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XENOTRANSPLANTATION

THIS ARTICLE COVERS 'DAILY CURRENT AFFAIRS' AND THE TOPIC DETAILS OF "**XENOTRANSPLANTATION**". THIS TOPIC IS RELEVANT IN THE "**SCIENCE AND TECHNOLOGY**" SECTION OF THE UPSC CSE EXAM.

Why in the News?

Richard Slayman, the first human to receive a pig kidney transplant, sadly passed away at 62, nearly two months after the pioneering surgery. Richard, from Weymouth, Massachusetts, underwent the procedure in March, marking a crucial step forward in increasing the availability of organs for transplant patients through the use of genetically modified pig kidneys.

WHAT IS XENOTRANSPLANTATION?

- Xenotransplantation is a medical technique that entails transplanting, implanting, or infusing living cells, tissues, or organs from a nonhuman animal into a human recipient.
- The procedure utilizes genetically modified animals, such as pigs, as donors. These animals are specifically bred to possess organs that closely resemble human organs both anatomically and physiologically, making them appropriate for transplantation.

TYPES OF XENOTRANSPLANTATION

Concordant Xenotransplantation

- This type involves transplantation between closely related species, such as different species of primates or various kinds of rodents. The immune response and rejection process in these cases are relatively mild. **Examples** include organ transplants between baboons and monkeys or between hamsters and rats.

