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MALIGNANT LESIONS OF THE SCALP: SURGICAL MANAGEMENT OF THE DEEPLY INVASIVE LESIONS

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ABSTRACT

The deeply invasive malignant lesions of the scalp present peculiar problems in relation to surgical management, especially due to the proximity of critically important structures such as the brain and intracranial venous sinuses. The paper presents a discussion of the principles of surgical management with regard to these lesions.

KEYWORDS: Malignant lesions scalp, cancer of scalp, scalp tumours.

INTRODUCTION

Malignancies of the scalp are most common among the Caucasian population who reside in comparatively warmer, sun-exposed parts of the world. The usual etiological factor implicated in the pathogenesis of such lesions is exposure to ultraviolet radiation.[1] The various kinds of malignancies reported to afflict the scalp include basal cell carcinomas, squamous cell carcinoma, merkel cell carcinoma, malignant melanoma, angiosarcoma, dermatofibrosarcoma protuberans, sweat gland carcinoma and malignant fibrous histiocytoma.[2] The scalp is characterized by a peculiar anatomy which modifies the tumour behavior and principles of management in this area. The various layers of scalp are often depicted by the acronym SCALP – Skin, subcutaneous Connective tissue, galea Aponeurotica, Loose areolar tissue and Periosteum (Fig. 1). In many parts of the world, the lesions limited to the skin layer are managed by way of MOHS Micrographic surgery.[3] However, this technique is not available in all the centers involved in surgical oncology. Its absence implies application of the basic principles of surgical oncology to the scalp lesions as well, i.e., resection with wide margins. The invasion of carcinomas into the scalp may be classified into three basic types,[2] all of which require different extent and technique of surgical resection. The three types of scalp cancer, based on the depth of invasion (Fig. 2), from skin towards the dura, may be described as below:

1. Superficial type – the tumour lies superficial to the aponeurotic layer, so that resection may be carried out to the level of galea aponeurotica.

2. Intermediate type – the tumour has penetrated the galea aponeurotica and satisfactory oncological resection would imply inclusion of periosteum into the surgical specimen. The outer table of cranium can be included if the periosteum is involved in the lesion.

3. Deep type – the tumour extends to the cranial bone, so that through-and-through resection is required, including the dura if necessary.

The basic principles of satisfactory oncological resection are same for all the above three types of tumour invasion. These include wide surgical excision with a 1 to 2 cm. margin,[4] depending upon the tumour type, followed by frozen section analysis of specimens 2-3 mm. in thickness, taken around the circumference and depth of incision. This is followed by reconstruction with skin grafts, pedicled flaps or free flaps, as and when required. The purpose of this paper is to discuss the surgical techniques employed for the management of deep type lesions and a detailed description of the same is discussed next.

SURGICAL RESECTION OF THE DEEP TYPE LESIONS

The surgical resection of deep type lesions will be discussed under the following headings

A) Basic surgical technique
B) Surgical anatomy of critical structures
C) Clinical implications
D) Management of cerebral involvement
E) Reconstruction

A) Basic surgical technique[4]

The surgical procedure begins with a full thickness incision through all the layers of the scalp, through the periosteum to the calvarial bone. As mentioned previously, depending on tumour type, a 1 to 2 cm. margin of healthy scalp tissue is included all around the periphery of tumour. Subsequently, multiple superficial and deep margins are sent for frozen section analysis. Deep margins of galea and periosteum, wide of the resection, must be taken because of the propensity of some tumours to spread along their facial planes. Raney clips and bipolar cautery are utilized to obtain haemostasis.

The edge of bone invasion is determined by gentle dissection of the periosteum with a periosteal elevator, until the tumour appears to be adherent. Any stippling of the bone must be considered as tumour invasion. Thenceforth, a bur hole is made and a craniotome is used to take approximately 1 cm. of healthy bone around the area of obvious tumour penetration. Frozen sections of the diploe must be sent to determine the integrity of bony margins. Subsequent to this, the area of dural invasion is attended to. The dura is highly resistant to both lateral tumour spread and to penetration beyond its inner layer to the underlying brain tissue. Usually, a margin of 5 mm. is satisfactory to establish dural clearance.[1] The margins must again be sampled to send for frozen section analysis.

The greatest problem in dealing with carcinoma of the scalp extending to dura, is the spread of tumour to adjacent bridging veins, particularly in the vicinity of the vein of Labbe and the superior sagittal sinus.[4] Hence, it is very important to delineate the surgical anatomy of these venous systems (Fig. 4), so as to emphasize the impending implications in relation to possible complications.

