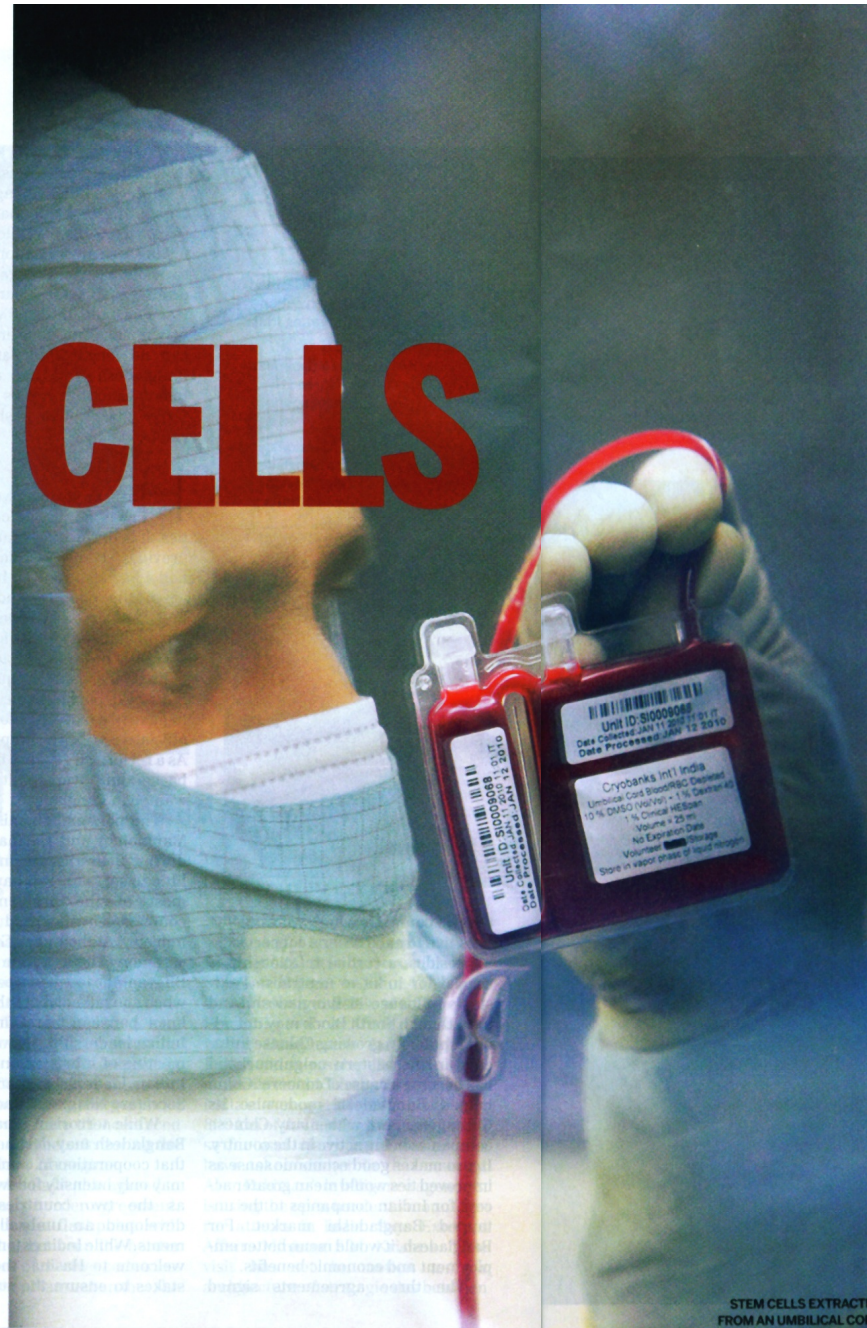


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HOW STEM CELLS CAN SAVE YOUR LIFE



STEM CELLS EXTRACTED FROM AN UMBILICAL CORD

Cutting edge stem cell research in India is creating a revolution in the treatment of a range of ailments

By Raj Chengappa

Any sufficiently advanced technology is indistinguishable from magic, Arthur C. Clarke once wrote. So it is with stem cells and their almost miraculous potential to save our lives. Stem cells are so tiny that it would take a million of them clustered together to form a pin head. Yet as their name denotes all other cells 'stem' from them. They can divide and multiply rapidly into cells that give rise to the brain, the heart, the spine, the limbs, the muscles, the skin and everything else that constitutes the human body. Once the body is fully grown they lie dormant in the marrow of your bones, in the cavities in your eye, under the nose, in your stomach and even in your skin waiting for the signal to transform into whichever tissue or organ that is needed. They are the body's hidden biological repair system—the super mechanics with a warehouse

