[3] Greenhalgh RM and Powell JT. Screening men for aortic aneurysm. BMJ. 2002; **325**: 1123-1124.

[4] The provision of emergency vascular services. Vascular Society of Great Britain and Ireland, 2001.

5. Anaesthesia

Introduction

This section examines the data collected from the anaesthetist responsible for the patient and recorded on the anaesthetic questionnaire. There are no data from patients in whom a decision was made not to operate and who received palliative care because no anaesthetic questionnaires were received relating to those patients.

5. Anaesthesia

Preoperative drug therapy >> Beta blockade

Beta blocking drugs were not widely prescribed before elective operation.

The anaesthetists caring for the patients in this study were asked whether the patient had received beta blockers before admission. There has been controversy about the possibility that the administration of beta blockers to patients with a history of cardiac disease undergoing major surgery could reduce the incidence of adverse outcomes. Some papers show a benefit whilst others fail to find any effect. Some authorities [1] have suggested that whenever possible beta blockers should be started days or weeks before surgery in high risk patients. This recommendation is likely to cover most patients undergoing aortic surgery.

Table 1 gives the number of elective patients receiving beta blockers for patients undergoing open procedures.

Table 1. Elective patients receiving beta blockers prior to admission (all open operation patients)

Beta blockers	Total	%
Yes	130	35
No	245	65
Sub-total	**375**	
Unknown	1	
Not answered	58	
Total	**434**	

Table 2 shows the number of patients admitted as an emergency who were receiving beta blockers prior to admission. Emergency patients are likely to have been receiving beta blockers as part of their regular medication rather than because beta blockers had been prescribed as part of preoperative optimisation.

Table 2. Emergency patients receiving beta blockers prior to admission

Beta blockers	Total	%
Yes	52	26
No	147	74
Sub-total	**199**	
Unknown	21	
Not answered	44	
Total	**264**	

35% (130/375) of elective patients were receiving beta blockers before admission, compared to 26% (52/199) of emergency admissions.

These data suggest that UK anaesthetists were choosing not to implement the recommendations on the use of preoperative beta blockade cited above at the time of this study. This is consistent with other recent studies showing that only a minority of vascular patients are prescribed beta blocking drugs preoperatively.

5. Anaesthesia

Preoperative drug therapy >> Statins

53% of elective admission patients were taking statins at the time of operation.

One could expect that the use of statins would have been widespread in this population, because patients with aortic aneurysms are regarded as being at risk of coronary heart disease and statins are indicated for any patient with a suspicion of coronary heart disease. There is also evidence that the outcome of surgery in patients at high risk of cardiac complications is improved by the administration of statins[2,3,4]. The questionnaire asked whether the patient was taking statins at the time of the operation (Table 3).

Table 3. Elective patients taking statins at the time of operation

Statins	Total	%
Yes	198	53
No	174	47
Sub-total	**372**	
Unknown	4	
Not answered	58	
Total	**434**	

Table 4 shows the number of patients admitted as an emergency who were taking statins at the time of operation.

Table 4. Emergency patients taking statins at the time of operation

Statins	Total	%
Yes	61	31
No	135	69
Sub-total	**196**	
Unknown	23	
Not answered	45	
Total	**264**	

53% (198/372) of patients admitted electively were receiving statins, compared with 31% (61/196) admitted as an emergency.

5. Anaesthesia

Preoperative drug therapy >> Effect of beta blockers and statins on outcome

This was an observational study. Differences in outcome between those patients who were and were not taking beta blockers before admission could be because of an effect of beta blockade or because patients with a greater risk of cardiac complications were more likely to be prescribed beta blockers. It had been hoped to apply case-mix corrections to the data but as described in the Methods chapter, this was not possible. Therefore it is unsafe to present any conclusions about outcomes in relation to the use of beta blockade. Similarly, no conclusions on the effect of statins on outcome are presented.

5. Anaesthesia

Preoperative investigations

The process of preoperative assessment is considered in the surgical section. This section considers the content of the preoperative assessment process.

Echocardiography was the most common cardiac investigation. Other cardiac investigations were not widely used.

All patients would have had a clinical examination and a 12 lead ECG. Anaesthetists were asked to indicate whether elective patients had received more sophisticated cardiac investigations. Emergency admission patients were excluded because it would have been unlikely that there would have been time to organise these sorts of investigations. For this analysis the figures do include patients who went on to have endovascular repair. The standard basic clinical history and examination together with a standard 12 lead ECG will allow patients to be allocated into one of three risk groups; low, intermediate or high. According to published guidelines [1] extra cardiac investigations are only indicated for the intermediate group, in order to identify whether patients in this group need further medication or intervention before operation.

Patients may have had more than one preoperative investigation. The results for large and for intermediate sized vascular units are shown in Figures 1 and 2. Only three cardiac investigations were reported from remote units, all being transthoracic echocardiography. In 14% (67/477) of questionnaires no data was available as to whether any investigations had been performed or not.

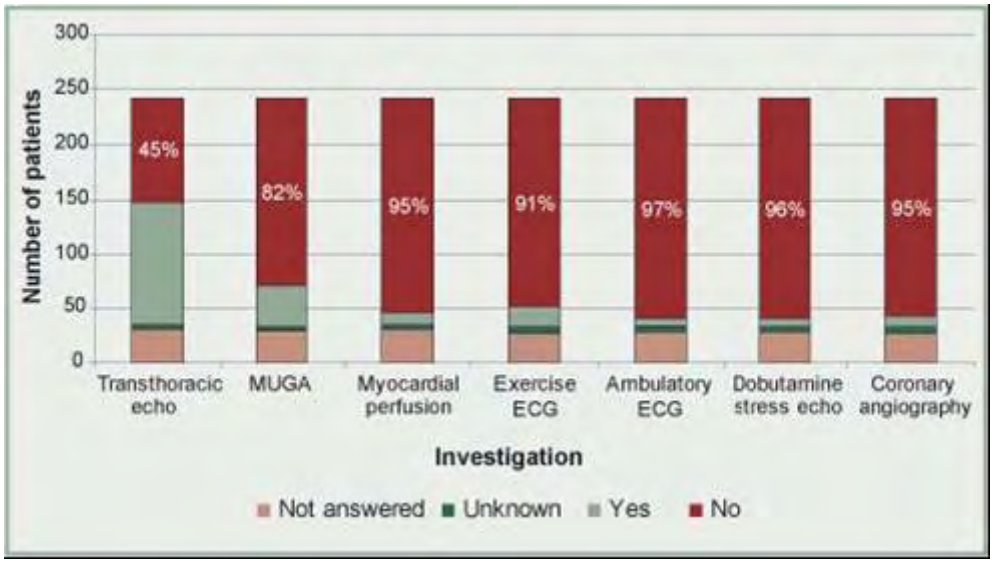


Figure 1. Investigations in large vascular units (elective open and endovascular procedure patients) n=242. Percentages refer to investigations that were not performed.

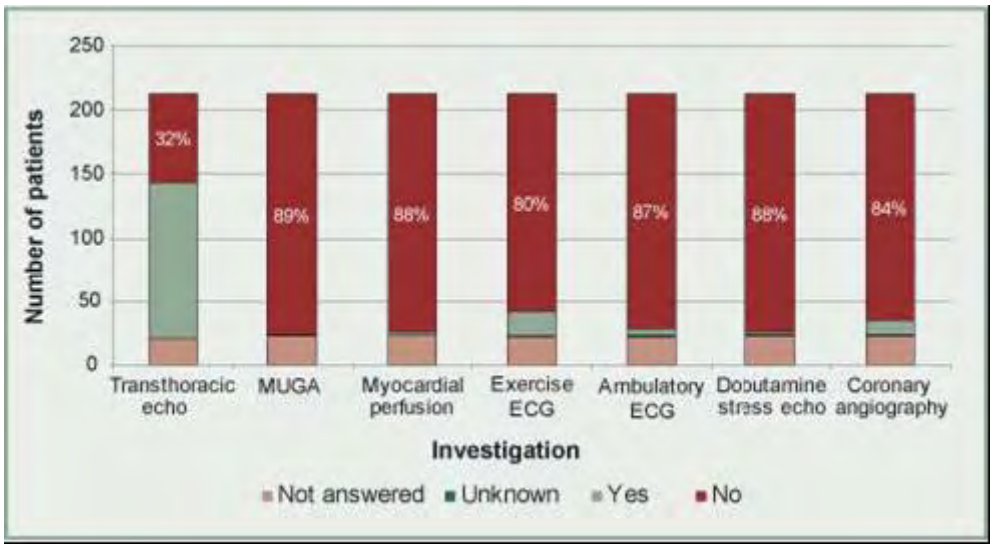


Figure 2. Investigations in intermediate vascular units (elective open and endovascular procedure patients) n=213. Percentages refer to investigations that were not performed.

Transthoracic echocardiography was the most common investigation being used in 60% (244/410) of cases overall. The NCEPOD advisors suggested that it is relatively easy to obtain a transthoracic echocardiography investigation for a vascular patient compared to the other investigations listed. The advisors were of the opinion that the test was helpful as an estimate of ventricular function and as a means of excluding unsuspected valvular disease, although there is little published evidence that the use of echocardiography affects outcome. It was thought that echocardiography was indicated in most aneurysm patients when it was not possible to judge ventricular function by simple clinical tests (e.g. the ability to climb two flights of stairs).

Other investigations were utilised to a small extent in the large units, but hardly at all in intermediate units. This may indicate greater difficulty in accessing sophisticated investigations at intermediate sized units. NCEPOD did not have enough information to calculate the cardiac risk for each individual patient so it was not possible to make an overall judgement as to whether the investigations were appropriate or not.

The anaesthetist was asked, if an investigation had been performed, whether or not they judged that the results of the investigations had affected the management of the patient. Table 5 details the numbers of tests, for all sizes of unit, which were regarded as affecting management.

Table 5. Investigations and effects on management of elective cases n=477

	Transthoracic echo	%	MUGA	%	Myocardial perfusion	%	Ex. ECG	%	Amb. ECG	%	Dob. stress echo	%	Coronary angiography	%
Yes	70	31	19	53	6	43	12	36	1	11	2	25	10	59
No	153		17		8		21		8		6		7	
Sub-total	**223**		**36**		**14**		**33**		**9**		**8**		**17**	
Unknown	1		1		0		2		0		0		0	
Not answered	20		2		0		3		2		2		4	
Total	**244**		**39**		**14**		**38**		**11**		**10**		**21**	

NCEPOD cannot tell how great the changes in management may have been. There was quite a variation in the utility of the different investigations. Overall these figures would suggest that investigations are not being misused, but individual units should ensure that they have protocols agreed with cardiology colleagues concerning the indications for ordering these investigations. A mechanism for audit of the usefulness of the results, in order to ensure the most effective use of resources, should be implemented.

