

forecast system, (ii) mesoscale models: cloud and land surface process, and (iii) dynamical extended range prediction.

The workshop was structured so that under each broad theme, scientists from both the countries presented the state-of-the-art available in their respective country and identified the problems encountered. There were eleven presentations from the US scientists and ten presentations from the Indian scientists. After presentations by the scientists, group discussions were held.

The presentations under the theme 'Improvement of global analysis – forecast system' focused on two aspects, viz. parametrization of physical processes and data assimilation. Thrust was on improving the forecast skill through assimilation of enhanced satellite-derived observations from the existing as well as future satellites, including Indian satellites, viz. INSAT 2E, METSAT, INSAT 3A and INSAT 3D. It was felt that the THORpex (The Hemispheric Observing System Research and Predictability Experiment) programme under WWRP (World Weather Research Programme) would provide the right kind of opportunity for India to make optimal usage of the enhanced operational observing system,

including the new satellite data for improved predictions of high-impact weather systems. In order to improve the model performance, ensemble forecasting with more members and multi-model super ensemble-based unified schemes for various physical processes were suggested.

Related to mesoscale modelling aspects, many presentations emphasized the importance of the land surface processes and surface characteristics in prediction of circulation patterns and regional scale weather systems. Performance of various kinds of mesoscale models was shown both over US as well as Indian regions. NCAR's effort in designing the next generation mesoscale model (WRF) was also discussed. Model performance of COAMPS (Coupled Ocean/Atmosphere Mesoscale Prediction System) in simulating tropical cyclone structure and track was presented. It was shown that the newly developed high-resolution initialization system improved the tropical cyclone structure analysis and forecast.

Joint cooperation in the field of disaster management in terms of cyclone-warning systems was urged. In general, a consensus was reached for mesoscale

assimilation with optimal usage of regional observations, along with improved representation of microphysical processes. Verification and validation aspects were also identified as key issues for future work.

Under the theme 'Dynamical extended range prediction', results on the simulation of Asian summer monsoon in the coupled ocean atmosphere (Cane-Zebiak) model and SST variability were presented. Presentations were also made on the procedure being followed for forecasting monsoon on long range in India. A need was felt to pursue studies on monsoon forecasts under the global warming scenario with specific role of snow cover and sensitivity of soil wetness.

Several topics identified for joint collaboration, may lead to long-term scientific arrangements with different organizations. As a follow-up of this workshop, NCMRWF and NCAR have already signed an MOU for collaborative research on 26 July 2002.

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MEETING REPORT

Emerging trends in biotechnology – stem cells*

Stem cell research has emerged as the most vibrant biological research activity. This is evidently a reflection of the fact that these cells have the capacity of self-renewal and the potential to differentiate into one or more cell types depending on the signals *in vivo*. The applications of such cells clearly go beyond medical

imagination, as they can possibly be used in the treatment of diseases like Parkinson's, Alzheimer's, diabetes, heart disorders, spinal cord injuries or for development of *in vitro* assay system for drug discovery and toxicity or for understanding basic developmental process. Rightly so, the journal *Science* (published by the American Association for the Advancement of Science, USA) believes that stem cell research would be actively pursued not just by academia, but also by the industry.

The international conference to discuss advances in this area was therefore a very timely effort. B. S. Bajaj (Chairman, All India Biotech Association – Southern Chapter) welcomed the guests and explained briefly the objectives of the conference. Martin J. Evans (Director, Cardiff School of Biosciences, Cardiff

University, UK), the discoverer of embryonic stem cells, delivering the keynote address on stem cells, described the events that resulted in the landmark discovery of mouse embryonic stem cells. He also discussed various potential applications, ethical and regulatory issues pertaining to stem cell research. He warned that stem cells are still in a research mode and have a long way to go before they are adopted in clinical practice.

He presented various aspects of embryonic stem cells and their ability to carry mutations introduced to test the function of a gene and an understanding of the disease process. He also covered new concepts in experimental mammalian genetics and their use in gene targeting, trapping and genetic manipulation. He highlighted the potential of embryonic

*A report on the international conference on 'Emerging Trends in Biotechnology: Stem Cells – Technology, Potential and Trends', organized by the All India Biotech Association – Southern Chapter, jointly with Andhra Pradesh Government, Centre for Cellular and Molecular Biology, Centre for DNA Fingerprinting and Diagnostics and Department of Animal Sciences, University of Hyderabad and supported by the Indian Council for Medical Research and other pharma and biotech industries, from 2 to 4 May 2002 at Hyderabad.

stem cells to treat many devastating diseases like cancers, cardiovascular disorders, juvenile diabetes and neurodegenerative disorders, and use of gene therapy in treating cystic fibrosis.

The conference was split into eight technical sessions, namely Limbal Stem Cells and Transplantation; Embryonic Stem Cells; Stem Cells: Basics; Stem Cells: Methodology; Adult Stem Cells I; Adult Stem Cells II; Stem Cells: Potential Clinical Applications; Stem Cells: Regulatory and Ethical Issues.

In the technical session on 'Limbal Stem Cells and Transplantation', Virendar Sangwan and Geeta Kashyap (both from L.V. Prasad Eye Institute, Hyderabad) presented advances in culturing the limbal stem cells and transplantation of these cultured limbal stem cells to treat ocular surface disease. They also highlighted their clinical successes in using these cells for corneal grafts. Geeta Kashyap discussed a simple, feeder-cell free, cost-effective way of culturing corneal epithelium from limbal tissue stem cells, by explant culture technique using human amniotic membrane as a carrier.

