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COMPLICATIONS OF POSTERIOR FOSSA TUMORS SURGERY IN ADULT

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ABSTRACT

Background: More essential structures are located in the posterior fossa, which is less accessible than any other area of the body. Therefore, posterior fossa surgery necessitates extraordinary caution while touching tissue and special care to make it easier to access the tumor. **Patients and Methods:** This hospital based case-series study design includes 35 patients, 19 females and 16 males, they were admitted to the Surgical Subspecialties Hospital, during the period between January 2012 and December 2013, for having symptoms and signs of posterior fossa lesions, and were diagnosed as having brain tumors; all of them were older than 16 years. **Results:** Age group 21-30 years representing 40.0% of the sample 42.8% of them are males. As an immediate post-operative complications, Apnea is found in 2 patients (6.2%), the early post-operative complications include Aspiration pneumonia which found in 4 patients (12.5%), the 7th nerve palsy is reported in 4 patients (12.5%), and Cerebellar dysfunction is found in 2 patients (6.2%), while each of long tract signs, CSF leak, and Tension pneumocephalus are reported in only one patient (3.1%). The late complications and shows that wound infection is found in 3 patients representing (9.3%) and Meningitis is found in only 2 patients constituting (6.2%). Six patients (17.1%) that distributed as 3 (8.5%) patients died due to aspiration pneumonia, 2 (5.7%) patients died due to apnea, and only 1 (2.8%) patient died due to persistent unresponsiveness brain stem edema. **Conclusion:** Higher mortality was encountered among patients with midline tumors. The main cause of death following posterior fossa surgery was respiratory failure in the postoperative period. It is for this reason that the practicing neurosurgeon, whenever it is feasible and appropriate, may adopt other modalities of treatment, such as stereotactic radio-surgery.

KEYWORDS: Complications, Posterior Fossa, Tumors surgery, Adult.

INTRODUCTION

Since Cushing's time, significant advancements have been made in the treatment of malignancies of the posterior cranial fossa (PCF). While some lesions, such as astrocytomas, were surgically treatable even in the early days of neurological surgery, improvements in diagnostic imaging, microsurgical technique, nuero-anesthesia, and critical care medicine have decreased the operative mortality and morbidity associated with their removal.[1] Significant improvements in the long-standing prognosis for patients with even the most malignant tumors have been made possible by advancements in radiation and chemical therapy as well as greater understanding of the cellular, as well as, molecular biology of brain tumors. For instance, while the cerebellar medulloblastoma was always fatal in Cushing's initial collection of 61 patients, current 5-year survival rates for all patients approach 60.0%, and for some "good-risk" patients, they reach 80.0%.[1,2] At Johns Hopkins Hospital, Walter Dandy (1886–1946), Cushing's student, received his training. Dandy contributed significantly to a variety of areas of neurosurgery. Dandy created the pneumoencephalography technique using Luckett's accidental discovery of the ventricles' air following a skull fracture (PEG) Dandy was the first to demonstrate that auditory neuromas may be completely eliminated.[2,3]

More essential structures are located in the posterior fossa, which is less accessible than any other area of the body. Therefore, posterior fossa surgery necessitates extraordinary caution while touching tissue and special care to make it easier to access the tumor. Reduced intracranial pressure, proper patient positioning,

specialized anesthetic, and the application of microsurgical techniques are used to meet these requirements.[3-5]

PATIENTS AND METHODS

This hospital based case-series study design includes 35 patients, 19 females and 16 males, they were admitted to the Surgical Subspecialties Hospital, during the period between January 2012 and December 2013, for having symptoms and signs of posterior fossa lesions, and were diagnosed as having brain tumors; all of them were older than 16 years. The clinical variables that had been considered are age, sex, the duration of clinical history including the initial symptom at the beginning of illness such as those resulted from abnormally high intracranial pressure i.e. headache, vomiting, blurring of vision, and symptoms of gait disturbances, auditory complaints like tinnitus or hearing disturbances, symptoms related to motor weakness i.e. hemiparesis or quadriparesis, and symptoms due to cranial nerve involvement. Regarding to the symptoms at time of diagnosis by clinical examination in addition to radiological examination by CT scan or by MRl examination, these symptoms are same as the initial symptoms but different in it series.