5. Anaesthesia

Preoperative investigations >> Assessment by a cardiologist

22% of elective admission patients were seen preoperatively by a cardiologist.

Anaesthetists were asked whether the patient had been assessed preoperatively by a cardiologist. Table 6 shows the results for elective patients. The data provide a useful benchmark, that approximately one patient in five was referred to a cardiologist.

Table 6. Preoperative assessment by cardiologist, elective open and endovascular procedure patients

Assessed by cardiologist	Large	%	Intermediate	%	Remote	%	Not answered	Total	%
Yes	46	23	37	20	1	33	4	**88**	**22**
No	157	77	149	80	2	67	4	**312**	**78**
Sub-total	**203**		**186**		**3**		**8**	**400**	
Unknown	5		5		0		0	**10**	
Not answered	34		22		1		10	**67**	
Total	**242**		**213**		**4**		**18**	**477**	

It is not possible to state an appropriate level of referral for a cardiology opinion. Referral to a cardiologist can assist in advising on further sophisticated cardiac investigations. Referral can also be very helpful in optimising the condition of patient with severe coronary artery disease or impairment of myocardial function. However, some patients may already be under review by the cardiology service so further referral is not necessary. For many others their cardiac status may be such that an anaesthetist who regularly anaesthetises patients for major vascular surgery is entirely competent to supervise their preoperative cardiac preparation. Referral to a cardiologist may introduce a delay before the patient is admitted for operation.

Coronary artery angioplasty and bypass before elective surgery

21 elective patients had coronary angiography. Three of the patients had coronary angioplasty and nine had coronary artery bypass grafting before surgery. This low rate of intervention mirrors evidence that the decision to offer patients bypass grafting or angioplasty should be based on their cardiac status alone and should not be influenced by the prospect of vascular surgery [5].

5. Anaesthesia

The anaesthetist >> Elective open operations

A consultant anaesthetist was involved in 97% of cases.

Table 7. Grade of the most senior anaesthetist present at the start of anaesthesia		
Grade of anaesthetist	**Total**	%
Consultant	351	93
Associate specialist	4	1
SpR year 3+	20	5
SpR year 1/2	2	<1
Other	1	<1
Sub-total	**378**	
Not answered	56	
Total	**434**	

Of the 27 non-consultant responses, a more senior anaesthetist took over responsibility during the operation in 14 cases. From the data available, a consultant anaesthetist started the operation in 93% (Table 7) of cases and had a part in 97%.

This probably represents excellent practice. However, the question was not completed in 13% (56/434) of cases. If a consultant had been present at the start of operation in all the cases with missing data, 94% of operations would have been started by a consultant anaesthetist: if a consultant had been present for none of the cases with missing data, 81% would have been started by a consultant.

5. Anaesthesia

The anaesthetist >> Emergency open operations

A consultant anaesthetist was involved in 97% of emergency cases.

Table 8. Grade of the most senior anaesthetist present at the start of anaesthesia

Grade of anaesthetist	Total	%
Consultant	185	85
Associate specialist	2	<1
Staff grade	3	1
SpR year 3+	25	11
SpR year 1/2	3	1
Sub-total	**218**	
Unknown	2	
Not answered	44	
Total	**264**	

A consultant anaesthetist was present at the start of the anaesthetic in 85% of cases. In 27 cases a more senior anaesthetist (always a consultant) took over responsibility during the operation, so that from the data available, overall a consultant was involved in 97% of cases.

Again this probably represents good practice but the question was not completed in 17% of cases. If a consultant had been present at the start of operation in all the cases with missing data, 88% of operations would have been started by a consultant anaesthetist: if a consultant had been present for none of the cases with missing data, 70% would have been started by a consultant.

5. Anaesthesia

The anaesthetist >> Membership of the VASGBI

VASGBI Membership

The anaesthetist was a member of the Vascular Anaesthesia Society of Great Britain and Ireland in 52% of elective admission cases and 26% of emergency admission cases.

Table 9 gives the number of anaesthetics for open operations when the most senior anaesthetist present was a member of the VASGBI.

Table 9. Proportion of anaesthetics given by whether anaesthetist was a member of VASGBI

Member of VASGBI	Elective operation	%	Emergency operation	%	Not answered	Total	%
Yes	187	52	54	26	19	**260**	**42**
No	170	48	153	74	32	**355**	**58**
Sub-total	**357**		**207**		**51**	**615**	
Unknown	20		12		1	**33**	
Not answered	57		45		2	**104**	
Total	**434**		**264**		**54**	**752**	

The objectives of the VASGBI are: “To promote the highest standard of management and care for patients suffering from cardiovascular disorders, and in particular those undergoing vascular surgery, and to further the development of the art and science of vascular anaesthesia” [6]. The Society runs educational meetings, awards travelling fellowships and research grants, and collects audit data on vascular anaesthesia. The advisors discussed whether membership of the VASGBI could be viewed as a surrogate for the competence of the anaesthetist at vascular surgery. It is important to recognise that the Society is open both to those who are actively involved in vascular anaesthesia on a regular basis and to those who wish to remain up to date but only have an occasional exposure to vascular cases. Membership is entirely optional, and highly competent vascular anaesthetists may not wish to join, for a variety of reasons. The anaesthetist was more likely to be a member of the VASGBI for elective operations, when the anaesthetist would probably cover the list regularly, than for emergency operations when the anaesthetist would be drawn from the whole of the on-call rota.

Outcome

There was no difference in the outcome of elective surgery associated with whether the anaesthetist was a member of the VASGBI or not. (Table 10).

Table 10. Anaesthetist's membership of the VASGBI by outcome of elective open repairs

Member of VASGBI	Died within 30 days	% died within 30 days	Alive at 30 days	Not answered	Total
Yes	12	6	174	1	**187**
No	12	7	158	0	**170**
Sub-total	**24**		**332**	**1**	**357**
Unknown	1		19	0	**20**
Not answered	2		54	1	**57**
Total	**27**		**405**	**2**	**434**

There was no difference in the outcome of emergency open operations for unruptured aneurysms (Table 11). However, there was a difference in the outcome of emergency open operations for ruptured aneurysms (Table 12).

Table 11. Anaesthetist's membership of the VASGBI by outcome of emergency open repairs for unruptured aneurysms

Member of VASGBI	Died within 30 days	% died within 30 days	Alive at 30 days	Total
Yes	5	16	26	**31**
No	6	14	37	**43**
Sub-total	**11**		**63**	**74**
Unknown	0		1	**1**
Not answered	7		4	**11**
Total	**18**		**68**	**86**

Table 12. Anaesthetist's membership of the VASGBI by outcome of emergency open repairs for ruptured aneurysms

Member of VASGBI	Died within 30 days	% died within 30 days	Alive at 30 days	Total
Yes	6	26	17	**23**
No	47	46	55	**102**
Sub-total	**53**		**72**	**125**
Unknown	5		6	**11**
Not answered	14		18	**32**
Total	**72**		**96**	**168**

There was a better outcome for open repair of ruptured aortic aneurysm associated with the presence of an anaesthetist who was a member of the VASGBI. The numbers are very small and data were missing in 26% of cases, so this finding should be treated with caution. Is this finding genuine? If so, is membership of the VASGBI by the anaesthetist only a marker of other differences in service provision?

5. Anaesthesia

The anaesthetist >> Volume of cases done by anaesthetists

Volume of cases done by anaesthetists

In 49% of cases the anaesthetist could not calculate the number of the anaesthetics they had given for aortic surgery from a logbook or information system.

One in five (22%) elective patients were cared for by anaesthetists who performed five or fewer elective aneurysm repairs in 2002/03.

Three out of five (61%) emergency patients were cared for by anaesthetists who performed five or fewer emergency aneurysm repairs in 2002/03.

The most senior anaesthetist present was asked to supply the number of anaesthetics for elective AAA repairs administered in 2002/03 and the source of that information. Figure 3 gives the number where the answer was taken from a logbook or other information system, and the number where the answer depended on memory.

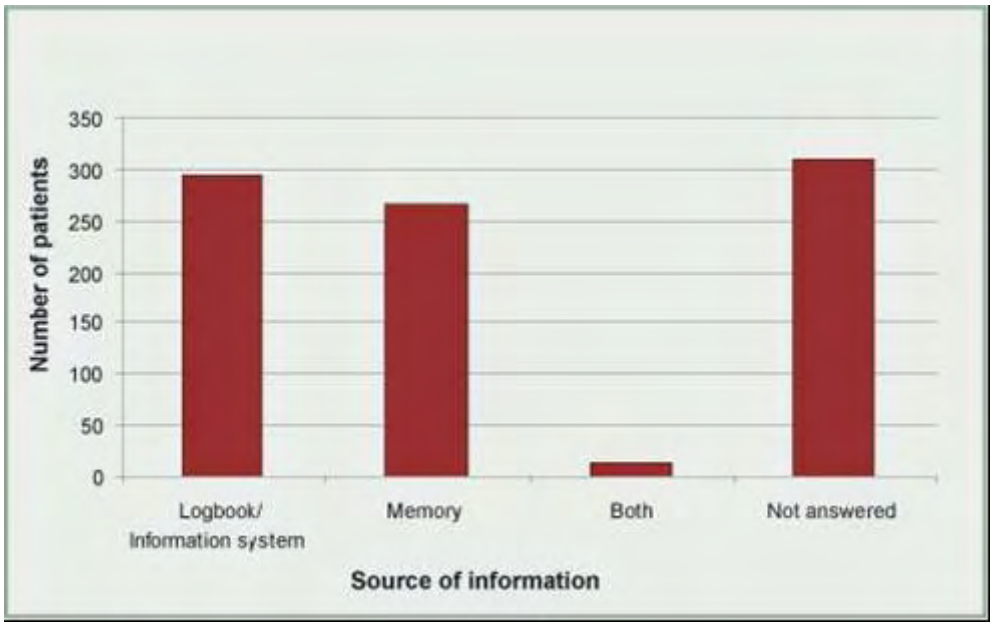


Figure 3. Source of information about the most senior anaesthetist involved in the operation
n=805

Of the 575 answers to this question, 295 (51%) reported using a logbook or information system alone rather than using their memory completely or in part. The question was unanswered in 309 cases.