B) Surgical anatomy of critical structures

The cerebral venous system may be classified into two broad groups – the superficial and the deep.[5] The deep venous cerebral system drains blood centripetally away from the deep white matter, basal ganglia and diencephalon, finally terminating into the great vein of Galen. The superficial venous system drains blood from the outer 2 cm. of cortex and underlying white matter, ultimately emptying into one of the several dural venous sinuses. A series of anastomotic veins run along the lateral surface of the brain (Fig. 5), which connect the superficial venous cortical system to the major venous sinuses. Three veins are the largest of these veins, being named as the vein of Labbe, the vein of Trolard and the superficial sylvian vein. Together, they drain the region around the lateral sulcus and temporal lobe. The vein of Labbe (or inferior anastomotic vein) crosses the temporal lobe between the sylvian fissure and the transverse sinus. It generally arises at the midpoint of sylvian fissure, then travels inferior and posterior towards the transverse sinus. The vein of Trolard (or superior anastomotic vein) crosses the cortical surface of the frontal and parietal lobes, travelling between the superior sagittal sinus and the sylvian fissure. The superficial sylvian vein (or superficial middle cerebral vein) arises at the posterior end of the sylvian fissure, running anteroinferiorly along the fissure. It receives contributions from veins along the sylvian fissure before commonly anastomosing with the veins of Trolard and Labbe.[6]

The vein of Labbe drains blood from the lateral surface of the temporal lobe and from the region adjacent to sylvian fissure, terminating nearly always into the transverse sinus. In anatomical studies conducted by Koperna et al,[7] the vein was clearly defined in 82% of cadavers, while 18% cases displayed two equal caliber veins along the temporal lobe. The finding was confirmed by other authors as well.[6,8]

The vein of Labbe varies in caliber relative to the vein of Trolard and the superficial sylvian vein. De Chiro[8] conducted a study of 180 radiographic cases and reported that in majority of the cases, one of the two veins predominate, while occasionally the two have equal size. The vein of Labbe presented as the dominant vessel in 40% of the cases, while vein of Trolard was dominant in 32%, the superficial sylvian vein being predominant in only 8% of cases. Codominance of vein of Labbe and vein of Trolard was observed in 11% of the cases. Another important finding revealed by the study was that the vein of Labbe tended to predominate on the left (dominant hemisphere), while vein of Trolard tended to predominate on right (non-dominant hemisphere).

The segment of vein of labbe which runs on the surface of brain is susceptible to injury from maneuvers such as prolonged compression with subsequent venous thrombosis, or laceration of vein directly by retraction. Also, the bridging segment of the vein, as it turns under the temporal lobe, may be subject to avulsion or traction injury, while the intradural segment may be placed at risk during electrocoagulation. While the anatomy of bridging and intradural segments of vein may be quite variable, there are some clear relationships which the surgeon may use to avoid intra-operative injuries to vein of Labbe. In Koperna's study,[7] the vein was noted to reach the transverse sinus via one of the tentorial sinuses (73% of cases) or through a lacuna in the dura of lateral skull wall (23% of the cases). There was a distance of 7mm. (Fig. 5) between the entry of vein of Labbe and the entry of superior petrosal sinus into the transverse sinus. Also, the authors noted that the vein was adherent to the tentorium over a varying length of 3 to 23 mm. The distance from entry into tentorium to medial border of transverse sinus measured upto 11 mm., and from the entry into dura of skull wall to edge of sinus upto 15 mm. In reference to the superior sagittal sinus, the number and diameter of veins draining into the superior sagittal sinus, is greater in the anatomical region between the coronal suture anteriorly and the lambdoid suture posteriorly, as compared to the number and diameter of veins located anterior to coronal suture and posterior to lambdoid suture.[9] As a direct clinical inference, the anterior frontal region and posterior parietal-occipital regions are safer for surgical procedures as compared to the functional areas of brain situated between the coronal suture anteriorly and lambdoid suture posteriorly. Also, great care would be required in cases requiring surgical procedures on this central functional area to prevent serious postoperative sequelae.[9]

C) Clinical implications

The superior sagittal sinus, if taken posteriorly to the coronal suture, carries a high incidence of fatality.[4] Similarly, in cases where the vein of Labbe is the predominant vessel, while the vein of Trolard is atretic, injury to the vein of Labbe will likely result in death of the patient.[4] The scalp veins that are more inferiorly located in the temporal skull, and close to the ear, may put this bridging vein in jeopardy. Such risk can be assessed preoperatively with the help of investigations such as MRI, CT scan, PET-CT, MR angiography or conventional angiography.

