Cell therapy glossary

Adult stem cells
Undifferentiated cells found in most adult tissues. Adult stem cells can renew themselves and differentiate to yield all the specialised cell types of the tissue from which they originated. Also referred too as 'somatic stem cells'.

Cell-based therapies
Treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or depleted adult cell populations or tissues.

Cellular therapy
A new way to treat disease and injury. It aims to repair damaged and diseased body-parts with healthy new cells provided by stem cell transplants.

Cones
A type of specialised light-sensitive cells (photoreceptors) in the retina that provide sharp central vision and colour vision. See also Rods.

Differentiation
The process whereby an unspecialised early embryonic cell acquires the features of a specialised cell, such as a heart, liver, or muscle cell.

Embryonic stem cells
Primitive (undifferentiated) cells from the embryo that have the potential to become all cell types found in the body (totipotent). Embryonic stem cells (ESCs) are derived from four to five day-old embryos.

Gene therapy
Therapy aimed at counteracting the gene defect by substituting normal gene material at the site of the problem.

Mesenchymal stem cells
Stem cells found primarily in the bone marrow that can transform into bone, cartilage, fat, and connective tissue. These cells are also referred to as bone marrow stromal cells.

Multipotent stem cells
Stem cells that can give rise to several other cell types, but those types are limited in number. An example of multipotent cells is haematopoietic cells – blood stem cells that can develop into several types of blood cells.

Photoreceptors
Cells that are sensitive to light.

Plasticity
The ability of stem cells from one adult tissue to generate the differentiated cell type of another.

Progenitor cells
Cells that can produce only one cell. They can differentiate into a limited number of cell types, but cannot make more stem cells (or renew themselves).

Proliferation
Expansion of a population of cells by the continuous division of single cells.

Regenerative medicine
A treatment in which stem cells are induced to differentiate into the specific cell type required to repair damaged or depleted adult cell populations or tissues.

Retina
The light-sensitive layer of tissue that lines the back of the eyeball; sends visual messages through the optic nerve to the brain.

Retinal pigment epithelium
The pigment cell layer that nourishes the retinal cells; located just outside the retina and attached to the choroid.

Rods
A type of specialised light-sensitive cells (photoreceptors) in the retina that provide side vision and the ability to see objects in dim light (night vision). Also see Cones.

Stem cells
Unspecialised cells that serve as the source, or 'stem', for specialised cells like heart, brain, or blood cells. They have two important characteristics that distinguish them from other cells in the body. Firstly, they can replenish their numbers for long periods through cell division. Secondly, after receiving certain chemical signals, they can differentiate, or transform into specialised cells with specific functions, such as a heart cell or nerve cell. Found in days-old embryos and a few adult organs.

Subfoveal
Beneath the fovea, the central pit in the macula that produces the sharpest vision.

Undifferentiated cells
Cells that have not changed to become a specialised type of cell.

REPORT

What will be new a

Shaheen Shah reports from the World C

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The World Ophthalmology Congress was held from February 19-24, 2006 in Brazil. I took the opportunity to ask some leading experts how they think the diagnosis and management of posterior segment conditions might be different in the future, specifically in the year 2020. What follows is a summary of their views, which we hope will generate interest and lively discussion amongst our readers and their colleagues.

Diabetic retinopathy

Dr Alexander Brucker, Professor of Ophthalmology at the University of Pennsylvania and Editor of the journal *Retina*, suggests that by the year 2020, decisions about treatment will be based on diagnosis using high definition optical coherence tomography (OCT) visualisation of the retina, in conjunction with fluorescein angiography (FA). Although the interpretation of the clinical findings may be similar, management will be more pharmacologically directed. He anticipates change will also be effected through alteration of the patient's individual risk factor profile. For proliferative disease, the treatment will probably continue to be with panretinal laser photocoagulation, but the addition of new pharmacologic agents (e.g. anti-Vascular Endothelial Growth Factor or anti-VEGF) could reduce the requirement for this destructive treatment.

According to Dr Alistair Laidlaw, Consultant Vitreoretinal Specialist at St Thomas' Hospital, London, UK, the prevention of diabetic retinopathy through effective screening will take priority. He foresees an increased use of non-mydriatic, wide-field, low-light systems, which will make screening comfortable and effective. Management will be through improved medical care of diabetes overall, and use of newer agents (e.g. protein kinase C inhibitors) as well as further developments in non-destructive laser systems.

Retinopathy of prematurity (ROP)

Dr Rajvardhan Azad, Professor of Ophthalmology and Head of Vitreo-Retinal and ROP unit at the Dr R.P. Centre for Ophthalmic Sciences, New Delhi, predicts that by 2020, there will be increased awareness of the condition amongst ophthalmologists and neonatologists through better, easier and more cost-effective imaging of the retina (e.g. RetCam).

… at the back of the eye in the year 2020?