Anaesthetists who were involved in more than one case in this study may have answered this question more than once, but it is surprising that in only a half of the cases anaesthetists could provide accurate data on their work. Logbook information is important for appraisal and for demonstrating competence in this and other specialised branches of anaesthesia.

Elective operations

The most senior anaesthetist present at elective open operations was asked to supply the number of

anaesthetics for elective AAA repairs they administered from April 2002 to March 2003. In 88 cases anaesthetists reported that the number of anaesthetics given for elective aneurysm repair in 2002/03 was 'Unknown'. 58 questionnaires failed to supply any answer.

288 questionnaires supplied a figure for the number of elective AAA repairs carried out in 2002/03 by the anaesthetist caring for that patient. Figure 4 gives the range of responses. Some anaesthetists may have been involved in more than one case.

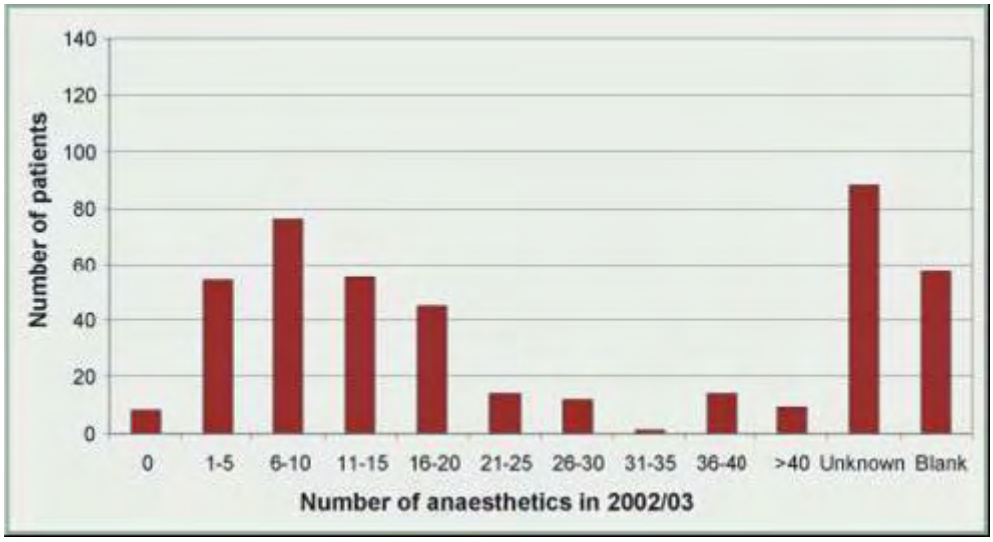


Figure 4. Number of anaesthetics for elective open AAA repair performed by most senior anaesthetist in 2002/03 n=434

48% (138/288) of the patients in this study anaesthetised for elective open AAA repair were cared for by anaesthetists who reported doing 10 or fewer elective aneurysm repairs in the year 2002/03, or less than one a month. 22% (62/288) of patients were cared for by anaesthetists who performed five or fewer a year. Is this level of experience of anaesthesia for aortic surgery acceptable?

It has been suggested that anaesthetists who undertake more vascular anaesthetics may be associated with patients who have a better outcome. NCEPOD has examined whether the data available to NCEPOD can be of use in examining this suggestion. The cases were allocated into two groups according to whether the most senior anaesthetist present reported doing more anaesthetics in 2002/03 than the median (high volume group) or fewer anaesthetics (low volume). The total number of patients who died before 30 days and who survived to 30 days were then calculated for each group. Table 13 shows the results of this analysis.

Table 13. Outcome of open AAA repair by number of anaesthetics for elective AAA repair given in 2002/03

	Low volume	%	High volume	%	Unknown	Total
Died within 30 days	13	9	6	4	8	**27**
Alive at 30 days	132		136		137	**405**
Sub-total	**145**		**142**		**145**	**432**
Unknown	1		0		1	**2**
Total	**146**		**142**		**146**	**434**

More deaths occurred in patients cared for by anaesthetists who undertook fewer anaesthetics than the median but the overall number of deaths was small. This pattern does conform with the

published evidence that hospitals and surgeons performing greater numbers of aortic aneurysm repairs have better results (see Organisation of vascular services). One cannot conclude that this pattern is caused by the anaesthetist. It may be that anaesthetists who perform few major vascular cases a year work in hospitals that do few aneurysms overall, with limited resources and expertise in caring for such patients.

Emergency operations

The most senior anaesthetist present at the 264 emergency open repairs was asked to supply the number of anaesthetics for elective and emergency AAA repairs they administered from April 2002 to March 2003.

Regarding elective aneurysm experience, 43 questionnaires reported that the number of anaesthetics given for elective aneurysm repair in 2002/03 was 'Unknown': 56 questionnaires failed to supply any answer. 78% (128/165) of emergency patients undergoing open aortic aneurysm repair were cared for by anaesthetists who anaesthetised 10 or less elective repairs in 2002/03. 61% (101/165) were cared for by anaesthetists who performed five or less elective repairs in 2002/03.

Regarding emergency aneurysm experience, 47 questionnaires reported that the number of anaesthetics given for elective aneurysm repair in 2002/03 was 'Unknown' and 48 questionnaires failed to supply any answer. 98% (166/169) of emergency patients undergoing open aortic aneurysm repair were cared for by anaesthetists who anaesthetised 10 or less emergency repairs in 2002/03: 85% (143/169) were cared for by anaesthetists who performed five or less emergency repairs in 2002/03. Only three anaesthetists reported anaesthetising more than 10 emergency patients for aortic aneurysm repair in 2002/03.

Figure 5 gives the range of responses.

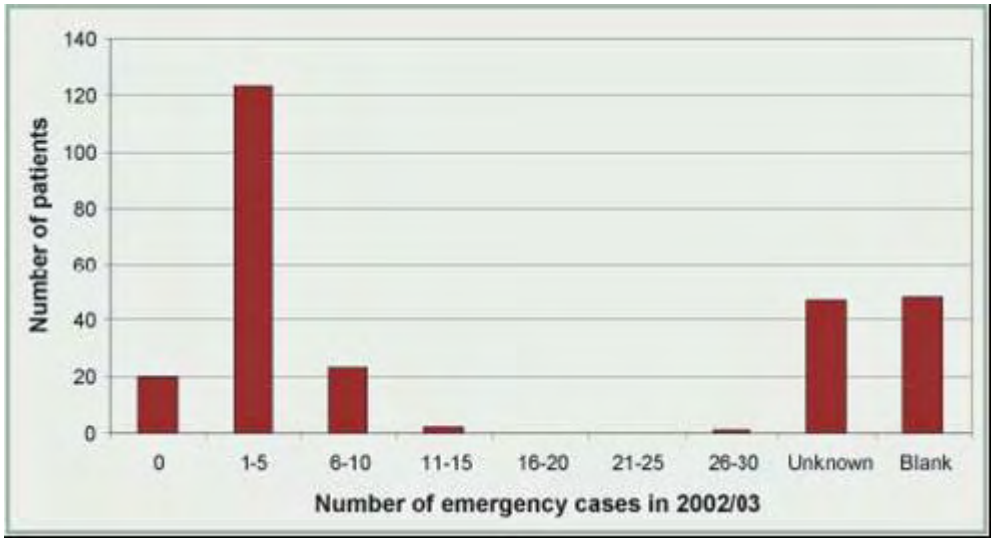


Figure 5. Number of anaesthetics for emergency open AAA repair performed by most senior anaesthetist in 2002/03 n=434

These data show that most anaesthetists have a very small exposure to the major emergency operation of emergency aortic aneurysm repair. Is this situation unavoidable given the number of anaesthetists on call for emergency aneurysm repair and the number of cases that present to each hospital a year?

The data for the outcome of emergency operations associated with the number of emergency cases performed by the anaesthetist have been analysed in the same manner as for elective operations (Table 14).

Table 14. Outcome of open AAA repair by number of anaesthetics for emergency AAA repair given in 2002-03						
	Low volume	%	**High volume**	%	**Unknown**	**Total**
Died within 30 days	32	40	23	27	39	**94**
Alive at 30 days	48		62		60	**170**
Sub-total	**80**		**85**		**99**	**264**
Unknown	0		0		0	**0**
Total	**80**		**85**		**99**	**264**

As with elective operations, there is a pattern that there were fewer deaths associated with the anaesthetists who performed more emergency procedures. NCEPOD cannot say that this pattern was directly related to the performance of the anaesthetist, only that anaesthetists who performed fewer emergency aneurysm repairs in 2002/03 were part of a system of care that appeared to result in less favourable outcome.

Given the very small number of cases, elective and emergency, that are done by many anaesthetists, anaesthetic departments should review whether these cases could be concentrated in the hands of a smaller number of anaesthetists, so that fewer anaesthetists do the occasional aneurysm repair. One change could be the introduction of a specialist vascular anaesthetic on-call rota.

5. Anaesthesia

The anaesthetist >> Use of epidural anaesthesia

Use of epidural anaesthesia

92% of elective admission patients received an epidural catheter as part of the anaesthetic technique.

An epidural catheter was inserted in 92% (345/377) of elective patients having an open operation. The question was unanswered in 57 cases. An epidural catheter was inserted in 73% (57/78) of emergency unruptured open aneurysm repairs. The question was unanswered in nine patients. In emergency ruptured aneurysm patients, an epidural catheter was inserted in 8% (11/133) of cases. Four were answered as unknown and 32 questions were unanswered.

Use of epidurals with agents that affect coagulation

Including the patients who underwent endovascular repair, a total of 465 patients received an epidural catheter. Anaesthetists were asked whether the epidural catheter had been inserted when the patient had received drugs that might impair coagulation.

Table 15. Preoperative epidural catheter insertion by whether patients received aspirin in the seven days before surgery

Aspirin in patients who received an epidural	Total	%
Yes	168	38
No	274	62
Sub-total	**442**	
Unknown	19	
Not answered	4	
Total	**465**	

Nine patients had received subcutaneous unfractionated heparin in the six hours before surgery, 448 had not.