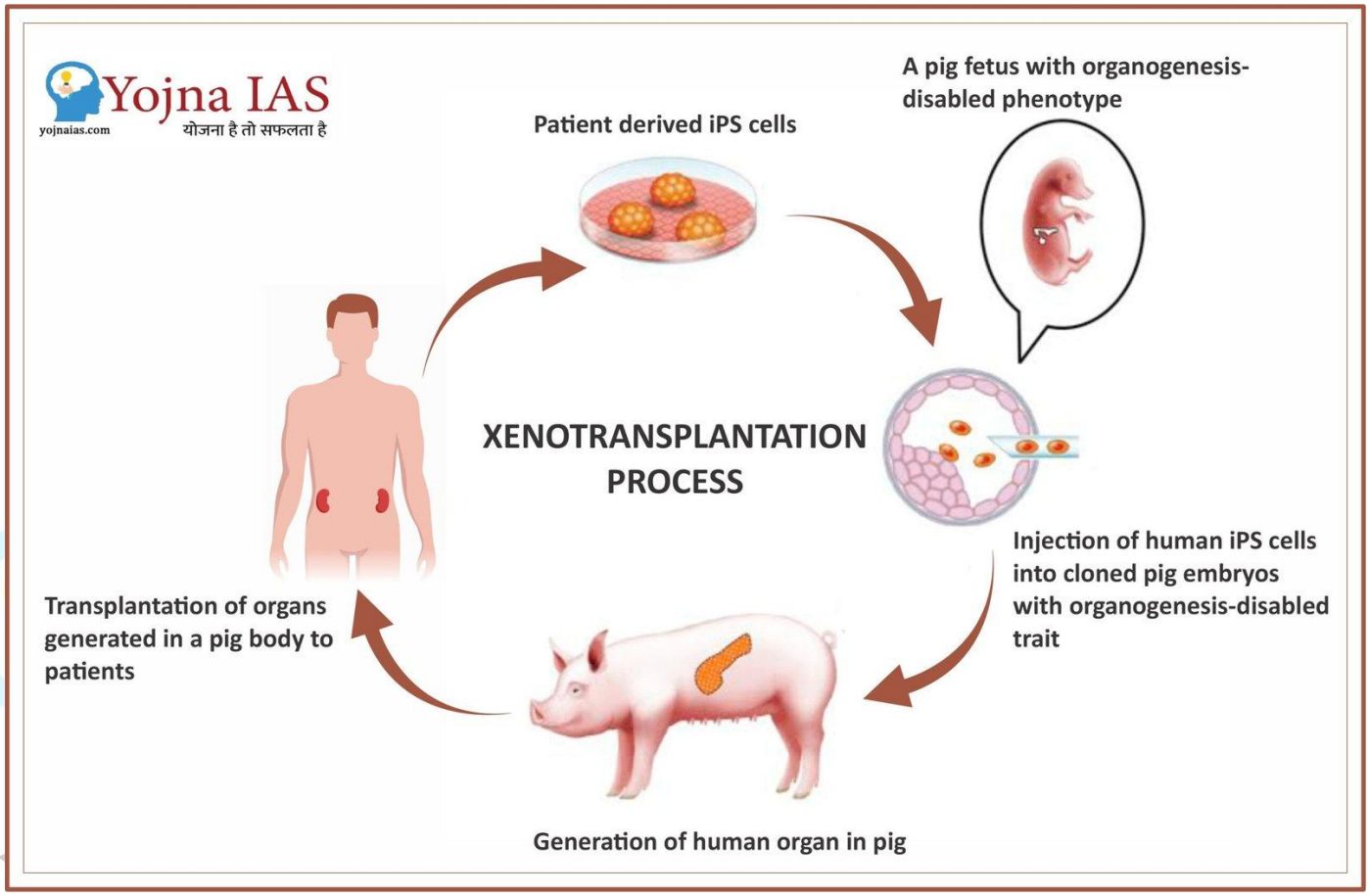
Discordant Xenotransplantation

- This type involves transplantation between distantly related species. The immune system's rejection response is much stronger in these cases than in concordant xenotransplantation. **Examples** include early 20th-century attempts to transplant organs from pigs, dogs, sheep, or monkeys into humans.

SIGNIFICANCE OF XENOTRANSPLANTATION

- **Bridging Organ Shortages:** It can significantly reduce the shortage of human organs available for transplantation by providing an alternative source, such as organs from genetically modified animals.

- **Saving Lives: Providing timely transplants can save the lives of patients who might otherwise die while waiting for a human donor organ.**
- **Advancing Medical Research:** It can enhance our understanding of human diseases and organ transplantation through research and experimental procedures, leading to improved techniques and outcomes.
- **Improving Quality of Life:** When human organs are not available, xenotransplantation can offer patients with chronic organ failure a chance for improved health and a better quality of life.
- **Reducing Transplant Waiting Times:** With a more readily available supply of donor organs, the waiting time for recipients could be significantly reduced, leading to better overall health outcomes.
- **Developing New Treatments:** The field can pave the way for new treatments and technologies that could benefit various medical conditions beyond organ failure.



RISKS ASSOCIATED WITH THE XENOTRANSPLANTATION PROCESS

- **Transmission of Zoonotic Diseases:** Xenotransplantation poses the risk of transmitting zoonotic and other infectious agents from donor animals to human recipients. These agents, not commonly found in human populations, could potentially introduce new infections into the human community.
- **Ethical Concerns:** The use of animals for organ transplants raises ethical questions regarding animal rights and welfare, as well as concerns about the genetic modification of animals.
- **Long-Term Viability:** The long-term function and survival of xenotransplanted organs are uncertain, as they may not perform as well or last as long as human organs.

- **Psychological Impact:** Recipients might face psychological challenges and social stigma associated with receiving animal organs, which can affect their mental health and quality of life.
- **Regulatory and Legal Issues:** Xenotransplantation is subject to strict regulatory oversight, and navigating these regulations can be complex and time-consuming, potentially delaying access to treatment.

WHY ARE PIGS CONSIDERED SUITABLE FOR XENOTRANSPLANTATION?

