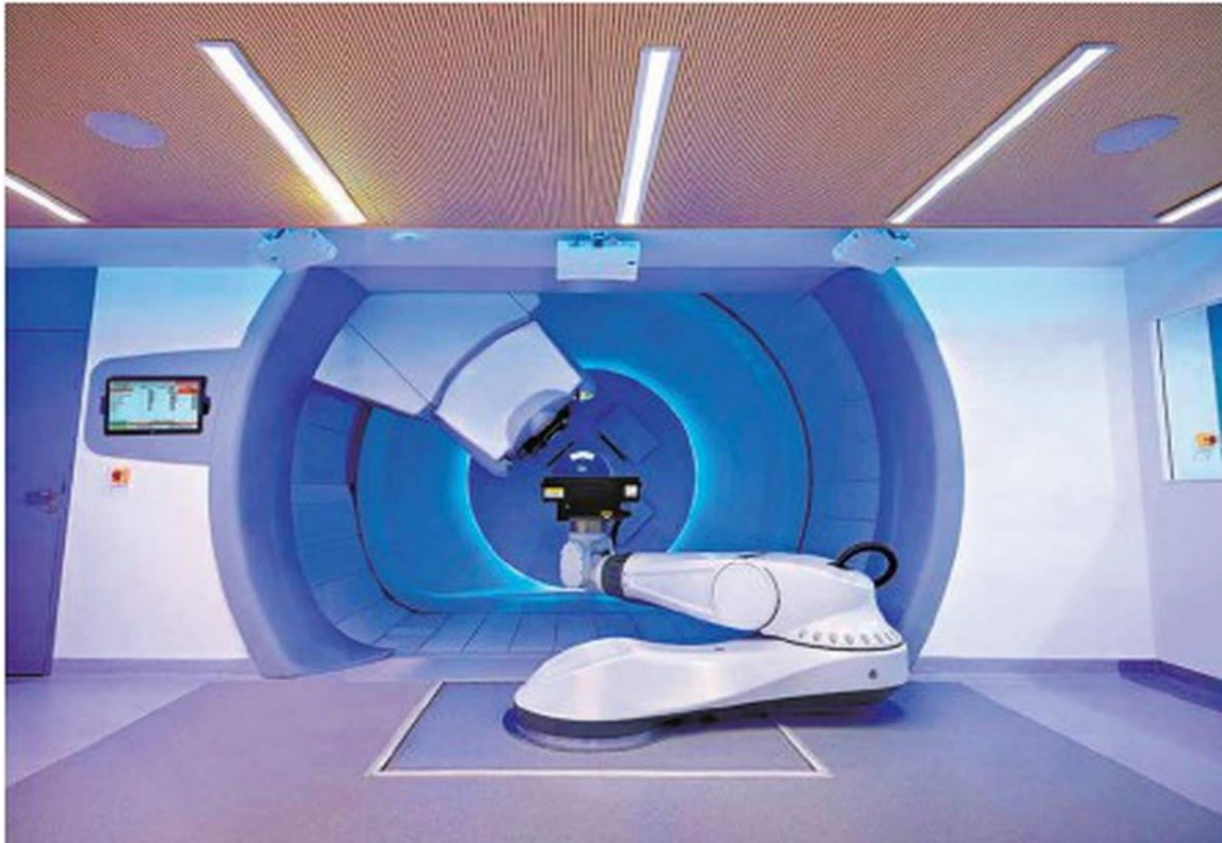


4. Proton Beam Therapy out of reach for many

Prelims Tag: Proton Beam Therapy

Mains Syllabus: GS-III Science & Technology - Awareness in the fields of it, Space, Computers, Robotics, Nano-Technology, Bio-Technology, Pharma Sector & Health Science



GATEWAY

Why in News?

- There is currently a demand-supply gap of proton beam therapy machines in India, leaving many cancer patients in a difficult situation.

What is Proton Beam Therapy?

- Proton beam therapy is a type of radiation therapy — a treatment that uses high-energy beams to treat tumors. Radiation therapy using X-rays has long been used to treat cancers and noncancerous (benign) tumors.
- It uses protons rather than x-rays to treat cancer. At high energy, protons can destroy cancer cells.
- It can also be combined with x-ray radiation therapy, surgery, chemotherapy, and/or immunotherapy.
- Like x-ray radiation, proton therapy is a type of external-beam radiation therapy.

MORE PRECISE, LESS HARMFUL

What is a proton?

It is a positively charged particle with high energy that can destroy cancer cells

What is proton therapy?