EYE DISORDERS

Abhishek Sharma, 35

By 24, Abhishek Sharma, who was afflicted with allergic conjunctivitis, had lost his vision in both eyes. "I couldn't recognise a person if he sat in front of me." He couldn't find a job or a bride. He approached the L.V. Prasad Eye Institute and his vision was restored within weeks. Now he is a call centre executive, married and has two children. He says: "For me it's like a miracle."

STATUS IN INDIA

Corneal regenerative procedures using stem cells are the most promising in India. The L.V. Prasad Institute has treated over 700 cases with much success. The Drugs Controller has approved of such therapy for widespread use.



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stacked with everything you need to make your body new again. A decade ago, not many knew how to harness their almost magical capability to heal the body. Now researchers are unlocking the mysteries these nano-sized cells store and are ushering in a revolution in the treatment of a range of debilitating diseases.

In Delhi, at the All India Institute of Medical Sciences (AIIMS), a steady stream of patients comes in for treatment of dilated cardiomyopathy, a condition in which the heart becomes weakened and enlarged. It cannot pump blood efficiently and one of its symptoms is a rapid pulse—twice the normal. Till now, short of having a heart transplant, it was among the most difficult cardiac disorders to treat. But for such patients there is new hope with AIIMS setting up a cardiovascular stem cell group that has begun, probably for the first time in the world, clinical trials to see whether the stem cells extracted from the bone marrow of patients, known as adult stem cells, could improve the heart's performance. The results are encouraging but Balram Bhargava, professor of cardiology and a co-principal investigator, says: "It's not magic yet. Still, in a field that has little options for patients, this is a definite improvement."

AIIMS is also conducting a major multi-centre trial to look at the role of stem cells in repairing tissue damaged during acute heart attacks. In many such cases, even bypass surgery doesn't seem to improve the functioning of the heart. Among the earliest beneficiaries of the wonders of such stem cell treatment is S. Kabilan, a former chief secretary of Assam. Four years ago he suffered a heart attack and underwent bypass surgery at AIIMS. When he heard about the new stem cell treatment which could regenerate damaged tissue, he readily consented to having it done. Since then the functioning of his heart has been regularly monitored and the ejection fraction—the amount of blood pumped out of a ventricle with each heartbeat—has shown considerable improvement. Says Kabilan: "I

THE BIOLOGICAL REPAIR SYSTEM

Though only a decade old, stem cell therapy holds the promise of radical and cost-effective treatment for medical disorders

① What are stem cells?

Stem cells are master cells that can divide and multiply rapidly into cells that give rise to the brain, heart, spine, the limbs, muscles, skin and everything else that constitutes the human body.

② Where they come from?

Embryonic Stem Cells
From embryos created during in-vitro fertilisation. These are the most potent and are used to produce many stem lines.

Umbilical Cord Cells
Taken from the umbilical cord at the time of delivery, they contain stem cells that can turn into bone, heart muscle and brain tissue.

Adult Stem Cells
Taken from the marrow of bones, they can be used to produce cells or tissue for a specific lineage such as cornea or heart muscle.