…d Ophthalmology Congress

These imaging systems will also improve diagnosis and therefore subsequent management. Therapies will include increased use of angiostatic agents, and more focal, less destructive laser treatments. The current belief that surgical techniques do not work will change as advances in techniques develop (e.g. use of plasminogen to liquefy the vitreous to reduce the traction).

Dr Clare Gilbert, Reader in International Eye Health at the London School of Hygiene and Tropical Medicine, believes that clinical trials currently underway (e.g. optimum oxygen concentrations for premature babies) will help to reduce the incidence of sight-threatening disease. Until now, detection of ROP has been performed by ophthalmologists using indirect ophthalmoscopy, but in the future digital imagery (taken by non-ophthalmologists) with automated image analysis, or remote (telemedicine) expert reading, will offer the possibility of screening in the true sense of the word. Regarding management, she believes that, as with other vasoproliferative eye conditions, there will be medical treatments that block the disease from progressing. The current use of ablation techniques will be kept to a minimum.

Retinoblastoma

Dr Carol Shields, Professor of Ophthalmology and Co-Director of the Oncology Service at the Wills Eye Hospital, Philadelphia, foresees earlier detection of cases through increased awareness (e.g routine screening of the red reflex) which will potentially identify the sporadic cases. A change in chemotherapy treatment from systemic to local delivery will reduce overall side-effects. New developments in slow-release mechanisms (e.g. a reservoir system inserted into the sub-Tenon space which can then be regularly filled with chemotherapeutic agent) and increased use of adjunctive treatments (e.g locally placed anti-proliferative agents like combretastatin), will further improve treatment success.

Dr Alejandra A. Valenzuela of the Royal Children's Hospital, University of Queensland, Australia, considers that by 2020, better education and increased surveillance by the health community will be fundamental to earlier diagnosis and sucessful outcomes. Multimodal therapeutic advances will save not only the life of the patient, but also preserve the eye and, in some cases, preserve the vision. The addition of gene therapy to the particular Rb1 mutation affecting some children may provide a further avenue in management.

Retinal detachments

Dr Yasuo Tano, Professor of Ophthalmology, University of Osaka, President of Asia-Pacific Academy of Ophthalmology, envisages that pars plana vitrectomy (PPV) will take over as the primary choice for detachment repair. Improved imaging with 3-dimensional OCT high resolution imaging will improve visualisation of the posterior segment. Non-vitrectomising macular surgery may offer the hope of non-accelerated progression of nuclear cataract that currently occurs following PPV. Bimanual techniques for surgery are also likely to be more widespread.

Shaheen Shah

The entrance to the World Ophthamology Congress

Dr G W Aylward, Medical Director at Moorfields Eye Hospital, London, foresees no significant change in the diagnostic and management techniques for routine retinal detachments, as reattachment rates currently reach 90 per cent. He suggests that the main thrust by the year 2020 will be focused at the public health level, such as alerting the public to early symptoms and signs in order to 'catch' detachments before the macula is affected.

Dr Borja Corcostegui, President of Española de Retina y Vítreo (SERV) and Director of Instituto de Microcirugía Ocular (IMO), Barcelona, added that, as the posterior segment diseases are better understood (particularly the vascular disorders), the range of conditions that require surgery and indications for intervention would be quite different in 2020.

Age-related macular degeneration (AMD)

Dr. Rosario Brancato, Professor of Ophthalmology, University San Raffaele, Milan, Italy and Editor of the *European Journal of Ophthalmology*, predicts that diagnosis for AMD will be directed at three levels:

- Understanding pathological angiogenic mechanisms
- Understanding these effects in the local tissue
- Epidemiological and genetic research regarding predispositions to AMD.

FA, Indocyanine Green (ICG) angiography and OCT will continue to prove useful for diagnosis and monitoring evolution of the disease.

Treatments will be directed by the diagnosis and will specifically target the pathogenic mechanisms. In this regard, finding an effective drug for the prevention and the regression of pathological neovascularisation will be important. Research and development into regenerative therapies will also increase in importance. An important challenge will also be to identify the best delivery systems for these medications (e.g. oral, subconjunctival, even topical).

Retinal dystrophies, e.g. retinitis pigmentosa

Dr Ian Constable, Professor of Ophthalmology, University of Western Australia and Director of Lions Eye Institute, Perth, believes that by the year 2020, the range of specific gene defects will have been documented for the various clinical phenotypes. Gene function (e.g. enzymatic, cell signaling) for most dystrophies will also be understood, and animal models in place. Gene therapies will predominantly be available for large families or populations, however there will be some scope for developing customised treatments. In general, the strategy will be:

- Autosomal recessive – replace the defunct gene
- Autosomal dominant – insert a separate gene.

Dr Richard Gisbert, Professor of Ophthalmology, University of Hamburg and co-founder of the European Society of Retinal Specialists (EURETINA), foresees potential treatment options for retinal dystrophies in the future to include cell replacement strategies (i.e. transplantation of stem cells, progenitor cells, primary retinal cells or retinal tissue), gene therapy, and, for advanced cases, electronic retinal prostheses.