D) Management of cerebral involvement

The criteria for resection of brain involvement by malignancy have been well described by Donald et al.[4] In their experience of skull base surgery cases at all sites, they have attempted a complete resection of involved noneloquent cerebral tissue invaded by malignant disease. The margin of safe resection is determined by the neurosurgeon, who also determines the extent to which the resection can be performed without significant neurological impairment.[4]

E) Reconstruction

The dura is repaired by the use of grafts of temporalis fascia (when available) or fascia lata. Bovine pericardium or Alloderm (Brachburg, NJ), or other alloplastic dural substitutes may be employed only in cases where the surgical field was not previously irradiated.[4] Complete effort is made to establish a water-tight seal. The calvarial resection is replaced by titanium mesh that is fixed to the bone with small titanium screws. Cutaneous defect is closed with a free flap taken from the rectus abdominis, the anterolateral thigh, or the latissimus dorsi. In some cases, the fat and subcutaneous tissue is too thick, so that the flap must be denuded down to the muscle, and the muscle is skin grafted. With time, the denervated muscle atrophies and flattens out to produce a more pleasing aesthetic result.[4]

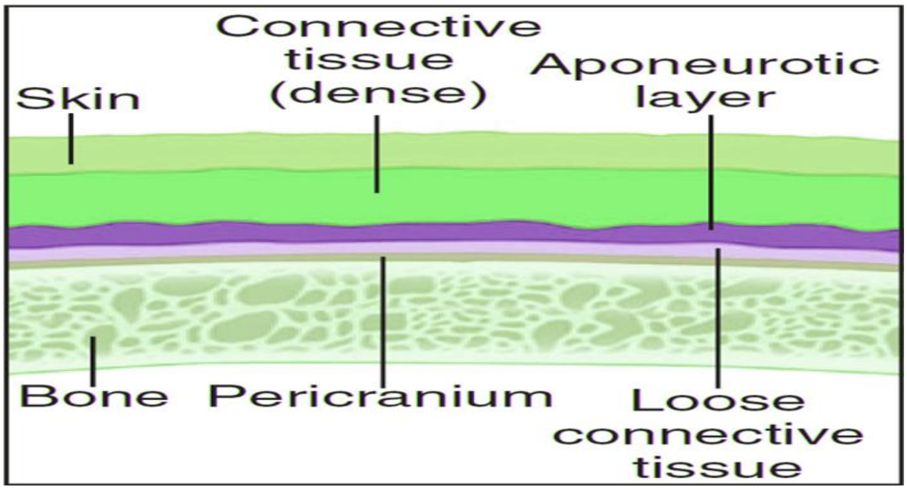

Fig. 1 : A schematic diagram illustrating the anatomy of scalp.

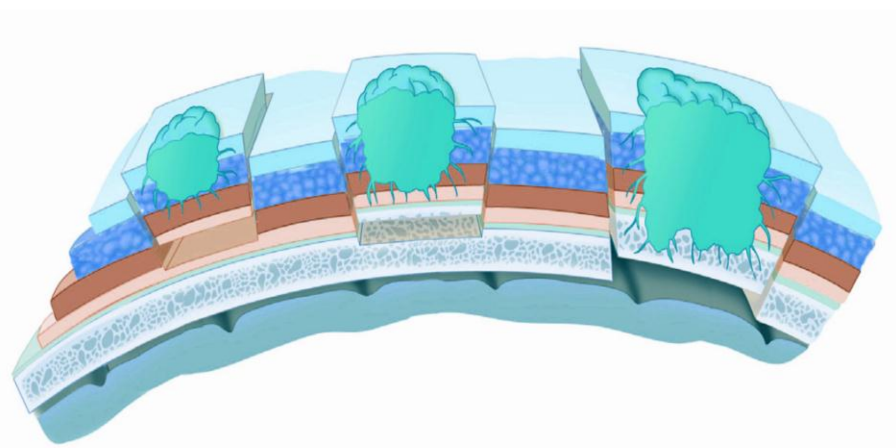

Fig. 2 : A schematic diagram illustrating the three types of surgical resection.