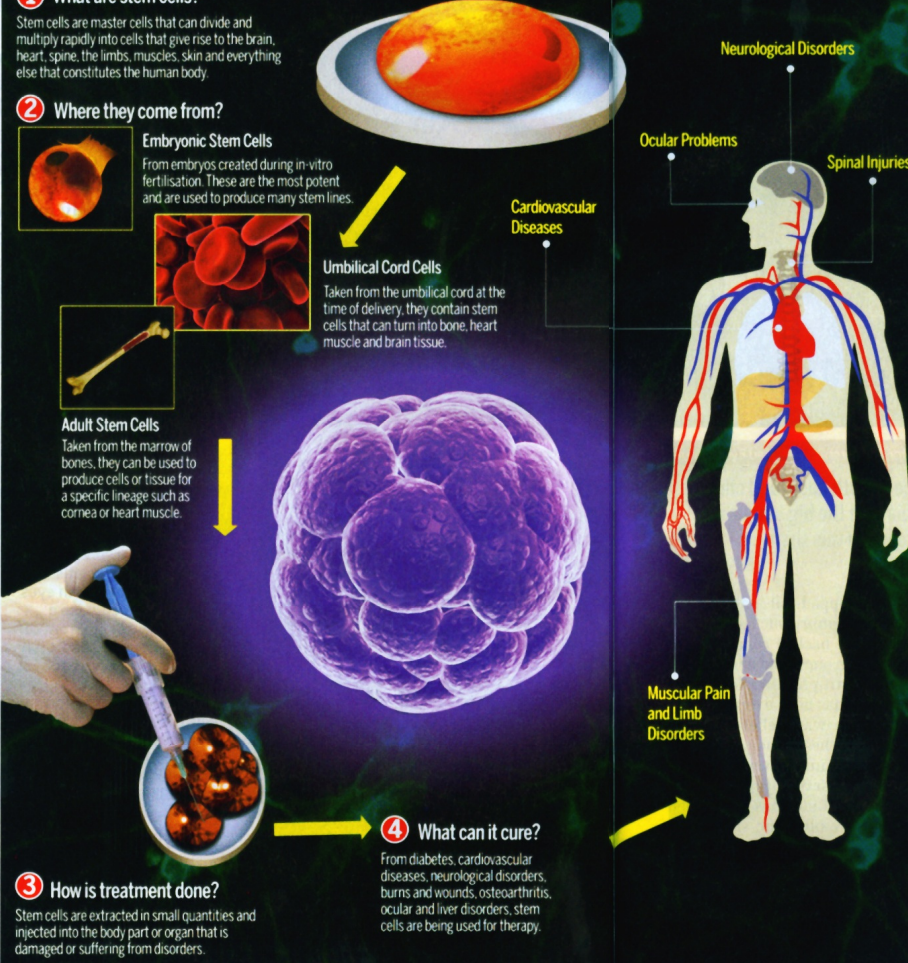
④ What can it cure?

From diabetes, cardiovascular diseases, neurological disorders, burns and wounds, osteoarthritis, ocular and liver disorders, stem cells are being used for therapy.

③ How is treatment done?

Stem cells are extracted in small quantities and injected into the body part or organ that is damaged or suffering from disorders.

Sources: NIA, S. Kabilan, Chik, Chik



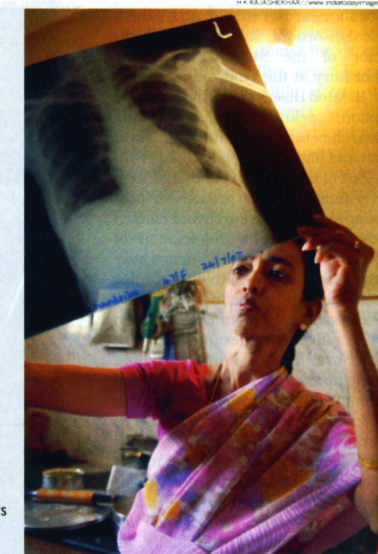
LIVER FAILURES

P. Chandrika, 39

She didn't have much of a honeymoon. Soon after being wed to B.S. Prasada Rao, a postal assistant, her liver started malfunctioning. She vomited frequently and lost weight over the years. Dispirited, she even advised her husband to remarry. Just two years back, doctors at the Lifeline Hospital, Chennai, gave her stem cell treatment and her recovery was astonishing. For the last two years there has been no complication and she is eating normally.

STATUS IN INDIA

Treatment of liver disorders using adult stem cells obtained from bone marrow is growing. The results are promising even in cases of cirrhosis of liver.



M.K. BHAN, Secretary, Department of Biotechnology

“What India has done is to build up the capacity, infrastructure and manpower to keep the nation at the forefront of the brilliant possibilities of stem cells.”

feel fit as a fiddle and have never felt better in recent times.”

In Hyderabad, inside an operation theatre at the L.V. Prasad Eye Institute, Dr Virender Sangwan, a surgeon, is in the process of implanting cornea tissue grown from stem cells into the left eye of a middle-aged factory worker who had accidentally burnt it, leaving him blind in that eye. Harvesting stem cells from the limbus, the region where the cornea touches the white of the eye, Sangwan and his team of specialists are confident of restoring the worker's sight in a matter of weeks. That stems from the fact that in the past nine years they have treated over 700 such patients with remarkable success, possibly one of the largest such regenerative experiments anywhere in the world. Because of the work of

the L.V. Prasad Eye Institute and others, the Drugs Controller of India has recently cleared Reliance Life Sciences to launch the first autologous limbal stem cell therapy—the first time stem cell therapy has been officially cleared for widespread use in India.