- Pig organs, specifically the kidney and heart, closely resemble human organs in both structure and function.
- Pigs can be easily bred in significant numbers and maintained in environments free from pathogens. They grow rapidly and can provide organs that match the size of human organs from infancy through adulthood.
- Recent advancements in gene editing have allowed scientists to modify pigs genetically to enhance the compatibility of their organs with the human immune system and blood clotting mechanisms.
- Pigs are favoured over primates like monkeys for xenotransplantation because they can be domesticated and reared under strict health conditions, whereas primates are not suited to such environments.
- Furthermore, using pigs circumvents the ethical issues related to primate use in medical research. Although other animals like cows have been considered, pigs are the leading donor species due to their anatomical similarities to humans, potential for genetic modification, and suitability for large-scale breeding programs.

SUITABLE ORGANS FOR XENOTRANSPLANTATION

- The kidneys, hearts, and livers are the organs most frequently used in xenotransplantation. Pigs are often the source of these organs for transplantation into humans.
- Kidneys are especially important because the demand for kidney transplants is very high, and there is a significant shortage of human donor kidneys compared to the number of patients needing transplants.

CURRENT STATUS OF XENOTRANSPLANTATION IN INDIA

- **India lacks specific regulations for xenotransplantation procedures.** The main legal framework for organ transplantation in India is the Transplantation of Human Organs Act of 1994, which does not mention xenotransplantation.
- In 1997, Dr. Dhani Ram Baruah, an Indian surgeon, performed a xenotransplantation by transplanting a pig's heart and lungs into a patient. Despite the Act not covering xenotransplantation, he was arrested and detained for 40 days by the state government for allegedly violating the Transplantation of Human Organs Act.

FUTURE PROSPECTS OF XENOTRANSPLANTATION

The future of xenotransplantation looks promising, with notable advancements in research and clinical practice suggesting potential breakthroughs. Key points highlighting the future of xenotransplantation include:

- **Huge Market Potential:** Industry projections forecast substantial growth in the global xenotransplantation market, expected to reach $16 billion by 2025 and $26 billion by 2032. This growth reflects increasing interest and investment in xenotransplantation as a viable medical solution.
- **Research Progress:** Xenotransplantation research is advancing rapidly, with the first clinical trials anticipated to begin in 2023 or early 2024. This marks a significant step towards applying research findings in clinical settings.

- **Regulatory Support and Clinical Trials:** The growing body of positive data in xenotransplantation is likely to garner support from national, regional, and global regulatory authorities. This support is crucial for scaling up animal-to-human transplants and expanding their use in surgeries.
- **Potential Advantages:** Xenotransplantation offers the potential to provide a steady supply of animal organs, benefiting patients who are currently ineligible for traditional organ transplants. This could increase the organ pool and mitigate issues related to human organ donation.
- **Investment Opportunities:** Investors are encouraged to actively engage in the xenotransplantation market, as staying informed and seizing emerging opportunities could yield significant rewards. Keeping up with developments in this field offers a competitive edge in this rapidly evolving market.

PRELIMS BASED QUESTION

Q1. Which of the following animals is most suitable for xenotransplantation?

1. Cow
2. Pig
3. Cat
4. Rabbit

ANSWER: B

MAINS BASED QUESTION

Q1. Evaluate the potential of xenotransplantation as a solution to the human organ shortage and its promise of life-saving treatments for patients with end-stage organ failure. Provide a critical analysis.

Vikas

CHABAHAR PORT

THIS ARTICLE COVERS 'DAILY CURRENT AFFAIRS' AND THE TOPIC DETAILS OF "CHABAHAR PORT". THIS TOPIC IS RELEVANT IN THE "INTERNATIONAL RELATIONS" SECTION OF THE UPSC CSE EXAM.

WHY IN THE NEWS?

The United States warned of "the potential risk of sanctions" against "anyone considering business deals with Iran" after India and Iran signed a '"long-term main contract" for the development of Shahid Beheshti Port Terminal in Chabahar, Iran. The US said any country considering business deals with Iran "needs to be aware of the potential risks".

