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Regenerative Medicines: Current therapies and future direction Repair Replace Restore Regenerate

Aneree Patel and Aarti Thakkar*

*President Science College,Gujarat University,Ahmedabad.
E-mail Id: aarti_thakkar2001@yahoo.com

*Corresponding Author

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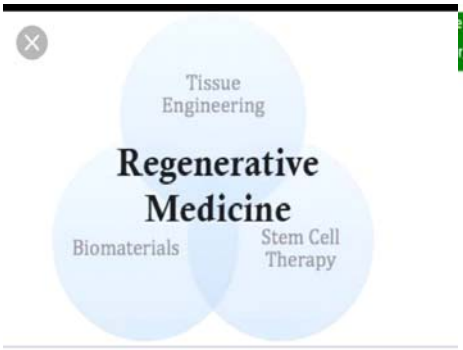
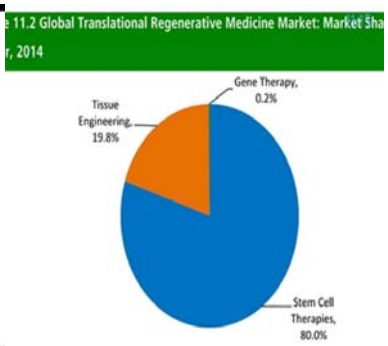
Introduction

Regenerative Medicine is a relatively new branch of translational research which deals with the "Process of replacing, engineering or regenerating human cells, tissues or organs to restore or establish normal cell function". Regenerative medicine also includes the possibility of growing tissues and organs in the laboratory and to take place of missing tissue, effectively replacing it both structurally and functionally, or to contribute to tissue healing. Regenerative medicine involves the

use stem cell technology and tissue engineering. This field holds the promise of changing the course of chronic disease.





Regenerative medicines mainly have three parts:

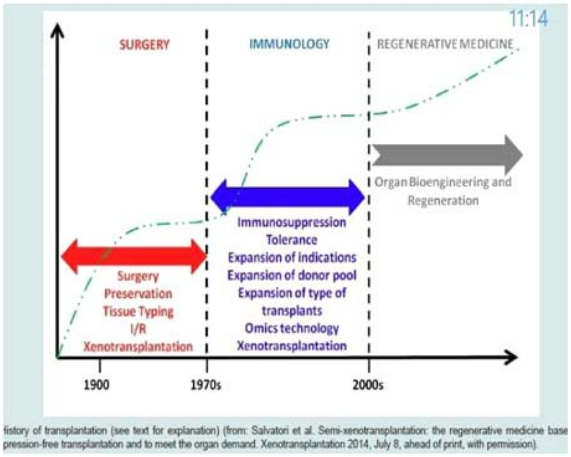
1. Tissue engineering
2. Stem cell therapy
3. Biomaterials

History:

Historically, the term regenerative medicine was used for the first time in a 1992 by Leland Kaiser, who listed the technologies which would impact the future of hospitals. The wide spread use of the term "regenerative medicine" is done by William Haseltine during 1999 in the attempt to describe an emerging field, which blent knowledge deriving from different subjects: tissue engineering (TE), cell transplantation, stem cell biology, biomechanics prosthetics, nanotechnology, biochemistry.

Table 1
A partial list of firsts in RM.

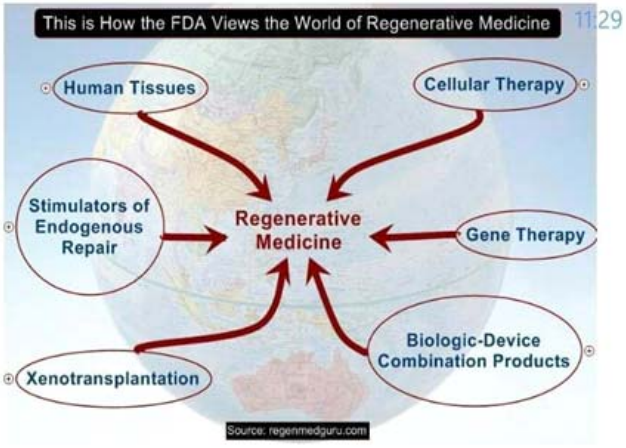
Year	First
1968	First cell transplantation: bone marrow transplant [11]
1978	Discovery of stem cells in human cord blood [15]
1981	First in vitro stem cell line developed from mice [16]
1981	First engineered tissue transplantation: skin [17]
1996	Creation of the first cloned animal: a sheep, named Dolly [18]
1998	Isolation of human embryonic stem cells [19]
1999	First laboratory-grown organ: an artificial bladder implanted in a patient suffering from myelomengicocele [20]
2004	Implantation of first engineered tubular organs (urine conduits) [21]
2007	Discovery of stem cells derived from amniotic fluid and placenta [22]
2009	First solid organ engineered by recycling donor liver [23]



history of transplantation (see text for explanation) (from: Salvatori et al. Semi-xenotransplantation: the regenerative medicine base pression-free transplantation and to meet the organ demand. Xenotransplantation 2014, July 8, ahead of print, with permission).

Therapies in the market:Since tissue engineering and regenerative medicine emerged as an industry about two decades ago, a number of therapies have received regulatory clearance or approval and are commercially available in the market.