The operative technique was documented with special attention to the following points, position of the patient whether sitting or prone, or lateral position, surgical incision whether midline, paramedian, hockey stick incision. The surgical procedure whether total, subtotal or a biopsy was taken, were recorded in a special format; samples collected during the surgical procedure were sent for histological analysis.

Post operatively, the patients were nursed at the intensive care unit for few days, when the patient's general condition became stable or had improved, they were sent back to their wards. The complications were subdivided into intra operative complications which were mostly vascular injury and brain stem edema and arrhythmia and postoperative complications. Patients were referred to Nuclear Medicine and Radiotherapy Institution for deep X- ray therapy (DXT) and/or chemotherapy. However, patients whose tumor was in a critical location such as in the brain stem and in whom surgical intervention was thought to carry a considerable morbidity were referred to the above institute without undergoing surgery. Therefore, though most of the tumors were histologically verified, the others were verified only radiologically. The morbidity and mortality were stated and discussed and the direct cause of death was mentioned.

RESULTS

Thirty five consecutive cases of adults (above 16 years) posterior fossa tumors that have been admitted, diagnosed and managed at Surgical Sub-specialties Hospital through the period Jan.2012_Dec.2013

I- Age and Sex

Figure (1) shows the distribution of study sample according to age groups and gender and demonstrates that 14 patients are found within age group 21-30 years representing 40.0% of the sample 42.8% of them are males. Three (8.5%) patients are present in the 16-20 and in 51-60 years; 7 (20.0%) patients for each age group 31-40 and 41-50 3 patients, the rest of patients is 1 (2.8%) in age group above 60 years. In 35 patients included in this series, 19 patients (54.2%) are females and 16 patients (45.7%) are males.

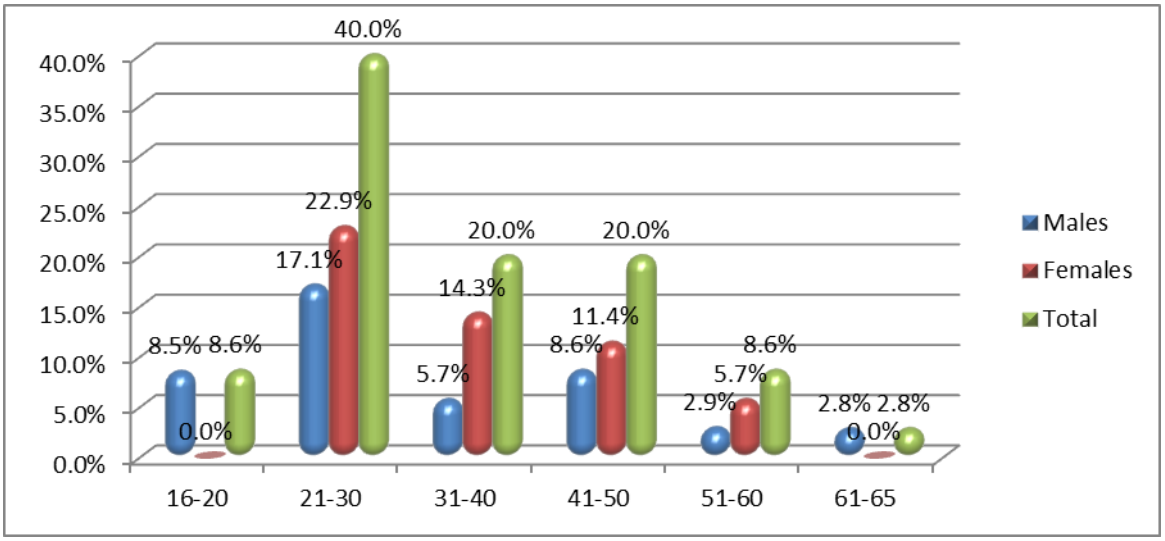

Figure (1): The distribution of study sample according to age groups and gender.