Table 16. Fractionated heparin in patients who received an epidural

Fractionated heparin in patients who received an epidural	Total	%
Yes	61	14
No	390	86
Sub-total	**451**	
Unknown	7	
Not answered	7	
Total	**465**	

It would appear that anaesthetists do not think there is much risk associated with placing epidural catheters when the patient has been taking aspirin (Table 15).

The finding that 14% of patients had an epidural catheter placed within 12 hours of receiving fractionated heparin is worrying (Table 16). The consensus is that this practice exposes the patient to a significant risk of developing an epidural haematoma and the morbidity associated with this complication of treatment.

Removal of epidural catheters

In 16% of patients undergoing elective open repair the anaesthetist could not report when the epidural catheter was removed.

For the 345 patients undergoing elective open repair in whom an epidural catheter was inserted, no answer at all was given in seven cases to the question asking when the epidural catheter was removed. Of the 338 responses, in 55 cases (16%) the anaesthetist reported that they did not know when the epidural catheter was removed. If an anaesthetist inserts an epidural catheter it is their responsibility to ensure that the management of the catheter and of the epidural analgesia is safe. Some anaesthetists will want to exercise that responsibility personally until the catheter is removed. Others will wish to delegate that responsibility to a properly organised acute pain team. The finding that the anaesthetist was often unable to retrieve from the patient's notes the date when the epidural catheter was removed suggests, at the least, failure in documentation of the care given to the patient. This would cause an anaesthetist considerable difficulty if there were a problem with the epidural catheter resulting in a complaint or medico-legal correspondence. More worryingly, this failure may be a symptom of problems with the supervision of epidural analgesia and the delivery of safe clinical care. Clinicians should ensure that hospitals have robust systems in place for the postoperative care of epidural catheters, that demonstrate who is responsible for the care of the epidural catheter and for the accompanying appropriate documentation.

5. Anaesthesia

The anaesthetist >> Blood loss in open operations

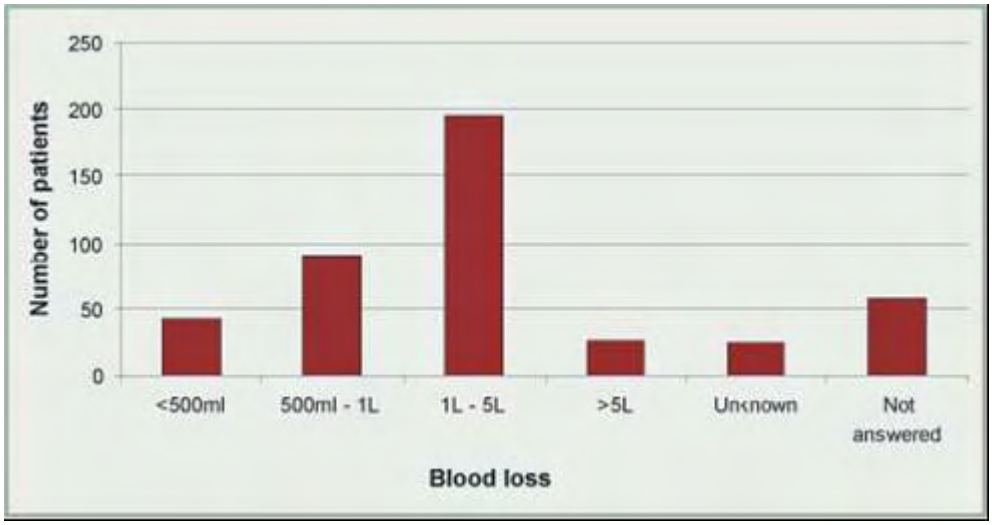


Figure 6. Blood loss in elective cases n=434

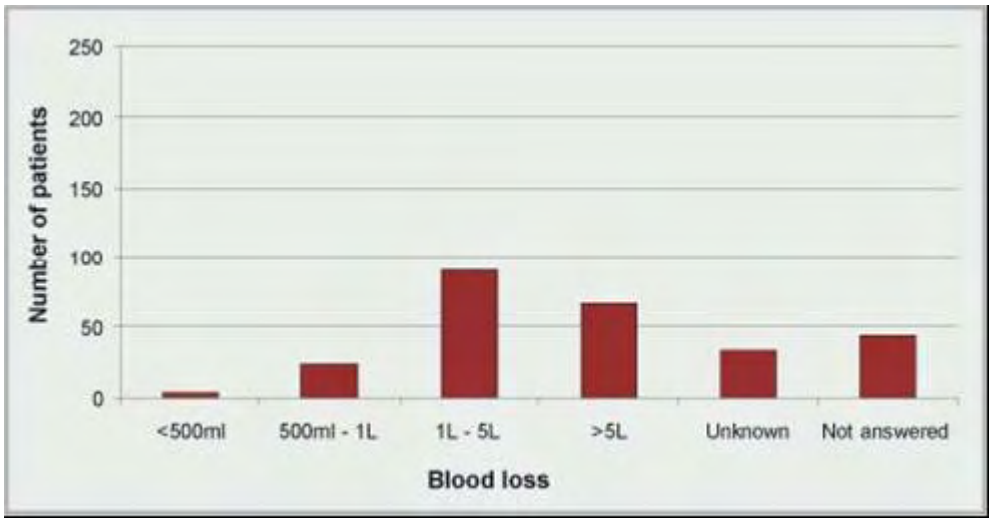


Figure 7. Blood loss in emergency cases n=264

The calculation of blood loss is recognised to be difficult for emergency operations (Figure 7). As expected, blood loss is less for elective operations (Figure 6) than for emergency ones, but 7% of patients (26/353) lost over five litres. The low blood loss reported for emergency aneurysm repair may be for cases when the aneurysm was unruptured.

91 patients were reported to have lost over five litres of blood at either elective or emergency open operations. 64% (58/91) of these patients received platelet transfusions, 77% (70/91) received fresh frozen plasma and 41% (40/98) received their own blood retrieved by a cell salvage system. 26% (25/98) received all three interventions. Are these figures acceptable?

The use of cell saver equipment is discussed in Organisation of vascular services. The NCEPOD advisors were of the opinion that there are sometimes problems with the release of blood products, especially platelets. There are published guidelines on the use of platelet replacement and the use of fresh frozen plasma[7,8]. These guidelines seek to reduce the inappropriate use of these components in the context of published evidence. They suggest that treatment should be decided on the results of clotting tests and that

factors are not required unless the platelet count is below $50*10^9$/L and coagulation times are increased. This situation is regarded as unlikely to occur until 1.5 blood volumes have been lost.

The guidelines acknowledge that there is very little published work on situations such as aortic aneurysm repair where there can be rapid ongoing surgical blood loss and they do sanction the use of components when there is clinical evidence of a coagulopathy. Guidelines from the American Society of Anesthesiologists recognise that these cases can require special arrangements for transfusion on the basis of observed blood loss and coagulopathy[9]. It may be helpful for Trusts to have protocols in place for the use of blood products for aortic aneurysm patients, and agreement about the utility of coagulation tests in this situation.

5. Anaesthesia

The anaesthetist >> Temperature

More than half the patients were hypothermic after open surgery.

Patients undergoing open aortic surgery are very vulnerable to heat loss. Anaesthetists were asked what site was used to monitor the patient's temperature (Table 17) and the patient's temperature at the end of the operation (Table 18).

Table 17. Site of temperature

Site	Total (answers may be multiple) n=752
Nasopharyngeal	426
Oesophageal	84
Tympanic	40
Axillary	16
Other	7
Unknown	38
Not answered	142

Table 18. Patient temperature at the end of the operation

Temperature	Elective	%	Emergency	%	Not answered	Total
> 36 degrees C	171	49	68	38	16	**255**
34 – 36 degrees C	171	49	93	51	26	**290**
< 34 degrees C	4	1	20	11	4	**28**
Sub-total	**346**		**181**		**46**	**573**
Unknown	29		38		7	**74**
Not answered	59		45		1	**105**
Total	**434**		**264**		**54**	**752**

More than half the patients were hypothermic (<36°C) at the end of the operation (Table 18). The adverse effects of low temperature are well documented: hypothermia can lead to cardiac arrhythmias and adverse effects on oxygen consumption, haemostasis and tissue perfusion. In view of the number of patients in whom the patient's temperature was being recorded, anaesthetists appear to recognise that temperature control is important. There are several interventions available to anaesthetists to prevent heat loss. Anaesthetists should make all possible efforts to prevent hypothermia.

5. Anaesthesia

The anaesthetist >> Monitoring and vasoactive drugs

It is reasonable to assume that all patients for aortic aneurysm repair surgery will be monitored with the standard mandatory monitors, together with direct arterial pressure and central venous pressure monitoring (subject to the exigencies of the emergency situation for ruptured aneurysms). There is less agreement about the use of pulmonary artery flotation catheters and cardiac output monitors.

Table 19 shows the number of patients undergoing open elective aneurysm repair in whom a pulmonary artery flotation catheter was inserted.

Table 19. Intraoperative use of pulmonary artery flotation catheter

Pulmonary catheter	Elective	%	Emergency	%	Not answered	Total
Yes	8	2	2	1	1	**11**
No	370	98	217	99	52	**639**
Sub-total	**378**		**219**		**53**	**650**
Unknown	0		2		0	**2**
Not answered	56		43		1	**100**
Total	**434**		**264**		**54**	**752**

It would appear that at the time of this study very few anaesthetists thought that the use of pulmonary artery catheters was justified for either elective or emergency open aneurysm repair.

Table 20 shows the number of patients undergoing open aneurysm repair in whom it was reported that the cardiac output was measured.

Table 20. Intraoperative measurement of cardiac output

Cardiac output monitoring	Elective	%	Emergency	%	Not answered	Total
Yes	30	8	14	6	3	**47**
No	347	92	204	94	50	**601**
Sub-total	**377**		**218**		**53**	**648**
Unknown	0		2		0	**2**
Not answered	57		44		1	**102**
Total	**434**		**264**		**54**	**752**

In 10 of the cases (two were emergencies) a pulmonary artery flotation catheter was inserted and presumably was used for measuring the cardiac output by the thermodilution technique. The use of other techniques in 37 patients must reflect the increasing availability of non-invasive methods such as oesophageal Doppler devices and rebreathing devices. Overall, cardiac output was monitored in 7% (47/648) of patients.