1. Extracellular Matrices (ECM):An ECM in its natural form is the combination of collagen, proteins, proteoglycans, glycosaminoglycans, and other biological materials produced by cells that form the structural and functional components of all soft tissues and organs in the body. These materials are commercially available and are used in reconstructive surgery, treatment of chronic wounds and some orthopaedic surgeries. Clinical studies are undergoing to evaluate the efficacy of the ECM in repair of damaged heart tissue and heart surgery.
2. Cord Blood (CB) Stem Cells:Multipotent stem cells are available in large numbers in umbilical cord blood (CB). CB stem cells are capable of giving rise to hematopoietic, epithelial, endothelial, and neural tissues both in vitro and in vivo. Cord blood stem cells are being explored in several conditions including Type 1 diabetes to determine if the cells can slow the loss of insulin production.



Therapies under clinical trial development:

The worldwide market size of regenerative medicine is 17.1 billion YEN and excepted to reach 250 billion YEN by 2015. Research in tissue engineering has a worldwide demand. The cells used in these therapies are either autologous or allogeneic and are typically differentiated cells that still maintain proliferate capacity. Following are the fields in which the regenerative medicines are used and research is going on:-

(1) Bone healing

(2) Genetic disorders

(3) Cartilage repair

(4) Ligament and tendon healing

(5) Spine

(I) Intervertebral disc regeneration

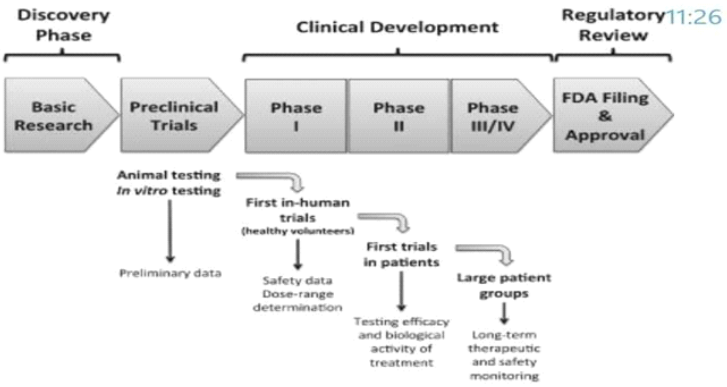
(ii) Spinal fusion

(iii) Spinal cord injury

(6) Osteoarthritis

(7) Rheumatoid arthritis

(8) Orthopaedic oncology



Regenerative medicine has shown great potential for treatment of various disabling orthopaedic disorders. Major research is on bone healing , where various osteoconductive molecules , stem cells ,gene therapy have shown potentially beneficial role. Genetic disorders like osteogenesisimperfecta are also being explored for an effective cure through regenerative medicine. Regenerative medicine also has shown a promising future treatment modality for spinal cord injury. Various inflammatory disorders like osteoarthritis and rheumatoid arthritis can also be treated through regenerative medicine. A significant opportunity exist to improve the cancer therapy beyond the capabilities of traditional cancer treatments such as chemotherapy and radiation. Regenerative

medicine is shaping these new therapies through the integration of its genomics , gene and cell therapy , small molecule drug discovery and protein therapeutic capabilities.

Limitations and Challenges:

There is risk of rejection of body parts in regenerative medicine , which could cause worse effects than the initial problem that was being treated. There aren't many uses for it because it is a new technique in medicine and the outcomes are still unknown. Treatments can be very costly and difficult because the field isn't very advanced. Most of the therapies that do not exist are only in the experimental stage, so most people do not yet have access to them. It is an argued topic because some people do not believe that idea of creating body parts is wrong. Issues surrounding the use of human cells.The development of clinical trials and follow up of participants and patients.

The Way Forward:

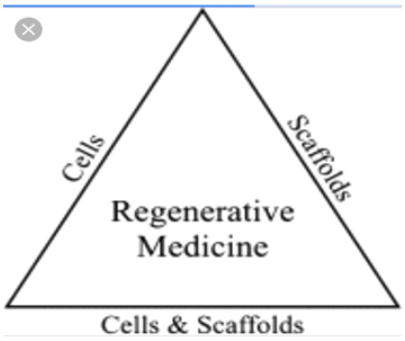
Patient access to regenerative health " It's A door we can open together".

"Our mission is to support and maintain patient access to safe , timely and effective regenerative medical technology and treatment". The regenerative outcomes foundation serves patient healing through regenerative medicine , is reflected in the way research is conducted , medicine is practiced , drugs are developed and patients are healed. On the basis of a cloud based electronic medical records and patient outcomes Tracking system generation of STEM DATA of 220 peoples have been done. Following are the way forward steps:

(1) Provide direct grants
(2) Promote inclusive advocacy
(3) Educate and support providers
(4) Research patient outcomes
(5) Raise public , providers and policy maker awareness
(6) Promote just regulatory policies
(7) Advance a cell therapy registry

Conclusion

The emerging field of regenerative medicine may one day revolutionize the treatment of heart diseases and neurodegenerative disorders , solve the organ donor shortage problem and completely restore damaged muscle , tendons and other tissues.



(a) A change of heart failure treatment : stem cells may transform treatment for heart failure.

(b) Doctors repair soldier's wounds with biological scaffolding material.

(c) Use for 3-D printers : Creating internal blood vessels for kidneys , livers , other large organs.

(d) Neural stem cell transplants may one day help parkinson's patient.

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