II- Initial symptoms

Figure (2) demonstrates the initial symptoms which have been described and recognized by the patients initially and shows that 60.0% (21 patients) of the initial symptoms are those of raised ICP, i.e. headache, vomiting, and blurring of vision; 17.1% (6 patients) complained of unsteady gait as their initial symptom, 8.5% (3 patients) complained hearing abnormalities, Tinnitus 5.7% (2 patients); 5.7% (2 patients) motor

weakness, one patient (2.8%) disturb level of consciousness and 2.8% (one patient) slurred speech.

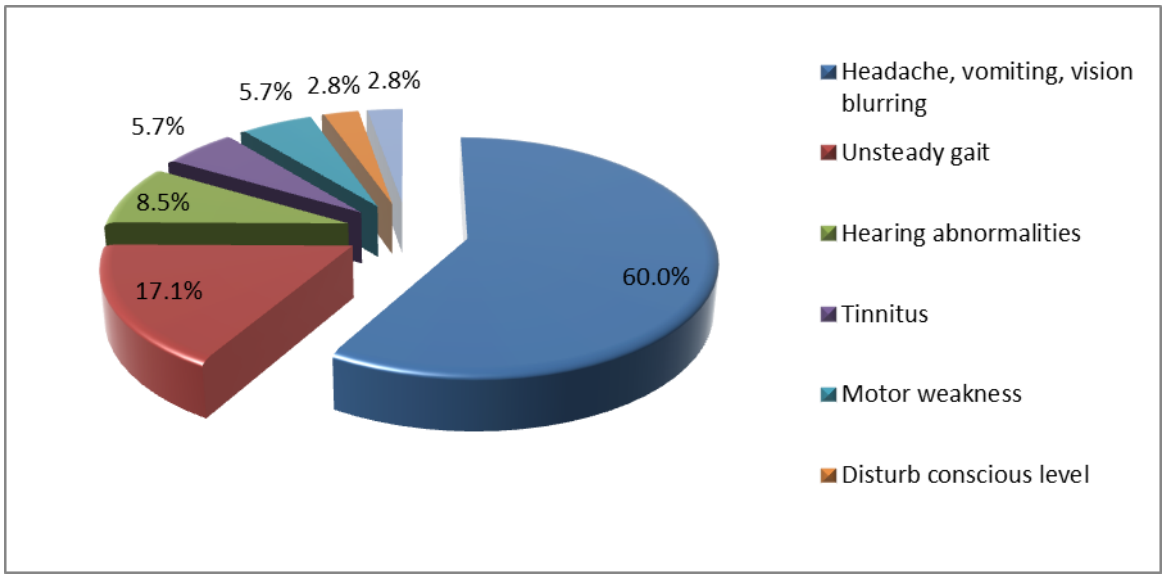

Figure (2): The initial symptoms which have been described.

III- Signs found in this study the patients:

Table (1) Clinical examination of the patients revealed papilloedema in (22) patients (62.8%), nystagmus in (17) the patients (48.5%), dysmetria & dysdiodokienesia in (15) patients (42.8%), intentional tremor in (10) patients (28.5%), Cranial nerves as following: VIII (7) patients (20.0%), VII (4) patients (11.4%), V(4) patients (11.4%), VI (3) patients (8.5), IX,X,XII (4) patients (11.4%), motor weakness (7) patients (20.0%), optic atrophy (1) patient (2.8%).

Table (1): Clinical examination of the patients.

Signs	Frequency	Percentage
Papilloedema	22	62.8
Nystagmus	17	48.5
Dysmetria & dysdiodokinesia	15	42.8
Intentional tremor	10	28.5
Cranial nerve		
VIII	7	20.0
VII	4	11.4
V	4	11.4
VI	3	8.5
IX,X,XII	4	11.4
Motor weakness	7	20.0
Optic atrophy	1	2.8

IV- Surgical /Radiation therapy

Figure (3) demonstrates the types of treatment and shows that 32 patients (91.5%) underwent appropriate sort of surgery, while only 3 patients (8.5%) are treating without surgical intervention; patients who underwent surgery are classified into groups according to the type of surgery; 5 patients (14.2%) (out of total of 35 case) have suboccipital craniectomy preceded by CSF shunting, followed by radiotherapy, 9 patients (25.7%) have been operated upon either by shunting or suboccipital craniectomy followed by radiotherapy, 2 patients (5.7%) are shunted and then operated upon by suboccipital craniectomy without referral to the radiotherapy, 15 patients (42.80%) are treated surgically just by suboccipital craniectomy without radiotherapy nor shunting, one patient (2.8%) has only shunting , because he died before further management step.