For once, Indian scientists are not lagging behind in a key area of cutting edge research and are rubbing shoulders with the best of the business which includes countries such as the UK, Australia, China, Italy and Korea. “India now has a global presence in both basic and clinical research in stem cells. We are in the big league now,” says D. Balasubramanian, L.V. Prasad's director of research and till recently chairman of the apex government committee overseeing stem cells work in the country. In areas such

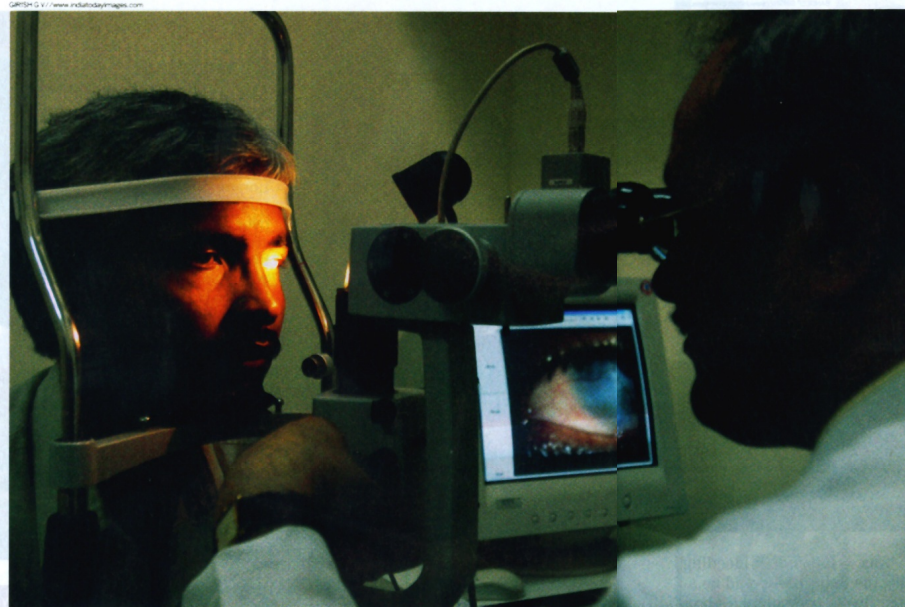
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as ocular, cardiovascular and neurological disorders, Stephen Minger, director of the Stem Cell Biology Laboratory at the Wolfson Centre for Age Related Diseases at King's College London, acknowledges that the research being done in India is "world class and has exciting possibilities".

Part of the reason is that the Union Government has been proactive in promoting stem cell research and clinical trials in India. The Department of Biotechnology (DBT) has launched over 100 projects at 18 premier institutes across the country to conduct not only basic research on stem cells but also test its efficacy in therapy. It has invested over Rs 300 crore, including setting up the first dedicated Institute for Stem Cell Biology and Regenerative Medicine (INSTEM) in Bangalore. M.K. Bhan, the erudite DBT secretary, says: "What we have done is to build up the capacity, infrastructure and manpower to keep India at the forefront of the brilliant possibilities that will unfold in this decade. Traditionally, we would do science but could not translate it for clinical use. Now we have a more balanced approach so that you can have an effective hospital-based treatment as well. We would need industry though to make it a truly mass revolution."

Among the first movers from industry has been the Mumbai-based Reliance Life Sciences, a unit of Mukesh Ambani's empire. It has already set up a sophisticated cord blood repository for couples opting to store stem cells extracted from the umbilical cord soon after delivery. Reliance Life Sciences is now developing a wide range of research-led, stem cell therapies and tissue engineered products, with the objective "of bringing about an era of regenerative medicine", as K.V. Subramaniam, its President and CEO, puts it. Subramaniam estimates that in just two years, about 164 million patients, or 16 per cent of India, suffering from diabetes, cardiovascular disorders, neurological disorders, burns and wounds, osteoarthritis, osteoporosis and liver disorders would benefit from stem cell therapies in India. But



A PATIENT WITH A CORNEAL DISORDER BEING READIED FOR STEM CELL TREATMENT

clinical treatment. Though with Shinya Yamanaka, the Japanese stem cell biologist, recently demonstrating that he could derive stem cells of the potency of embryonic ones from skin tissue, it has become a game changer. Ethical debates over its use may soon be a thing of the past if his technique is perfected and it shows that no tumours develop. Karan Goel, organiser of the Stem Cell Global Foundation, estimates that the world market for stem cell therapy is projected to increase from an estimated \$30 billion (Rs 1,44,000 crore) in 2009 to \$96 billion (Rs 4,60,800 crore) by 2015.