In the session on 'Embryonic Stem Cells', Satish Totey (Reliance Life Science, Mumbai), explained the details of human embryonic stem (ES) cell establishment and differentiation, and their dual ability to proliferate indefinitely and differentiate into multiple tissue types so as to provide an unlimited supply of tissues for transplantation. Shyamala Mani (NBRC, Gurgaon) spoke on the regulation of neuronal differentiation into specific subtypes of neurons, sonic hedgehog (*shh*)-mediated neuronal differentiation and the upregulation of genes in response to *shh*. Maneesha Inamdar (JNCASR, Bangalore) elaborated on the comparative development of blood vessels during embryogenesis and on the culture of pluripotent ES cells as a model to study genes involved in vascular development. Polani Sheshagiri (IISc, Bangalore) spoke about the perspectives and prospects of ES cell differentiation, and listed the advantages and their biomedical applications.

In the third technical session on 'Stem Cells: Basics' Chirag Joshi (Institute of Cancer Research, London) delivered a lecture on the transcriptional programming of the hematopoietic stem cells, both at ground state and under microenvironment changes, and relationship of these studies in the ability of stem cells to

trans-differentiate across lineages. Jyotsna Dhawan (CCMB, Hyderabad) gave an account of modelling of muscle stem cells in culture and identification of new markers on the muscle stem cells, and how activated satellite cells will differentiate into myoblasts to repair muscle damage and also induce the infiltration during muscle damage. Bryan Peterson (University of Florida, USA) covered the details of activation and proliferation of a distinct phenotype of stem cells called oval stem cells, after severe hepatic injuries, and their differentiation into different cell lineages.

In the session on 'Stem Cells: Methodology', Ram Rambhadran (Tranzyme Inc., USA) deliberated on Tranzyme's proprietary technology, TExT™ (Tranzyme expression technology), as a means for highly efficient and safe transfer of genes to mammalian cells, to cells and organs *ex vivo*, and organ systems *in vivo* using TranzVector™ (a lentiviral vector). K. P. Mishra (BARC, Mumbai) elaborated on the advantages of electroporation of cells in gene delivery system. Matapurkar (Maulana Azad Medical College, New Delhi) emphasized the success he achieved on the formation of new organs and new tissues in the body from pluripotent stem cells extracted from developed autogenous tissues.

The 'Adult Stem Cells' session had James E. Dennis of Case Western University, USA, describing mesenchymal stem cells (MSC) and their role in tissue repair, and on the application of MSCs to repair the articular cartilage defects through the use of biphasic matrix composed of solid-phase and gel-phase matrices. He also elaborated on a novel cell-painting technology which is being tested as a means to target and bind MSCs to matrix molecules within articular cartilage. T. Venkata Gopal (NHLBI, NIH, USA) invoked interest in a novel population of non-satellite stem cells present in adult skeletal muscle that progress under primary cell culture conditions to autonomously beating cardiac muscle cells, which can be exploited for cardiovascular transplantations. R. L. Kumar (Bioheart, New York, USA) presented details of catheter-based cell therapy and the advantage of using the skeletal myoblasts for treating patients suffering from congestive heart failure. Nibedita Lenka (NCCS, Pune) highlighted the use of murine ES cell system as a model to investigate the early neurogenic

proceedings *in vitro* and its efficacy in generation of functional neuronal progenitors and dopaminergic neurons.

In the session on 'Stem Cells: Potential Clinical Applications', C. M. Habibullah (Owaisi Hospital and Research Centre, Hyderabad) explained in detail about hepatocyte transplantation in treating various liver disorders and acute liver failure, and also about liver-directed gene therapy. Padma Vanguri (Osiris Therapeutics, USA) elaborated on potentials of human MSCs (hMSCs) in regenerative medicine, in gene therapy and involvement of Osiris Therapeutics Inc. in developing cost-effective MSC-based cellular therapies. She discussed in detail the hMSCs-guided repair of damaged articular cartilage to treat osteoarthritis, use of hMSCs to treat infarcted myocardium, and the use of hMSCs transduced with alpha-galactosidase, A gene to treat Fabry disease. Gihan Tennekoon (Children's Hospital of Philadelphia, USA) spoke about the ability of bone marrow stromal cells to differentiate into different cell types like osteoblasts, myoblasts, etc. and in using them for treating various human diseases like osteogenesis imperfecta in children. Mohan C. Vemuri (Thomas Jefferson University, USA) elucidated the use of stem cells in producing dopaminergic neurons to treat Parkinson's disease. He also elaborated on the use of stem cells for pre-clinical drug screening and toxicity evaluation.

B. K. Singh (ICMR, New Delhi) spoke on different regulatory and ethical issues pertaining to stem cells research. Ramesh Vemuri (NIH, USA), spoke in particular about the US government and NIH, USA policy on federal funding to promote stem cell research. N. K. Ganguly (ICMR, New Delhi) delivering the valedictory address, discussed the ethical and regulatory issues relating to stem cell research in the Indian context. He said that Indian government has prepared guidelines for research on stem cells after a series of meetings with experts from all over the country.

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