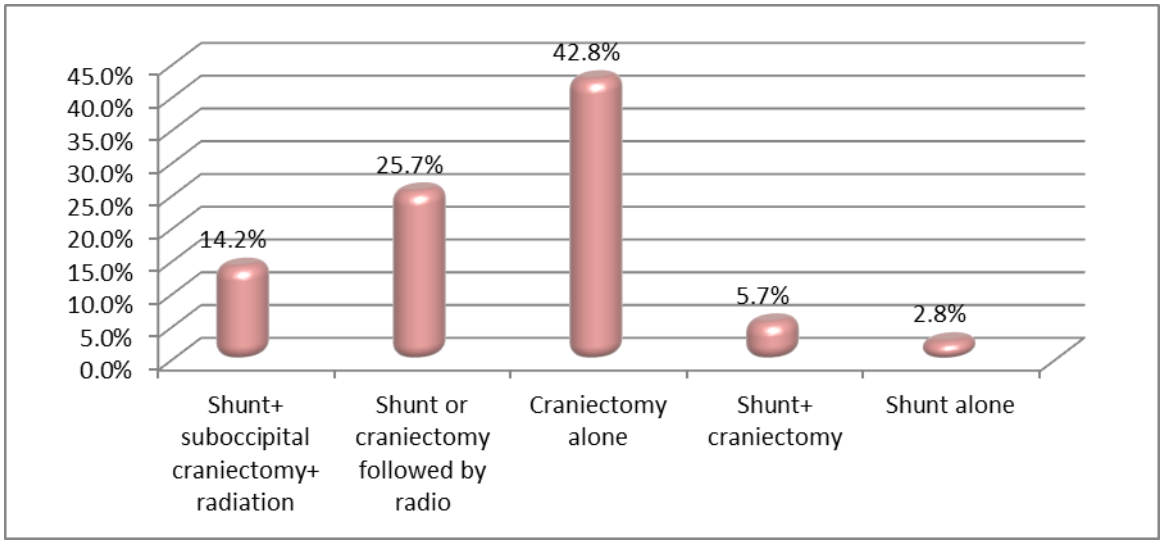

Figure (3): The types of treatment.

Figure (4) demonstrates the types of incisions that are used in sub-occipital craniectomy (27cases) and displays that midline incision done in 12 patients (44.5%), para-median incision in 12 patients (44.5%) for CPA lesions. Hockey - stick incision for CPA lesions in 3 patients (11.1%).