At the same time, Indian couples are flocking in droves to cord blood banks to preserve stem cells that could be extracted from the umbilical cord when it is severed after delivery. The steep prices of between Rs 75,000 to Rs 1 lakh to preserve cord blood in cryogenic storage vaults for a period of 21 years hasn't discouraged takers and over a dozen such banks have been set up in all ma-

for metros. In Gurgaon last week, a couple frantically registered with Cryobanks International for extracting cells of the wife's second pregnancy. Their first child, a boy, was suffering from leukemia and they came to know that cord blood stem cells could be used for treating even the siblings and parents of the baby. Cryobanks CEO Chaitanya Nerikar says that since it was set up three years ago, it has expanded to 75 collection centres and now has over 10,000 samples stored in its vaults. The unit is run almost like a nuclear research facility with tight security and protocols.

The growing popularity of cord blood banks is partly because of the encouraging results coming out from a host of clinical research being done in hospitals across the country. At the Lifeline Multispecialty Hospital in Chennai, Latif Ahmed, a truck driver, is showing all the signs of an astonishing recovery after being diagnosed for cirrhosis of the liver caused possibly by overuse of alcohol. He could barely eat his favourite non-vegetarian food, his blood pressure had dropped and



D. BALASUBRAMANIAN, Director, Research, L.V. Prasad Eye Institute
"With a global presence in both basic and clinical research in stem cells, India is in the big league now. The future will see an increase in this therapy."

he cautions that it is still a long haul as the scalability of treatment remains an issue. Reliance is also one among the score of institutions in the world that has developed its own independent embryonic stem cell lines and is conducting research on them.

Fortunately for India, stem cell research here has not been derailed or devoid of funding over ethical issues concerning the use of embryonic stem cells as it had been in the US. Embryonic stem cells which are harvested within less than a week after fertilisation takes place in an ovum are among the most powerful cells with an ability to develop into any of the 200 types of cells or tissues needed by the body. Former US President George

Bush had stopped all government funding for embryonic stem cell research as he backed conservatives and religious groups who argued that you cannot destroy life in order to save it. Bush's veto has been overturned by Barack Obama who believed in the argument that these embryonic stem cells hardly constituted lives and in fact more lives were saved by research.

Meanwhile, India has developed over a dozen embryonic stem lines and is now using them to carry out basic research in key laboratories. But as in most countries of the world, the Indian Council for Medical Research (ICMR), in its guidelines for stem cell research formulated in 2007 has forbidden the use of embryonic cells for



HEART DISEASES

S. Kabilan, 62

S. Kabilan, a senior bureaucrat and former chief secretary of Assam, had a bypass surgery at AIIMS, Delhi, four years ago. He was advised stem cell therapy to repair his damaged heart. Within six months of treatment, the amount of blood pumped out of his ventricles with each heartbeat showed considerable improvement. Four years later his heart is in good condition and Kabilan says, "I feel fit as a fiddle."

STATUS IN INDIA

India is among the leaders in the world in the treatment of heart disorders using stem cells. AIIMS itself has treated over 100 cases of both acute heart attacks and cardiomyopathy with some success. Multi-clinical trials are now in five institutes to validate the efficacy of stem cell treatment for heart diseases.



BALRAM BHARGAVA, Professor of Cardiology, AIIMS

"The treatment of cardiac diseases is encouraging but it's not magic. Still, in a field that has few options for patients this is a definite improvement."

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K.V. SUBRAMANIAM, President and CEO, Reliance Life Sciences
“By 2012, about 164 million Indians suffering from diabetes, cardiovascular and neurological disorders, and liver failure would benefit from stem cell therapy.”