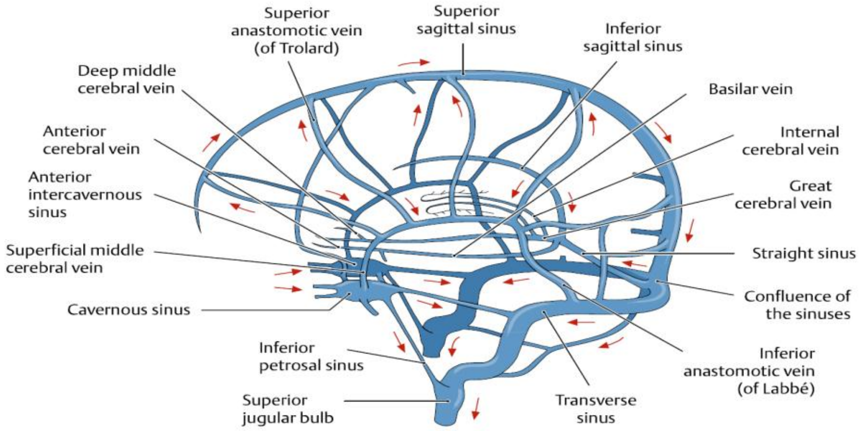

Fig. 3: Diagram illustrating the superior sagittal sinus and vein of Labbe.

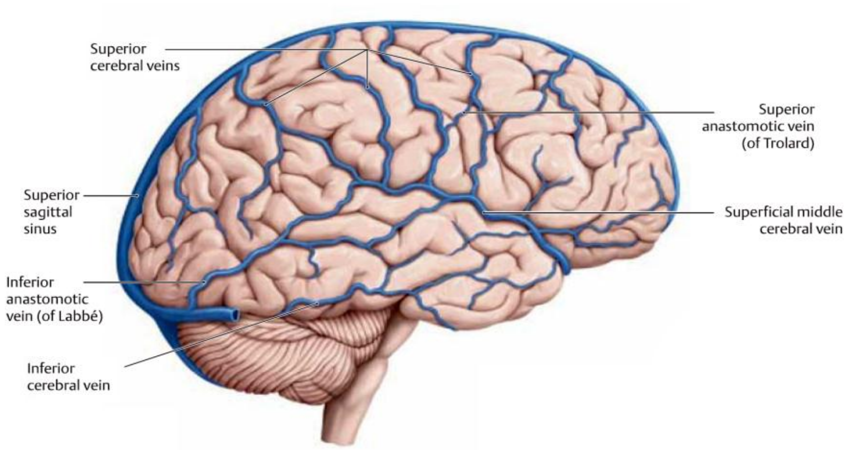

Fig. 4 : Veins on the lateral surface of cerebrum.

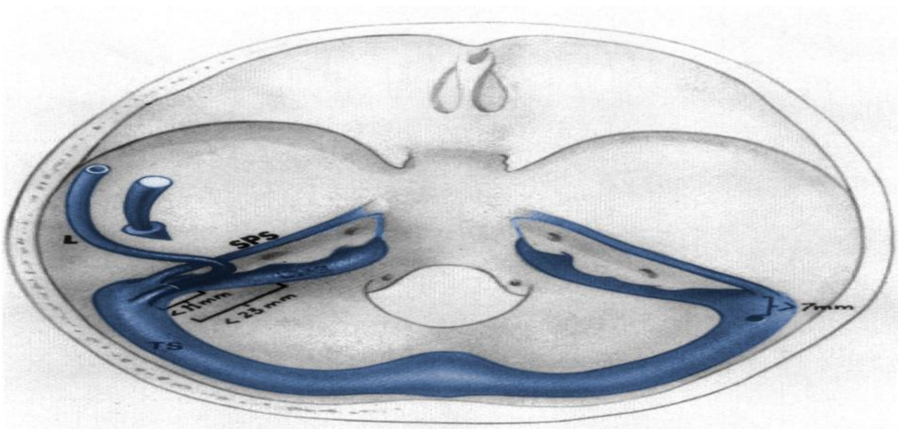

Fig. 5: Surgical anatomy of the vein of Labbe.

DISCUSSION

Various authors have reported their results of management of carcinoma arising in scalp, such as Aspoas,[10] Leedy,[11] Iblher,[12] etc. However, the study by Donald et al[4] has reported improved results even when the cancer invades dura and cerebral tissue. The authors reported a 2-year survival rate of 58.3% and local control rate of 77.8%. They emphasized the importance of applying interdisciplinary principles of skull base surgery to the management of deeply invading cancer of scalp.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests that could influence this work.

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