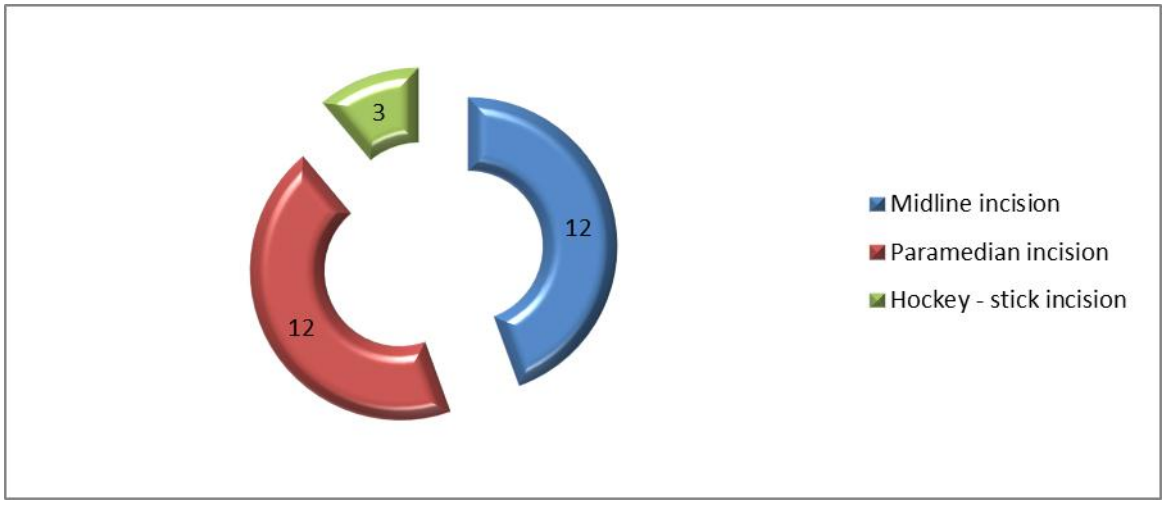

Figure (4): The types of incisions that are used in sub-occipital craniectomy.

V- Complications (32 patients)

Intra-operative complications

Table (2) demonstrates the frequency of injury of vertebral artery during surgery with resultant severe bleeding and hypotension and shows that bradycardia and arrhythmia due to manipulation near the brain stem found in 3 patients (9.3%). Massive swelling & cerebellar herniation occur in 2 patients (6.2%), while each of hemorrhage and hypotension found in 1 patient (3.1%).

Table (2): The frequency of injury of vertebral artery during surgery with resultant severe bleeding and hypotension.

Intra-operative complications	Frequency	Percentage
Bradycardia arrhythmia	3	9.3%
Massive swelling & cerebellar herniation	2	6.2%
Hemorrhage	1	3.1%
Hypotension	1	3.1%

Postoperative complications

Immediate post-operative complications

Table (3) demonstrates the immediate post-operative complications (<6hours) and shows that the Apnea is found in 2 patients (6.2%) (Due to lower cranial nerves injury IX and X during surgical manipulation and

maintained on ventilator respiration). Moreover, Unresponsiveness is noticed in also 2 patients (6.2%).

Table (3): The immediate post-operative complications.

Immediate post-operative complications	Frequency	Percentage
Apnea	2	6.2%
unresponsive	2	6.2%

Early post-operative complications (within 72 hours)
Table (4) demonstrates the early post-operative complications and shows that Aspiration pneumonia is found in 4 patients (12.5%) (Because of dysphagia and cough reflex impairment), the 7th nerve palsy is reported in 4 patients (12.5%), and Cerebellar dysfunction is found in 2 patients (6.2%), while each of long tract signs, CSF leak, and Tension pneumocephalus are reported in only one patient (3.1%).

Table (4): The early post-operative complications.

Early post-operative complications	Frequency	Percentage
Aspiration pneumonia	4	12.4%
7th palsy	4	12.4%
Cerebellar dysfunction	2	6.2%
Long tract sign	1	3.1%
Tension pneumocephalus	1	3.1%
C.S.F leak	1	3.1%

Late complications (>3 days until patient leave the hospital):
Table (5) demonstrates the late complications and shows that wound infection is found in 3 patients representing (9.3%) and Meningitis is found in only 2 patients constituting (6.2%).

Table (5): The late complications.

Late post-operative complications	Frequency	Percentage
Wound infection	3	9.3%
Meningitis	2	6.2%

Figure (5) shows the total number of patients died at hospital was 6 patients (17.1%) that distributed as 3 (8.5%) patients died due to aspiration pneumonia, 2 (5.7%) patients died due to apnea, and only 1 (2.8%) patient died due to persistent unresponsiveness brain stem edema.