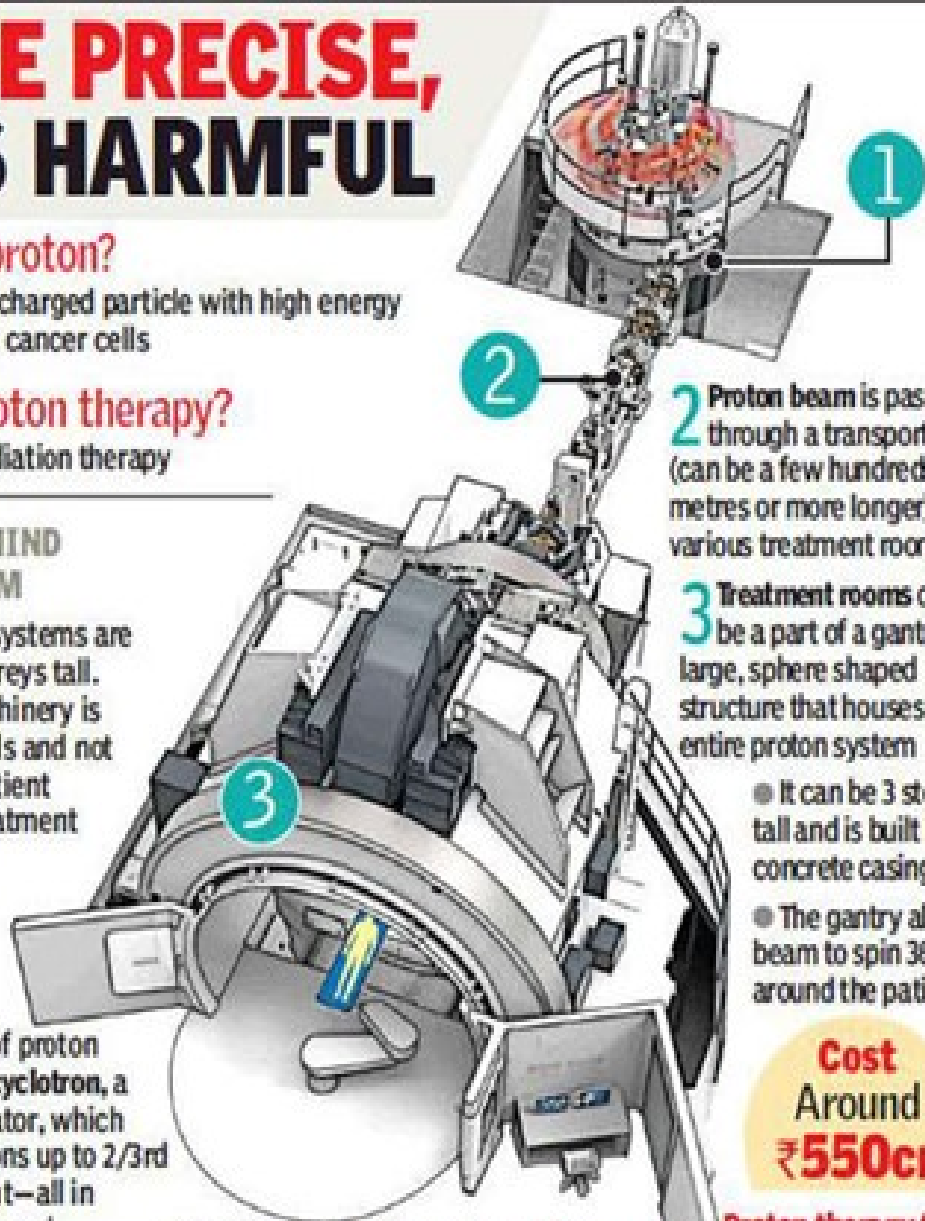
It is a kind of radiation therapy

PHYSICS BEHIND PROTON BEAM

Proton therapy systems are huge—a few storeys tall. Most of the machinery is built behind walls and not visible to the patient entering the treatment room, which is like any CT, MRI or PET scan unit

1 At the heart of proton ensemble is cyclotron, a particle accelerator, which accelerate protons up to 2/3rd the speed of light—all in fractions of a second

(Sizes of human and machine are in proportion)



2 Proton beam is passed through a transport line (can be a few hundreds of metres or more longer) to various treatment rooms

3 Treatment rooms could be a part of a gantry—a large, sphere shaped structure that houses the entire proton system

- It can be 3 storeys tall and is built into a concrete casing
- The gantry allows beam to spin 360° around the patient

**Cost
Around
₹550cr**

Proton therapy for cancers of Skull base, liver, spine, brain, lung, head and neck, breast, lymphomas, esophagus, pancreatic, paediatric, prostate, a gastrointestinal, bone

- Proton therapy may also be used for tumors that recur in areas that have previously been treated with standard radiation therapy

DIFFERENCE BETWEEN PROTON AND STANDARD RADIATION THERAPY



- Standard radiation therapy uses X-rays (photons) which deliver radiation not only to the targeted tumour but even to healthy tissues beyond

- Proton beams, on the other hand, can be adjusted to deliver most of their energy to a particular point



How it works?

- Fundamentally, all tissue cells are made up of molecules with atoms as their building blocks.
- In the center of every atom is the nucleus. Orbiting the nucleus of the atom are negatively charged electrons.
- When energized protons pass near orbiting electrons, the positive charge of the protons attracts the negatively charged electrons, pulling them out of their orbits. This is called ionization.
- It changes the characteristics of the atom and consequentially the character of the molecule within which the atom resides.
- Because of ionization, the radiation damages molecules within the cells, especially the DNA.
- Damaging the DNA destroys specific cell functions, particularly the ability to divide or proliferate.
- While both normal and cancerous cells go through this repair process, a cancer cell's ability to repair molecular injury is frequently inferior.
- As a result, cancer cells sustain more permanent damage and subsequent cell death than occurs in the normal cell population.

Why in news?

- There is currently a significant demand-supply gap of proton beam therapy machines in India, with only a few machines available in the country.
- This has resulted in long wait times for patients who need the treatment, and many patients are forced to travel abroad to access the treatment, which can be prohibitively expensive.

Various challenges

- **Huge demand:** The demand for PBT machines is also increasing, as more and more patients are being diagnosed with cancer and are seeking the latest and most effective treatments available.
- **High cost:** One of the major challenges in setting up PBT machines is the high cost involved, as the machines are complex and require a significant investment.
- **Shortage of personnel:** In addition, there is a shortage of trained personnel who can operate and maintain the machines, which further limits their availability.

Way Forward:

- The government and private sector need to invest more in setting up and maintaining the machines. This could include-
- Offering tax incentives and subsidies to private healthcare providers who invest in PBT machines
- Providing training and education to personnel who can operate and maintain the machines
- Setting up more public hospitals that offer proton beam therapy, which would help to make the treatment more accessible and affordable to patients who need it