Table 21 shows the numbers of patients who received inotropic drugs, defined as “drugs given for inotropic effect e.g. epinephrine, dobutamine”.

Table 21. Use of inotropes						
Inotropes	**Elective**	%	**Emergency**	%	**Not answered**	**Total**
Yes	113	30	115	53	23	**251**
No	263	70	103	47	30	**396**
Sub-total	**376**		**218**		**53**	**647**
Unknown	1		2		0	**3**
Not answered	57		44		1	**102**
Total	**434**		**264**		**54**	**752**

Table 22 shows the numbers of patients who received vasoconstrictor drugs, defined as "…drugs ... given for vasoconstrictor effect e.g. metaraminol, phenylephrine, norepinephrine".

Table 22. Use of vasoconstrictors						
Vasoconstrictors	**Elective**	%	**Emergency**	%	**Not answered**	**Total**
Yes	258	69	142	66	34	**434**
No	117	31	74	34	18	**209**
Sub-total	**375**		**216**		**52**	**643**
Unknown	2		3		0	**5**
Not answered	57		45		2	**104**
Total	**434**		**264**		**54**	**752**

It is not surprising that vasoactive drugs were used frequently. Patients undergoing elective operation are likely to have received vasodilating anaesthetic techniques such as epidural anaesthesia, and emergency operation patients may have been hypotensive due to hypovolaemia or myocardial ischaemia. The logical use of vasoactive drugs requires knowledge of the effect of therapy on cardiac output and systemic vascular resistance, not just the effect on the blood pressure. It is of concern that whilst a total of 39% (251/647) of patients received inotropic drugs and 67% (434/643) of patients received vasoconstrictor drugs, the cardiac output was monitored in only 7% of patients. When cardiac output monitoring was not used, was the anaesthetist certain that the patient's condition was being optimised with minimal effects on myocardial ischaemia?

5. Anaesthesia

The anaesthetist >> Destination after surgery

56% of elective patients went to ICU after operation.

9% of elective patients were nursed in a recovery area for a significant time after surgery.

32 patients died in theatre, four of which we could not determine whether they were elective or emergency cases. The destinations of patients who left theatre after open surgery are given in Tables 23 and 24.

Table 23. Immediate destination of patients after elective surgery

Destination	Total	%
Recovery area	35	9
Level 3 care (e.g. ICU)	210	56
Level 2 care (e.g. HDU)	125	33
Level 1 care (vascular surgical ward)	2	<1
Other	2	<1
Died in theatre	3	<1
Sub-total	**377**	
Not answered	57	
Total	**434**	

Table 24. Immediate destination of patients after emergency surgery

Destination	Total	%
Recovery area	10	4
Level 3 care (e.g. ICU)	156	70
Level 2 care (e.g. HDU)	27	12
Level 1 care (vascular surgical ward)	1	<1
Another hospital	2	<1
Other	2	<1
Died in theatre	25	11
Sub-total	**223**	
Unknown	3	
Not answered	38	
Total	**264**	

The figure of 79% of emergency repair patients going to Level 3 care is to be expected as it is usual for patients undergoing emergency aneurysm repair to require this level of care. 23 of the 27 patients who underwent emergency repair and were sent to Level 2 care after surgery had unruptured aneurysms so may have been more stable during operation.

It is very surprising that 56% of patients undergoing elective repair were sent to Level 3 care. With current anaesthetic techniques it should be possible for most patients at the end of surgery to be warm, with a stable cardiovascular system, breathing spontaneously and with their pain controlled, such that Level 2 care

only is required. Is this not a misuse of the limited availability of Level 3 resources?

The practice of postoperative mechanical ventilation of the lungs is considered in the following section.

The numbers of patients nursed in recovery areas after operation is disturbing. The use of recovery areas for the prolonged care of patients after aortic surgery is discussed in Organisation of vascular services. Recovery areas have neither the staffing, medical or nursing, nor the equipment to care properly for such patients for extended periods. Patients cannot give valid consent to their care and treatment if the possibility of being nursed in a recovery area and the risks involved are not explained to them.

5. Anaesthesia

The anaesthetist >> Mechanical ventilation after surgery

42% of elective patients were ventilated after surgery.

Table 25 shows the numbers of open operation patients who left theatre whose lungs were mechanically ventilated after open surgery.

Table 25. Mechanical ventilation of lungs postoperatively

Ventilation postoperatively	Elective	%	Emergency	%	Not answered	Total
Not ventilated	215	58	42	22	25	**282**
< 4 hours	49	13	9	5	4	**62**
4 – 24 hours	78	21	81	42	11	**170**
> 24 and < 72 hrs	15	4	29	15	3	**47**
> 72 hours	13	4	32	17	7	**52**
Sub-total	**370**		**193**		**50**	**613**
Unknown	4		6		0	**10**
Not answered	60		65		4	**129**
Total	**434**		**264**		**54**	**752**

Is there scope for the anaesthetists of the 127 (34%) of elective patients whose lungs were ventilated for less than 24 hours to review their management of elective open aortic aneurysm repair? It might have been possible for most of these patients to breathe spontaneously at the end of surgery and to be sent to an HDU for postoperative care. Analysis shows that 51 of the 127 patients lost less than five litres of blood and had a temperature greater than 36º C, and a further 53 had a blood loss of less than five litres and a temperature between 34º C and 36º C.

54 of the 215 elective patients who did not receive mechanical ventilation after surgery were admitted to Intensive Care Units. This would appear to be another misuse of Level 3 beds. Is it historical practice that causes clinicians to continue to mechanically ventilate the lungs and to send patients to Level 3 beds after elective aortic surgery?

5. Anaesthesia

Death certification

NCEPOD asked for details of the mode of death, and the cause of death, as stated on the death certificate. As might be expected, the main modes of death included cardiac failure, multi-organ dysfunction syndrome and respiratory failure, but the variability of responses did not allow any detailed analysis.

Similarly, the way in which death following aneurysm repair was described on death certificates was very varied. Some entries would include conditions such as haemorrhage or cardiac failure, with aortic aneurysm entered under (b) or (c) of Part 1 of the death certificate; other entries would have “Ruptured aortic aneurysm” alone. Some entries would have “Aortic aneurysm” in Part 1, others in Part 2. Most worryingly, there were some death certificates that made no mention of “Aortic aneurysm” in the death certificate at all, although it was quite clear that the patient would not have died at that time unless they had had an operation for repair of an aneurysm.

NCEPOD has commented on inadequacies in the formulation of the cause of death in death certificates before[10,11]. These data provide further evidence of failings in the completion of the medical certificates of cause of death. The Office of National Statistics derives data for the main causes of death from the bottom line of Part 1 in the medical certificate of the cause of death. If doctors complete the certificate wrongly they are misleading relatives and distorting national statistics on the causes of death of the population.

5. Anaesthesia

Recommendations

Trusts should ensure that anaesthetists can identify the major cases that they have managed in order to support audit and appraisal.

Anaesthetic departments should review the allocation of vascular cases so as to reduce the number of anaesthetists caring for very small volumes of elective and emergency aortic surgery cases.

Trusts should ensure they that they have robust systems for the postoperative care of epidural catheters with accompanying appropriate documentation.

Anaesthetic departments and critical care units should review together whether vascular surgery patients who routinely receive postoperative mechanical ventilation could be managed in a Level 2 High Dependency Unit breathing spontaneously.

5. Anaesthesia

References

1 CC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery – executive summary. Circulation. 2002; **105**: 1257-1267.

2 Poldermans D, Bax JJ, Kertai MD et al. Statins are associated with a reduced incidence of perioperative mortality in patients undergoing major noncardiac vascular surgery. Circulation. 2003; **107**: 1848-51.

3 Durazzo AE, Machado FS, Ikeoka DT et al. Reduction in cardiovascular events after vascular surgery with atorvastatin. J.Vasc. Surg. 2004; **39**: 967-75.

4 Lindenauer PK, Pekow P, Wang K, Gutierrez B, Benjamin EM. Lipid-lowering therapy and in-hospital mortality following major noncardiac surgery. JAMA 2004; **291**: 2092-9.

5 McFalls EO, Ward HB, Moritz TE et al. Coronary-artery revascularization before elective major vascular surgery. N.Engl.J.Med. 2004; **351**: 2795-804.

6 http://www.vasgbi.com/constitn.htm

7 Guidelines for the use of platelet transfusions. British Committee for Standards in Haematology. British Journal of Haematology. 2003, **122**: 10-23.

8 Guidelines for the use of fresh-frozen plasma, cryoprecipitate and cryosupernatant. British Committee for Standards in Haematology. http://www.bcshguidelines.com/pdf/freshfrozen_280604.pdf

9 Practice guidelines for blood component therapy. American Society of Anesthesiologists. http://www.asahq.org/publicationsAndServices/blood_component.html

10 National Confidential Enquiry into Patient Outcome and Death. Scoping our practice? 2004.

11 National Confidential Enquiry into Patient Outcome and Death. An Acute Problem? 2005.

6. Endovascular aneurysm repair

Introduction

The standard treatment for aortic aneurysm, open repair, involves a large abdominal incision and cross-clamping of the aorta. In recent years, a minimally invasive technique, endovascular aneurysm repair (EVAR) has been developed: a graft is placed in the aorta via the femoral arteries, without an abdominal incision and with much smaller changes in cardiovascular haemodynamics. Potential advantages over open repair include reduced morbidity and mortality, the possibility of operating on patients unfit for open surgery, and reduced length of hospital stay.

This new procedure is the subject of ongoing trials to determine whether or not EVAR has advantages over conventional surgery and in what circumstances. NCEPOD felt it was important to include EVAR in this study of the management of aortic aneurysm repair. Unfortunately data were received on only 53 endovascular repairs so the conclusions that can be drawn are limited and no recommendations have been made. The results of two major trials of EVAR in the UK have now been published. EVAR 1 randomised suitable patients between endovascular and conventional repair. The 30 day operative mortality after an endovascular approach was reduced by two thirds compared to open surgery[1]. However, after a median follow up of 3.3 years it was clear that patients who underwent an endovascular repair were much more likely to need further intervention and all cause mortality did not differ significantly between the two groups[2].

