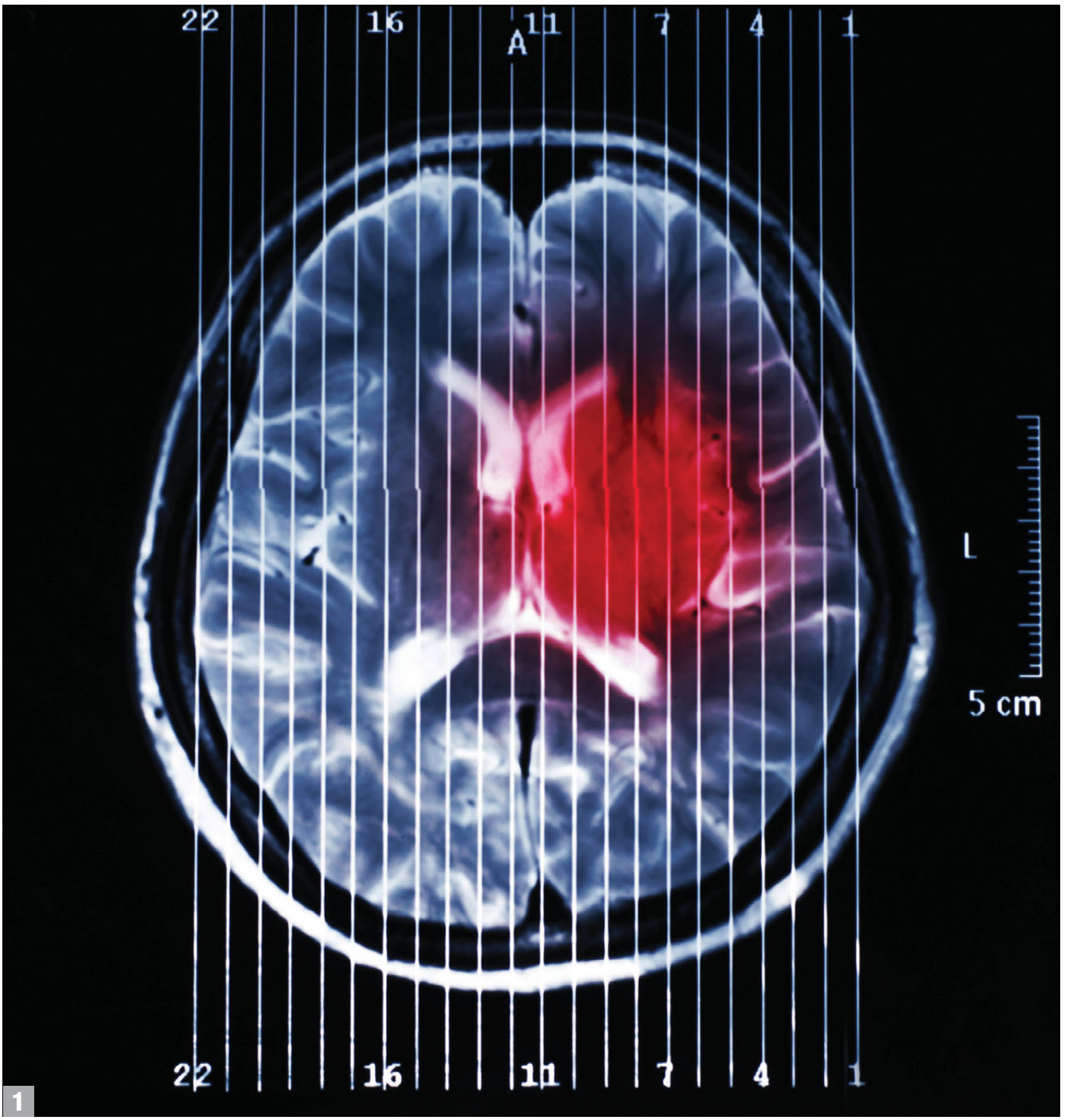

Advancements in brain tumour surgery

1. The brain is posed for variety of tumours including malignancy.

Technology helps to protect and preserve the integrity of normal brain tissue, screen and preserve normal blood vessel

BY DR NK VENKATARAMANA

Brain tumours are the most difficult tumours in the body causing significant disability, morbidity as well as death. Brain tumours can occur from the brain in the foetus all the way to old age. The incidence of brain tumours is gradually increasing year by year and this could be possibly due to awareness and detection. The brain is posed for variety of tumours including malignancy.