India signed a 10-year agreement with Iran to develop and manage the Chabahar port, marking a pivotal development in bilateral ties between the two nations. The agreement replaces an initial pact in 2016 that covered India's operations at the Shahid Beheshti terminal of Chabahar port, which has been renewed annually.

ABOUT CHABAHAR PORT:

- Chabahar Port is a seaport in Chabahar, southeastern Iran, on the Gulf of Oman.
- The port is located in the Sistan-Balochistan province.
- It offers a direct trade route for Iran with the Indian Ocean, bypassing the crowded and strategically sensitive Strait of Hormuz.
- The port consists of two separate ports, Shahid Beheshti and Shahid Kalantari.
- The Chabahar port is a crucial trade gateway for India, Iran, and Afghanistan with Central Asia.
- In May 2016, India, Iran, and Afghanistan agreed to develop Chabahar's Shahid Beheshti Terminal.
- It is India's first foreign port project.
- The port would enable India to bypass Pakistan, access Afghanistan, and ultimately Central Asia.
- The distance from Kandla port in Gujarat to Chabahar port is 550 Nautical Miles, and from Chabahar to Mumbai, it extends to 786 Nautical Miles.

IMPORTANCE OF CHAHABAR PORT FOR INDIA:

India has invested significantly in developing Chabahar Port to enhance connectivity with Afghanistan and Central Asia while circumventing Pakistan. The port has been central to developing the International North-South Transport Corridor (INSTC), a multi-mode network of ship, rail, and road routes for moving freight between India, Russia, Iran, Europe, and Central Asia. India, Iran, and Afghanistan have also agreed to grant preferential treatment and tariff reductions at Chabahar to facilitate trade.

Chabahar POrt is of significant strategic and economic importance to India. **Here are the key aspects:**

1. Chabahar Port is located on the southeastern coast of Iran, along the Gulf of Oman. It provides India with direct access to the Arabian Sea, bypassing Pakistan and allowing India to access Afghanistan and Central Asia directly. This reduces India's dependence on Pakistan for trade with these regions and mitigates geopolitical risks.
2. The port is a crucial link in the International North-South Transport Corridor (INSTC), facilitating India's trade with Afghanistan and the broader Central Asian region. This connectivity is vital for India's strategic and economic interests, as it opens up new markets and trade routes.
3. Chabahar Port can contribute to India's energy security strategy. It provides a potential transit point for the import of natural gas and oil from Iran and other Central Asian countries, contributing to India's energy diversification efforts.
4. By developing Chabahar Port, India strengthens its diplomatic and economic ties with Iran and Afghanistan. This enhances India's regional influence and counterbalances China's presence, mainly through the China-Pakistan Economic Corridor (CPEC) and Gwadar Port in Pakistan.
5. Chabahar Port enables India to send humanitarian aid, such as wheat, to Afghanistan, showcasing its support for the Afghan people.

CONCLUSION:

The development of Chabahar Port marks a crucial geopolitical and economic venture, poised to transform the landscape of regional commerce and strengthen the bonds among Iran, India, Afghanistan, and Central Asia. Serving as a pivotal element of India's agenda to boost regional connectivity, commerce, and its clout, Chabahar Port provides a vital access point to Afghanistan and Central Asia, circumventing geopolitical hurdles and playing a key role in furthering India's extensive economic and strategic ambitions in the region.

PRELIMS PRACTICE QUESTION:

Q. CONSIDER THE FOLLOWING STATEMENTS ABOUT THE CHABAHAR PORT:

1. The port consists of two separate ports, Shahid Beheshti and Shahid Kalantari.
2. It is India's first foreign port project.

Which of the statements given above is/are correct?

A. Only 1

B. Only 2

C. Both 1 and 2

D. Neither 1 nor 2

ANSWER: C

MAINS PRACTICE QUESTION:

Q. What is Chabahar Port's strategic significance for India in terms of trade and geopolitics? What environmental concerns are associated with its development, and how are they being addressed?

AMIT PRADHAN