The EVAR trial 2 randomised patients between endovascular repair and observation. All patients were considered ‘unfit’ and at high risk of mortality with a conventional aneurysm repair. The 30 day mortality after endovascular repair was 9% compared to 1.7% in the EVAR 1 trial. Analysed by intention to treat there was no reduction in mortality compared to the control group after a median follow up of 2.4 years[3]. At present, the cost of endovascular repair is greater than that of open repair and the long term outcomes remain uncertain.

6. Endovascular aneurysm repair

Demographics

92% (49/53) of patients undergoing EVAR were male. The age range was from 59 to 88 years (Figure 1).

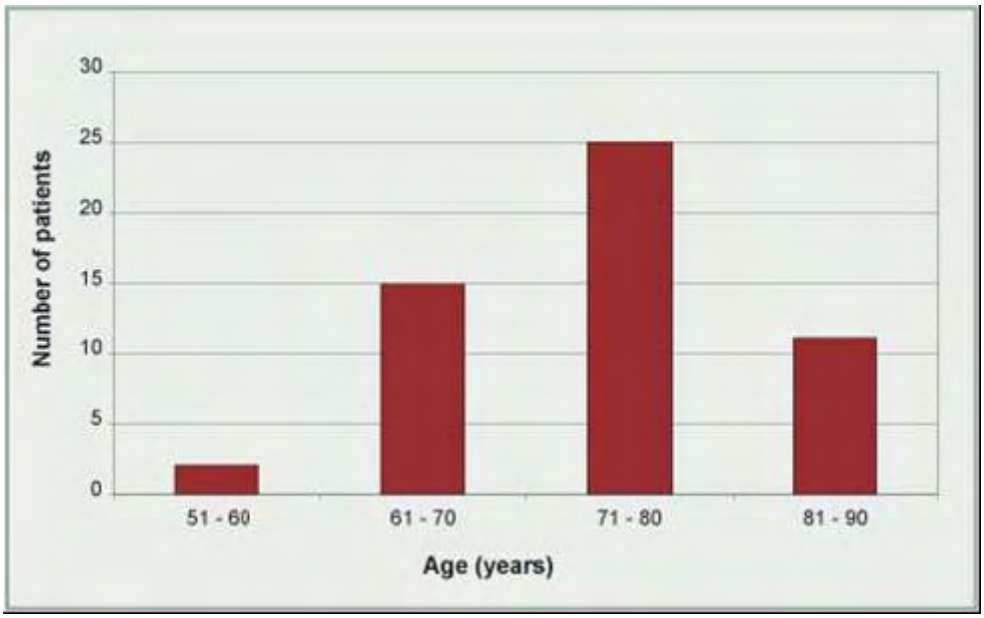


Figure 1. Age of endovascular patients n=53

43 were admitted for an elective procedure, three were emergencies, and one an emergency transfer. The method of admission for the remaining six cases was unknown.

6. Endovascular aneurysm repair

Reason for decision to treat with endovascular repair

NCEPOD asked what factors influenced the decision to opt for endovascular repair. The most frequent reason given was the fitness of the patient as graded by the American Society of Anesthesiologists (ASA) classification (Figure 2).

46 patients had a bifurcated graft, three aorto-uni-iliac and four had other unspecified grafts.

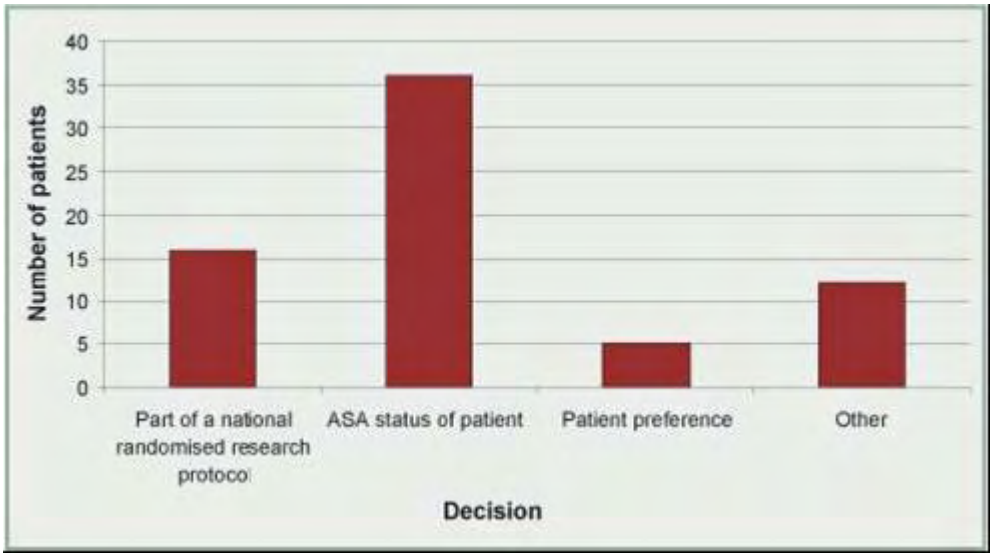


Figure 2. Decision to treat by stent graft n=53. Answers may be multiple.

6. Endovascular aneurysm repair

Participation in trials

As discussed in the previous page, at the time of this study there were ongoing trials to establish the place of endovascular repair in the management of aortic aneurysm. In addition, it has been recommended that all cases involving endovascular repairs should either be entered into one of the trials or else information about the case should be entered on an endovascular repair registry. NCEPOD asked whether the patient had been entered into a trial. 30% (16/53) of cases had been entered into a trial, 11 cases were enrolled in the EVAR 1 trial and five in the EVAR 2 trial. It is not known how many of the other cases had been placed on the registry.

6. Endovascular aneurysm repair

Status of aneurysm

Table 1. Status of aneurysm on admission		
Status	**Total**	%
Unruptured: asymptomatic	48	91
Unruptured: symptomatic	4	8
Ruptured	1	<2
Total	**53**	

The great majority of aneurysms were unruptured and asymptomatic. The advisors suggested that at present very few centres in the United Kingdom are able to treat ruptured aneurysms by EVAR. Successful endovascular treatment of a ruptured aneurysm requires that the patient is cardiovascularly stable, so that they can proceed immediately to CT examination, and then to a staffed angiography suite. It is difficult for radiology departments to organise this flexibility of service with current workload and staff resources.

6. Endovascular aneurysm repair

Length of procedure

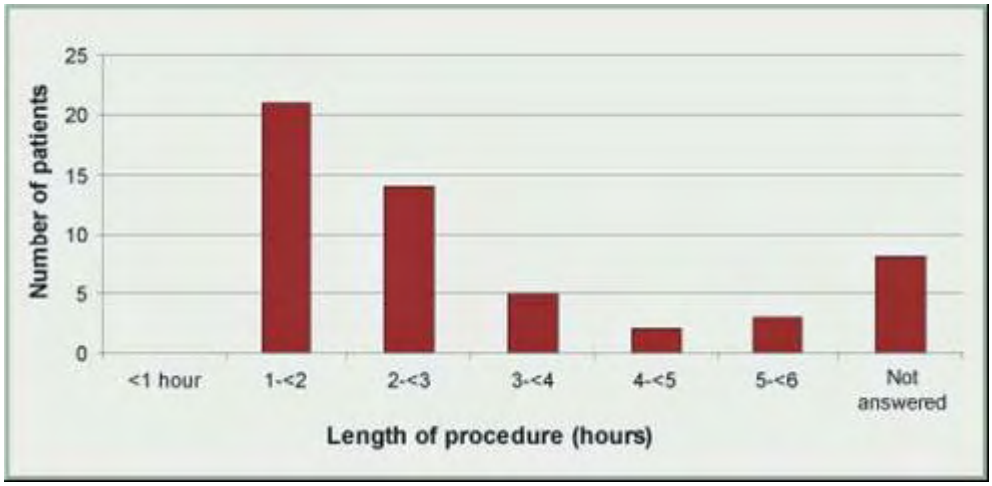


Figure 3. Length of the procedure n=53

The length of procedure was calculated from the time of the first angiogram to groin closure. As can be seen the reported length of endovascular repair was very variable with some cases being very prolonged.

Other interventions performed at the time of surgery included femoro-femoral crossover (3), internal iliac embolisation (3), additional cuff insertion (3), and other unspecified and infrequent procedures (4).

6. Endovascular aneurysm repair

The radiologist

All endovascular repairs were performed by a consultant.

All the endovascular repairs were done by a consultant radiologist. In 46 cases the radiologist described themselves as a vascular radiologist and in the other seven cases as a general radiologist with a vascular interest. This represents excellent care. NCEPOD is aware that vascular surgeons participate to expose the femoral arteries and close arteriotomies, and some vascular surgeons have been trained in, and do perform, stent insertion.

The radiologist was asked to supply information on how many endovascular repairs they had done in 2002/03, and the source of that information.

Table 2. Source of information about the most senior radiologist responsible for the decision to treat the aneurysm by endovascular repair

Source	Total	%
Logbook / Information system	32	62
Memory	20	38
Sub-total	**52**	
Not answered	1	
Total	**53**	

It is worrying that in a third of cases (20/52) radiologists were unable to provide an accurate record of their workload for this novel procedure.

Figure 4 shows the number of cases where the radiologist performed no elective endovascular repairs in 2002/03, the number of cases where the radiologist performed between one and five, and so forth.

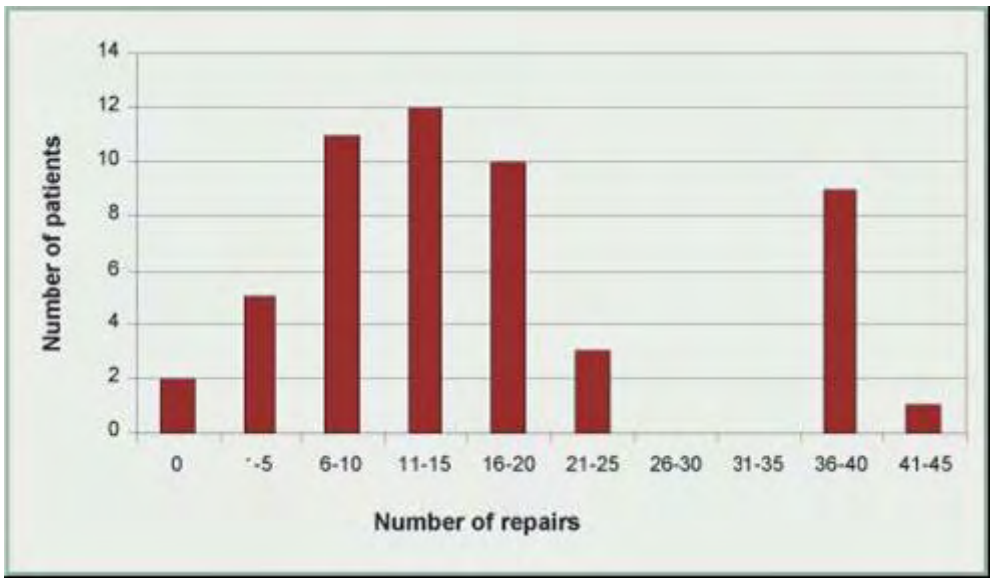


Figure 4 . Endovascular repairs performed by the most senior radiologist, April 2002-March 2003
n=53

Some radiologists may have returned more than one questionnaire. Most radiologists seem to have been performing a reasonable number of cases a year. It is possible that the radiologists performing

small numbers in 2002/03 had only just begun to do endovascular repairs and that their workload in succeeding years has been greater. Circumstances may be changing rapidly depending on how quickly endovascular services are expanding.