According to a study, the prevalence of brain tumour cases stands at 8.2 cases for every 1 lakh population in the world. In this, 15-20 per cent of the brain tumour cases occur in children. In children after blood malignancy, brain tumour is the second major form of malignancy.

Brain tumours arising from the neuron, blood vessels, nerves and nerve sheaths starting with skull bones, pituitary glands, pineal glands are termed as primary brain tumour. Some of them are benign, but a good number of tumours are malignant. In addition, brains can also have metastatic tumours starting from the breast, lungs, pancreas, kidney, intestine, etc.

This isn't all, brain tumours can also affect the spinal cord and the vertebral column. Younger the child, more malignant are the tumours. The tumours are more even in the foetus, sometimes called the congenital brain tumour. In children, the brain tumours are more commonly found in the posterior part, whereas in adult the tumours are mostly located in the deep brain. These tumours primarily increase intra-cranial pressure (pressure effects) causing headache, vomiting, and secondly it leads to compression effects causing focal neurological defects, dysfunction of the nerves, brain or the spinal cord and thirdly, it causes general problems like convulsions, psychological issues, pain, etc.

Clinical examination and imaging are the major form of diagnosis when it comes to the brain tumour. MRI is the gold standard in identifying the tumours which are less than a centimetre lesion, its location, size, vascularity, effect on the surrounding area and MR tractography can provide information about the white matter tracts and the MR spectroscopy can give a gross idea about the tumour and the degree of malignancy. The gold standard of treatment for brain tumour remains the surgery followed by radio therapy and chemotherapy if the tumours are malignant. Meanwhile, a variety of supportive therapies are now being tried to compliment the primary therapy.

However, the exact etiology or the cause of the brain tumour is still not clear. A variety of genetics, environmental, toxins, exposure to radiation, drugs have been incriminated. Going ahead, the development of molecular biology of tumours might throw light about the exact causative factor in the future.

When we go back to the history, it has been found that the first brain tumour surgery was performed in England by Richmond Bradley. Yesteryears have witnessed a series of problem due to lack of imaging, illumination, infection control and surgical instrumentation. Due to this many brain tumour surgeries were difficult to perform as some of the areas were not accessible, making the total removal of the tumour difficult. In addition, the surgery was associated with significant morbidity.

Over the last three decades, there has

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been a significant development, the technology adoption has made the brain tumour surgery as one of the most successful field with very good outcome. Imaging today will give all the relevant information to the surgeon about the tumour and the surrounding brain structure, blood vessels and 3D orientation. The operating microscope has helped the illumination and the magnification in such a way that the tumour from all location of the brain can now be operated upon. Every neural structure can be visualised clearly so that it can be protected and preserved during the surgery.

The high speed drill has created rapid access to the brain, thus reducing the duration of the surgery as well as the bleeding. The bipolar diathermy has contributed to the precise control of the bleeding. The understanding and comprehension of the anatomy of the brain has paved the way for specialised approaches to the weaker areas through the safer zone like three sylvian feature, subarchnoid systems, trans-corpus callosum approach, trans-ventricular approach and trans-fulcul approaches minimizing the brain damage and the neurological effects.

Making new strides and development in the field of brain tumour treatment, the self retaining retractive system have become sophisticated to create a clear scene for the surgeon. Similarly, the controlled suction can keep the operative field clean without any blood. The ultrasonic surgical aspirator is able to break the tumour into pieces and aspirate using the high-power ultrasound technology. This can facilitate rapid debulking of the tumour and at the same time preventing fraction to avoid the damage to the surrounding normal brain. The laser system sometimes can help to evaporate the tumours using laser energy. All these gadgets have helped in achieving the gross total removal of the tumour, irrespective of the location and type of the tumour.