SPINAL INJURIES

PIYUSH SHARMA, 30

While returning from Corbett National Park two years ago, Piyush Sharma had a car ram his motor-bike leaving him with an injured spinal cord. He was paralysed from waist down and doctors implanted a steel plate in his back. Stem cell treatment at a private hospital in Rudrapur, Uttarakhand, six months ago, made him capable of moving his lower limbs partially and regain bladder control. He says, “It has given me new hope.”

STATUS IN INDIA

Treatment of spinal injuries using stem cell therapy has been encouraging if not spectacular. In Chennai, a study of 280-odd patients found 23 per cent registering improvement.



there was internal bleeding. Normally, the only cure would be an expensive liver transplant. About nine months ago, doctors treated his liver with stem cells extracted from his bone marrow. Within a month, his liver showed signs of recovering and last week it was almost back to normal. Ahmed says, “I am back to eating mutton biryani without any discomfort.”

Apart from liver complications, Lifeline has treated over 280 patients having severe spinal injuries, including paralysis, with stem cells. Almost one out of four showed significant motor and sensory improvement. There have been controversies over whether Lifeline has been ethical in its methods of treatment and claims of success. But J. S. Rajkumar, its chairman, dismisses all such criticism saying, “It’s easy to rubbish our work but our data speaks for itself. People can always say why, but I say why not. It’s not a panacea but stem cells are a great alternative. It is already bringing down the costs of treatment.”

Controversies have always dogged stem cell treatment ever since it began

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BLOOD DISORDERS

HARSHIL NANDA, 2

Harshil was diagnosed with thalassemia major at birth, a rare blood disorder where its ability to produce haemoglobin is defective. His parents, Ravin Nanda, a paan shop owner in Ahmedabad, and Trupti, were devastated. Stem cell treatment at the Gujarat Cancer Research Institute by Dr Sandip Shah was a success, making Harshil the second such patient to be successfully treated and showing a ray of hope to such patients in India.

STATUS IN INDIA

Treatment of disorders like thalassemia and cancers of the blood is only now gaining a foothold in India. While experts say the potential is good, it is far from being realised.



J. S. RAJKUMAR, Chairman, Lifeline Hospital

“People say why; I say why not. It’s not a panacea but it’s a great alternative. No one is dying on the table. Treatment costs are coming down.”

in earnest a decade ago. In Moscow, beauty salons began offering it as a cure for wrinkles, hair loss and dry skin but many of the patients reportedly ended up with tumours. In South Korea, a leading researcher was exposed for fraudulently claiming he had developed a human stem line through nuclear transfer. In India, P. Venugopal, a former AIIMS director, walked the ethical edge when he rammed through stem cell treatment for cardiac disorders when he was head of the institution. Since then, as Geeta Jotwani of ICMR points out, the DBT along with the ICMR have tightened controls and issued stringent guidelines for both research on stem cells and clinical trials. Balasubramanian says, “The problem is that it is more unethical than illegal, so you do have fly-by-night operators which patients have to be careful about.” Bhan is for a legislation to be passed but prefers to wait for a year because, “so rapid

are the changes in stem cell research that the law may become outdated even before it is passed.”

There is a clear need to tone down the hype about the benefits of stem cell therapy till solid basic research validates its efficacy. Jyotsna Dhawan, dean of the newly formed INSTEM, says, “We should not have stem cells hyped up as being a magic bullet. There is need for a lot more basic research to understand the mechanism that affects the degenerative and regenerative process. We need to understand how these cells are set aside and retained as a reserve population and remain neither divided nor differen-

tiated till the appropriate time. Also, how they go about repairing tissue.” There are still huge gaps in the understanding of how the stem cells actually go about doing their work and how they will behave in the body. Doctors don’t want to be putting a stem cell into the brain and discovering that it was a bone! Moreover as Sujata Mohanty, head of AIIMS Stem Cells Facility, points out, “There is a huge difference between what we achieve in the lab and its efficacy with patients. Each patient has his or her own recovery pattern and would need different cell dosages. So we still have plenty to understand about the processes.” Getting stem cells to grow a tooth or as a cure for baldness is still a long way. Yet as Balasubramanian says, “Stem cells are both exciting and promising, and the future would only see an increase in this therapy.” Therein lies the hope. **with inputs from**

Senthil Kumar and Uday Mahurkar



JYOTSNA DHAWAN, Dean, INSTEM

“We should not have stem cells hyped up as being a magic bullet. A lot more basic research is needed to understand how they go about repairing tissue.”

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