Because of the small numbers of returns, no attempt has been made to correlate the experience of the radiologist with the number of complications or the overall outcome.

6. Endovascular aneurysm repair

Anaesthesia grade and type

86% of anaesthetics for endovascular repair were given by a consultant.

Table 3. Grade of the most senior anaesthetist present at the start of anaesthesia n=53

Grade of anaesthetist	Total	%
Consultant	44	86
SpR year 3+	6	12
SpR year 1/2	1	2
Sub-total	**51**	
Not answered	2	
Total	**53**	

As with open repair, the great majority, 86% (44/51), of cases were done by consultants.

An epidural catheter was placed in 33% (17/51) of patients with an unruptured aneurysm. In one case the question was unanswered. The only patient with a ruptured aneurysm was managed without an epidural.

As has been shown, endovascular repairs can take several hours. If the team are confident that the procedure will be relatively short then it is reasonable to use epidural anaesthesia, but some patients may have difficulty tolerating procedures lasting more than two or three hours without general anaesthesia.

6. Endovascular aneurysm repair

Destination after the procedure

Only one patient went to a Level 3 Intensive Care bed after the procedure.

Table 4. Immediate destination of patients after endovascular repair

Destination	**Total**	%
Recovery area	21	40
ICU	1	2
HDU	25	48
Vascular surgical ward	5	10
Sub-total	**52**	
Not answered	1	
Total	**53**	

Only one patient was admitted to ICU after the procedure. This compares with 56% of elective open repairs in this study who went to Level 3 care after surgery. The reduced requirement for critical care beds after EVAR is a secondary benefit to the service, which may help to free the resource for other patients and reduces the chance of other operations being cancelled because no critical care bed is available. Whether or not a patient goes to a recovery area may depend on local factors including the proximity of the angiography suite to theatres.

6. Endovascular aneurysm repair

Complications

The morbidity of endovascular repair was reduced compared to open repair.

14 patients developed an endoleak, most commonly type II where there is retrograde filling of the sac by patent aortic side branches (Table 5).

Table 5. Postoperative complications within 30 days of endovascular repair n=53. Answers may be multiple.

Type	Total
Type I endoleak	5
Type II endoleak	8
Type IV endoleak	1
Limb occlusion	3
Returned to suite for further endovascular treatment	1
Other	2

One endovascular patient suffered a myocardial infarction compared to 7% (31/428) of patients who underwent an elective open repair. Infection was less common than with open repair as 9% (4/47) of patients had a chest infection after endovascular repair while 14% of elective open repair patients were reported to have had a chest infection. 4% (2/47) of patients had postoperative renal impairment compared to 10% of elective open repair patients. There were no complications reported for stroke, paraplegia or ischaemic bowel.

6. Endovascular aneurysm repair

Outcome

All the patients on whom we had data were alive at 30 days.

No outcome was reported for six cases. The remaining 47 patients survived to 30 days after the procedure. 45 had been discharged and two were alive but still in hospital at 30 days. NCEPOD has no information as to why these two patients were still in hospital at 30 days. The 30 day mortality rate for elective open aneurysm repair in this study was 6.2%.

Although the numbers are small, the findings of this study are consistent with other published work, that short term morbidity and mortality are much reduced after endovascular aneurysm repair compared to open repair.

6. Endovascular aneurysm repair

References

1 Greenhalgh RM, Brown LC, Kwong GP et al. Comparison of endovascular aneurysm repair with open repair in patients with abdominal aortic aneurysm (EVAR trial 1), 30 day operative mortality results: randomised controlled trial. Lancet. 2004; **346**: 843-48.

2 EVAR trial participants. Endovascular aneurysm repair versus open repair in patients with abdominal aortic aneurysm (EVAR trial 1): randomised controlled trial. Lancet. 2005; **365**: 2179-86.

3 EVAR trial participants. Endovascular aneurysm repair and outcome in patients unfit for open repair of abdominal aortic aneurysm (EVAR trial 2): randomised controlled trial. Lancet. 2005; **365**: 2187-92.

7. The care of patients who did not undergo surgery

Introduction

Some patients admitted as an emergency with a diagnosis of aortic aneurysm do not undergo surgery. The surgical team may judge that the likelihood of survival after operation is so low that the operation would be futile, or the patient may decide that they wish to receive supportive and palliative care only, in the knowledge that without operation death is inevitable for a patient with a ruptured aortic aneurysm. This chapter explores the characteristics of the patients in this study who did not undergo surgery.

7. The care of patients who did not undergo surgery

Demographics

78 emergency patients received palliative care and did not undergo surgery. The one remaining patient who received palliative care was an elective admission. The average age was 83 years. This compares with an average age of 73 for all emergency patients in whom a decision was made to operate (Figure 1).

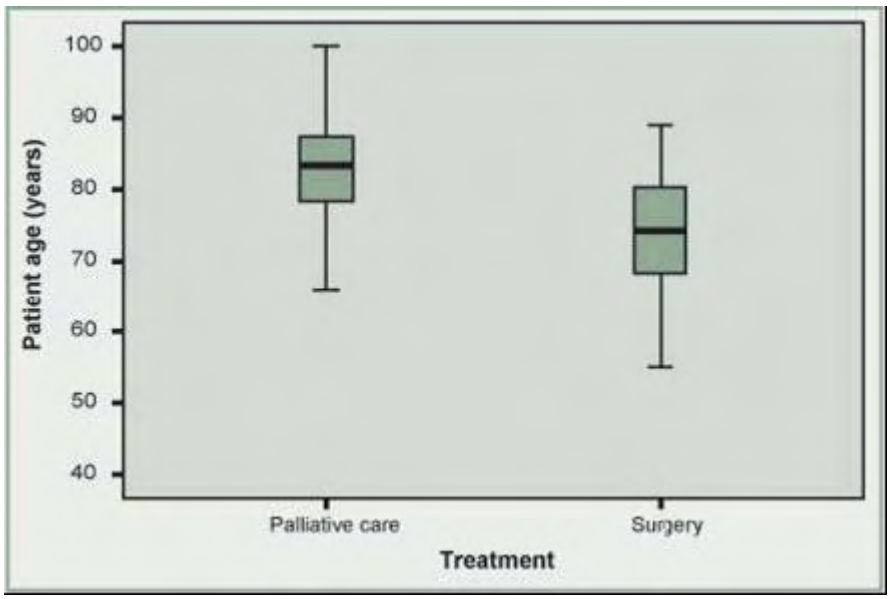


Figure 1. Age by type of treatment

64% (50/78) were males compared with 81% (218/268) of males in operated emergency patients.

43% (33/76) of patients were known to have an aortic aneurysm before presentation as an emergency admission, compared with 26% (54/211) of emergency patients who had an operation.

55% (68/124) of emergency admission patients aged 80 or over underwent surgery compared to 90% (196/218) of patients aged less than 80 years. However of the 68 patients aged 80 or over who did have surgery, 37% (25/68) were discharged from hospital within 30 days of surgery and 9% (6/68) were alive but had not left hospital.

Decisions about major emergency surgery on elderly patients are very difficult. NCEPOD has recommended against futile surgery in the past [1]. Although, elderly patients undergoing emergency aortic aneurysm repair did survive to 30 days, NCEPOD has no information on the length or quality of life of those who survived. Considerable resources such as the use of scarce critical care beds will have been consumed in caring for all those elderly patients undergoing surgery who did not survive.

7. The care of patients who did not undergo surgery

Size of unit

A greater proportion of emergency patients underwent surgery at large units than at intermediate or remote units.

The data were analysed to ascertain whether the type of unit into which emergency patients were admitted was associated with a difference in the likelihood of receiving palliative care rather than surgery (Figure 2).

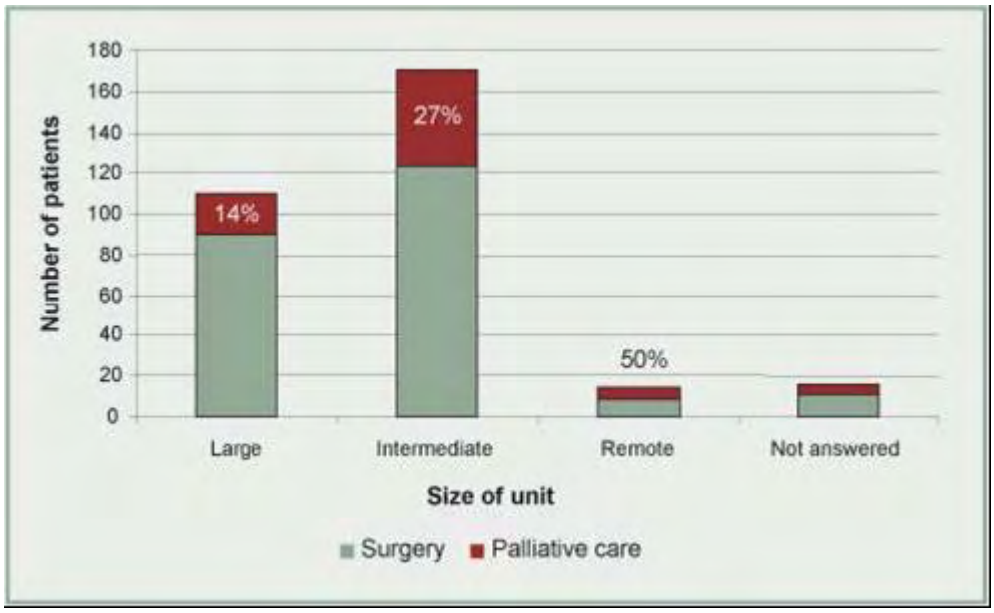


Figure 2. Care of patients by size of vascular unit n=342

The smaller the size of the unit, the more likely it was that the patient would receive palliative care. As reported in the chapter on Method, NCEPOD has been unable to carry out case-mix correction so these differences may be due to differences in patient population. Also, if surgery did take place, data was collected from the hospital where the operation took place. If a patient was admitted to one hospital and then transferred to another hospital for surgery, data was collected about the patient from the receiving hospital not the referring hospital. It may have been that smaller units transferred out patients with a good chance of survival, consequently more patients overall at smaller units would have received palliative care.