Secondly, the technology helps to protect and preserve the integrity of the normal brain tissue, screen and preserve the normal blood vessel that supplies the brain, selectively blocking the blood supply to the tumour, so that the Ischemic injury to the brain is prevented. We are able to preserve every single cranial nerve, thus reducing the morbidity significantly and also improving the function of the individual. Overall, all

3. Computer-assisted surgery helps the surgeon to approach the tumour through a small scale.

these factors can contribute in improving the quality of life after the surgery.

With these great advancement, neuro surgery has become one of the finest branches of medicine that can lead to gratifying results with satisfactory outcome.

The tumour fluorescence technology is able to provide better visualisation of the tumour tissue under the microscope. The colour difference will be able to differentiate the tumour tissue from the normal brain, helping the surgeon to remove selectively and totally the tumour tissue- thereby preserving the normal brain.

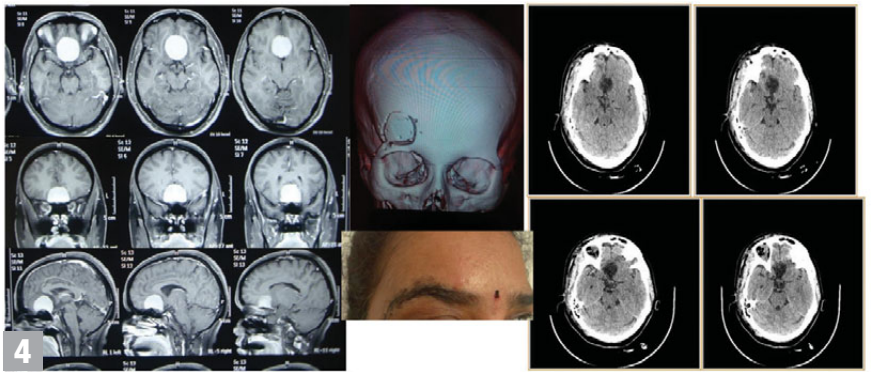
The endoscopic system has enhanced the visibility and accessibility of deep-seated tumours. With the advent of endoscopy and endoscopic micro-instruments, neurosurgery became the key-hole surgery as well as minimally invasive surgery. Good number of tumours located in the intraventricular space can be removed using the endoscope through key-hole approaches. This has minimal retraction of the brain and greater visualisation and endoscopic assisted surgery is a great compliment to the micro-surgery in order to visualise the blind corners and achieve total removal. Intra-operative MRI is a real time imaging technology that can help the surgeon to achieve complete removal of the tumour as well as get the real time verification of the complete mess of the surgery.

Computer-assisted surgery or navigation surgery is another great advancement which will helps the surgeon to approach the tumour through a small scale and in real time verify the location, trajectory and the progress of the surgery. We can also plan the approach through the safer areas of the brain and navigate oneself accordingly- avoiding injury to the important structure. All these can be pre-determined, pre-planned, previous day using specialised computer software and execute the plan effectively.

Stereotactic surgery is yet another additional specialised area. This allows the access to deep seated tumours in a minimally invasive way in order to access, obtain biopsy and also treat some of the tumours. This stereotactic technique is also used to provide targeted therapy like targeted radiotherapy, targeted chemotherapy and targeted cell therapy as well as implantation of drug delivery devices.

In addition to this, a variety of other supportive therapies are also being researched. These include cell therapy, immune therapy, gene therapy, targeted drug delivery through nano-technology and MR-guided radio frequency ablation. The angiography and endovascular intervention sometimes helps to identify the vascularity of the tumour as well as to reduce the vascularity by tumour embolisation and provide selective intra-vascular drug delivery.

The future holds a lot of promises in the field of molecular biology, drug delivery by modulating the blood brain barrier, targeted therapy, and drug discovery. The optics thus contributes to a different operating system where one will be able to see the tumour and the cell activity using specialised devices. Now the goal of research is towards early identification of tumour, non-invasive method of monitoring and the targeted therapy in order to attack tumour selectively without causing any cell damage. HR



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