6. Traumatic Brain Injuries - Science & Technology

Indian researchers have developed CEREBO, a portable device using near-infrared spectroscopy to rapidly diagnose Traumatic Brain Injuries (TBIs) like internal bleeding. This addresses a critical need in India, where most TBIs are from road accidents, aiming to improve survival rates by enabling early detection in rural areas lacking CT/MRI facilities.

Context and Overview of Traumatic Brain Injuries (TBI)

The Innovation - The Indian Council of Medical Research (ICMR), in collaboration with AIIMS Bhopal, NIMHANS Bengaluru, MDMS Secretariat, and Bioscan Research, has developed a new portable diagnostic tool called CEREBO for Traumatic Brain Injuries (TBI).

What is TBI?

Cause - TBI is an injury that disrupts normal brain function, caused by a sudden trauma, jolt, or blow to the head.

Severity - The severity can range from a mild concussion to a severe, life-threatening injury.

Major Causes of TBI in India -

Road Traffic Accidents - Account for the majority, at 60%.

Falls - The second leading cause, at 20–25%.

Violence - Contributes to approximately 10% of cases.

Consequences of TBI - Injuries can lead to severe outcomes, including internal bleeding, swelling (edema), cognitive impairments, behavioral changes, physical disabilities, and increased long-term risks of neurodegenerative diseases.

About CEREBO - The Portable TBI Diagnostic Tool

Nature - CEREBO is a handheld, portable, and non-invasive diagnostic device designed specifically for the rapid assessment of traumatic brain injuries.

Core Technology - It is built on a platform of near-infrared spectroscopy which is combined with a machine learning algorithm to analyze the data.

Speed and Detection - It is extremely fast, capable of detecting intracranial bleeding and edema in under one minute.

Output - The device provides results that are color-coded for easy interpretation, completely radiation-free, and cost-effective compared to traditional imaging.

Safety and Ease of Use - Its non-invasive and radiation-free nature makes it safe for all patients, including infants and pregnant women. It is designed to be simple to operate, requiring only 30 minutes of training for paramedics or even unskilled personnel.

Intended Applications - CEREBO is designed for use in pre-hospital and remote settings, including ambulances, trauma centers, rural clinics, and disaster response units.

Significance of CEREBO

Early and Accessible Detection - It provides a crucial advantage by enabling timely diagnosis in situations where gold-standard facilities like CT (Computed Tomography) and MRI (Magnetic Resonance Imaging) are either unavailable or delayed.

Bridging the Urban-Rural Gap - The device can be widely deployed in rural and underserved areas that lack the expensive infrastructure required for conventional imaging.

Improved Emergency Efficiency - CEREBO significantly reduces the "time-to-decision" in emergencies, helps paramedics and doctors optimize triage (prioritizing patients), and lowers overall healthcare costs by reducing the need for expensive imaging.

Global and Primary-Care Relevance - It has potential for adoption in military healthcare and international disaster response systems. It facilitates rapid and reliable triage at the first point of contact—in primary-care centers and ambulances—which is critical for improving survival rates.

The Need for the CEREBO Device in India

High Burden of TBI - India faces a severe public health challenge from head injuries. Over 100,000 deaths occur annually due to head injuries .More than 1 million people suffer serious brain injuries each year.

Limitations of Existing Methods - Glasgow Coma Scale - This is a common clinical assessment tool, but it is often prone to error and subjectivity.

CT/MRI Scans - These are the definitive diagnostic tools but require costly infrastructure and trained specialists, making them inaccessible in most rural and remote areas.

The Critical "Golden Hour" - Early detection is paramount, as half of all deaths from TBI occur within the first two hours of the injury. Delay in diagnosis allows secondary brain injury (swelling and bleeding that occurs after the initial impact) to worsen, leading to poorer outcomes.

Comparison of Existing Imaging Technologies - CT vs. MRI

Feature	CT (Computed Tomography)	MRI (Magnetic Resonance Imaging)
Technology	Uses X-rays and computer processing to create cross-sectional "slice" images of the body.	Uses strong magnetic fields and radio waves to generate highly detailed images of organs and tissues.
Best For	Excellent for head injuries, skull fractures, detecting acute bleeding and clots, chest/abdomen injuries, and fast diagnosis in emergencies/accidents.	Superior for evaluating soft tissues like the brain and spinal cord, detecting tumors, and examining joints, ligaments, and cartilage. It's the preferred tool for stroke and neurological disorders.
Speed	Very fast, with a scan typically taking only a few minutes. This makes it ideal for trauma and emergency situations.	Slower, with a detailed scan often taking 30 to 60 minutes to complete.
Image Detail	Provides better detail for bones and acute bleeding.	Offers superior detail for soft tissues, nerves, and complex brain structures.
Cost	Generally cheaper than an MRI scan.	More expensive due to the complexity of the equipment and longer scan times.
Risks	Involves exposure to ionizing radiation (X-rays), making it less ideal for repeated scans, especially in children and pregnant women.	No radiation exposure. However, it is unsuitable for patients with metal implants or pacemakers. The enclosed space can also cause claustrophobia in some patients.

Source - https - //www.thehindu.com/sci-tech/health/what-is-cerebo-explained/article70001314.ece