7. The care of patients who did not undergo surgery

Membership of the Vascular Society of Great Britain and Ireland (VSGBI)

A greater proportion of emergency patients underwent surgery when managed by a member of the Vascular Society of Great Britain and Ireland.

The data were analysed to ascertain whether the likelihood of receiving palliative care was associated with the surgeon caring for the patient being a member of the VSGBI (Figure 3).

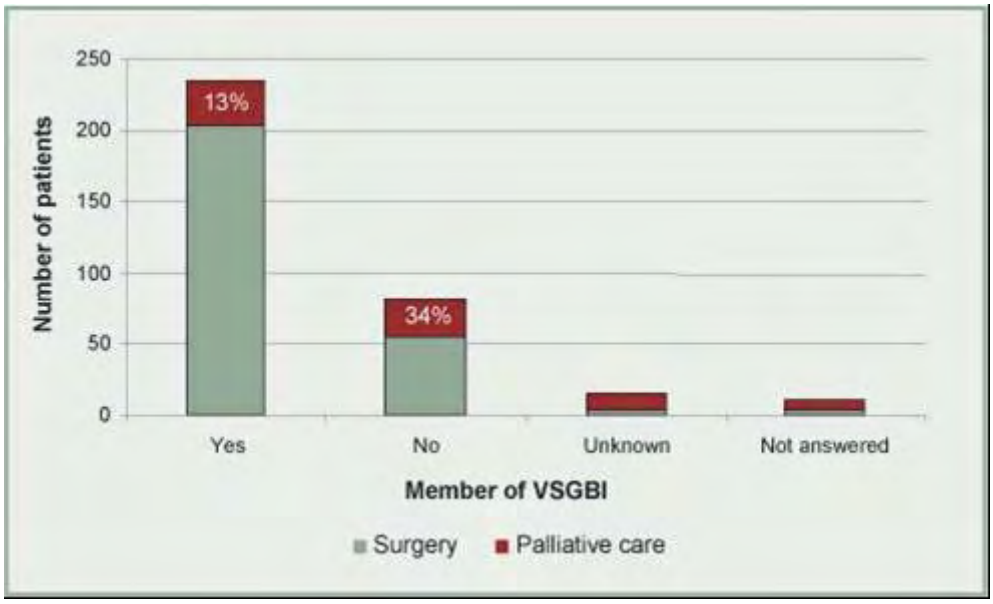


Figure 3. Surgeon's membership of the VSGBI by treatment decision n=342

Although it has been made clear in the section on Surgery that membership of the VSGBI cannot be exclusively related to expertise in vascular surgery, the patient was more likely to receive palliative care if the surgeon was not a member of the Vascular Society.

Unfortunately NCEPOD did not ask about the specialty of the surgeon who made the decision as to whether the patient should undergo operation or receive palliative care, so we cannot examine whether a vascular surgeon would have been more likely to operate on the patient than a general surgeon or a consultant in another subspecialty of general surgery who was covering vascular surgical emergencies.

7. The care of patients who did not undergo surgery

On-call rotas

A greater proportion of emergency patients underwent surgery when treated in a hospital with a vascular surgery on-call rota.

The relationship was examined between the number of patients for whom the decision was made to operate and the presence of a surgical vascular on-call rota (Figure 4).

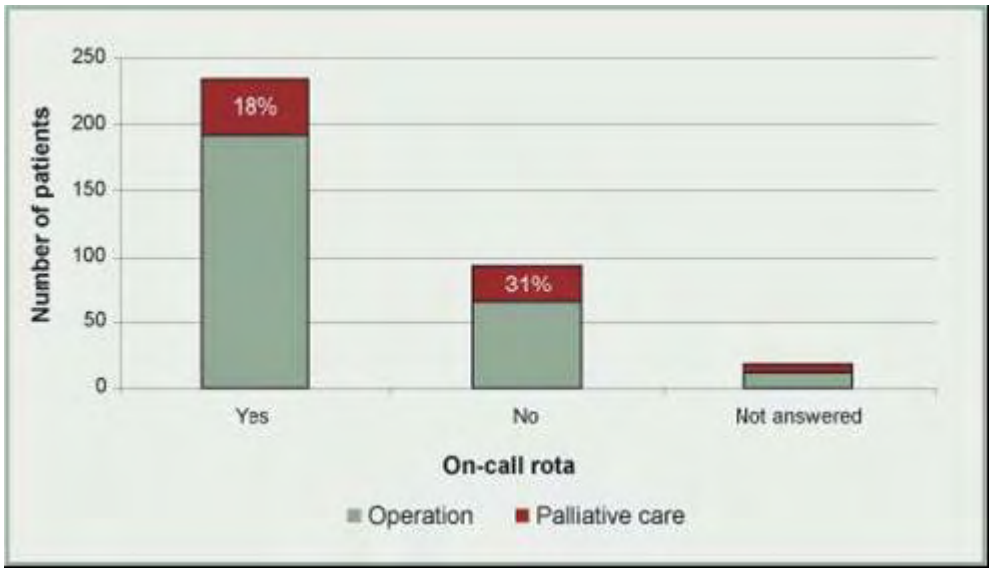


Figure 4. Separate on-call rota for vascular surgery by treatment decision in all emergency admission patients n=342

18% (42/231) of patients received palliative care in units where there was an on-call rota for vascular surgery and 31% (29/93) received palliative care in units where there was not an on-call rota (no information about on-call rotas was given for 18 patients). NCEPOD does not know whether these data were affected by hospitals that did not have an on-call rota transferring patients to hospitals that did.

These factors are linked, because membership of the VSGBI and surgical on-call rotas are more likely to be associated with working in a large vascular unit. Data in Table 6 in Organisation of vascular services show that the outcome of surgery after emergency admission was slightly better at large vascular units. Is it possible that there were some patients who received palliative care who might have undergone surgery if they had been admitted to a larger hospital or had come under the care of a surgeon with a greater involvement with vascular surgery?

7. The care of patients who did not undergo surgery

References

Then and Now. The 2000 Report of the National Confidential Enquiry into Perioperative Deaths. 2000.

Appendices

Glossary

Abdominal aortic aneurysm

Aneurysms result from the stretching of a weakened artery, which balloons out rather like a worn motorcar tyre. When this happens there is a risk that the artery may burst. The most common artery to be affected is the aorta, which is the main artery in the abdomen.

The aneurysm can be repaired either by conventional surgery or by a technique which involves a graft being threaded into the aortic aneurysm via a small incision in the groin (endovascular repair).

Further information about this condition can be found on the Vascular Society website at www.vascularsociety.org.uk/patient/aaa.html

American Society of Anesthesiologists (ASA) classification of physical status

ASA 1: A normal healthy patient.

ASA 2: A patient with mild systemic disease.

ASA 3: A patient with severe systemic disease.

ASA 4: A patient with severe systemic disease that is a constant threat to life.

ASA 5: A moribund patient who is not expected to survive without the operation.

ASA 6: A declared brain-dead patient whose organs are being removed for donor purposes.

EVAR trials

EVAR 1 This trial randomised patients between endovascular and conventional surgery.

EVAR 2

This trial randomised patients between endovascular repair and observation.

Glasgow Coma Score

A method of assessing the level of consciousness of a patient.

Levels of care

Level 0

Patients whose needs can be met through normal ward care in an acute hospital.

Level 1

Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the critical care team.

Level 2

Patients requiring more detailed observation or intervention including support for a single failing organ system or postoperative care and those ‘stepping down’ from higher levels of care.

Level 3

Patients requiring advanced respiratory support alone or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure.

Local reporter

A hospital member of staff who provides information on cases to NCEPOD.

Size of vascular unit

Large

Hospital with sufficiently large catchment population (at least 500,000) to employ at least four vascular surgeons and the potential for an on-site vascular rota.

Intermediate

Hospital with catchment population of less than 500,000, fully equipped for vascular surgery but with insufficient vascular surgeons for an on-site emergency rota.

Remote

Separated by long distances from other hospitals, and usually serving a small catchment population.

Appendices

Abbreviations

AAA Abdominal aortic aneurysm

ASGBI Association of Surgeons of Great Britain and Ireland

CT Computed tomography

CVP Central venous pressure

ECG Electrocardiograph

EVAR Endovascular aneurysm repair

GCS Glasgow Coma Score

HES Hospital episode statistics

HDU High dependency unit

ICD International Classification of Diseases (10th revision)

ICU Intensive care unit

JVP Jugular venous pressure

MI Myocardial infarction

MRI Magnetic resonance imaging

MRSA Methicillin resistant staphylococcus aureus

MUGA Multiple gated acquisition scan

NPSA National Patient Safety Agency

OPCS Office of Population Census and Surveys procedure codes (4th revision)

PRHO Pre-registration house officer

SAS Staff and associate specialist grade

SHO Senior house officer

SpR Specialist registrar

SpR 1/2 Year 1 or 2 specialist registrar

SpR 3+ Year 3 or more specialist registrar

VASGBI Vascular Anaesthetic Society of Great Britain and Ireland

V-BHOM Vascular biochemical and haematological outcome modelling

VSGBI Vascular Society of Great Britain and Ireland

Appendices

Questionnaires

To download the questionnaires (in Adobe PDF format) from our website, please use the links below. The questionnaires have not been included in this document to help reduce the size of the file.

- Organisational questionnaire
- Surgical questionnaire
- Anaesthetic questionnaire
- Endovascular questionnaire