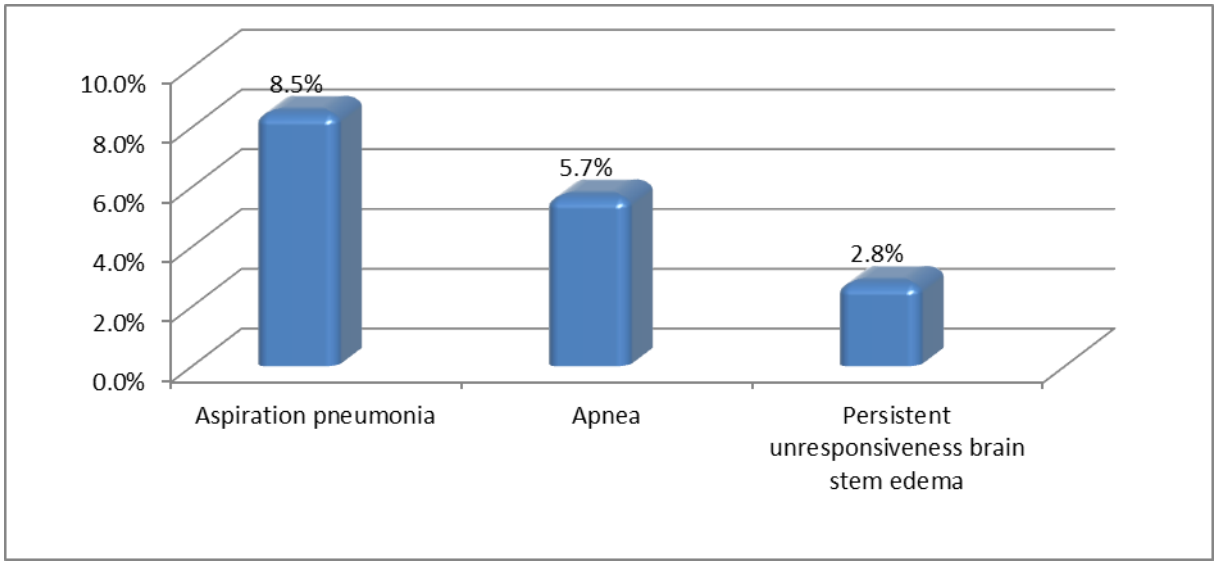

Figure (5): The total number of patients died at hospital.

DISCUSSION

According to its neuronal tissue composition, the PCF is a significant and crucial part of the cranium. It contains the ascending and descending motor and sensory pathways, respiratory and cardiac centers in the medulla oblongata, and many other structures that are vital for maintenance of a healthy life. Neoplastic lesions, whether benign or malignant, as those described in this study, can pose a serious threat to life in this region.

All of the cases were beyond the age of 16, and 40.0% of them were between 21 and 30 years. This supports the findings of Salih Adham's study of adult infratentorial tumors conducted in 2001.

A ratio of roughly 1.4:1 was observed, with female patients accounting for 57.2% of all patients and male patients accounting for 42.8%; the female predominance observed in meningioma, auditory neuroma, and epidermoid tumors was evident and consistent with the literature.[6-8] Brain stem gliomas, medulloblastomas, and cerebellar astrocytomas do not exhibit a sex preference.[9-11]

Although 31.4% of the cases were identified within a month of the symptoms' onset of, 61.9% of cases were identified between one and twelve months later. The medical staff's lack of clinical awareness, the patients' families' ignorance, and the absence of appropriate inquiry are the three most significant preventable factors for the delay in the diagnosis. In order to prevent this situation of diagnostic delay, a high indicator of suspicion is required, and the neurodiagnostic instruments, especially the MRI should be accessible across the nation.

The main benefits of the sitting posture are improved CSF and venous drainage, good exposure, especially for midline lesions; however, there are three known concerns that may be present, including hypotension, air embolism, and pneumocephalus with postoperative intracranial hypertension. In people with hypertension or artery disease, it should be avoided.[12]

Deep-seated lesions in the PCF can be treated with the CPA, petrous apex, or clivus, among other methods. The authors prefer the suboccipital-transmeatal method over the translabyrinthine, middle fossa, translabyrinthine-transtentorial, and subtemporal-transtentorial procedures when it comes to operating on the CPA.[13]

The internal auditory canal and its surrounding areas can be directly reached anatomically using the translabyrinthine approach to CPA malignancies and its modifications, transcochlear and retrosigmoid. The facial nerve is located distal to the tumor before the tumor is found, and exposure is made easier by bone removal rather than cerebellar traction. After navigating the labyrinth, the operated ear is deafened completely. As a result, this strategy should only be used for CPA lesions that cannot be treated with a hearing-conserving treatment. Translabyrinthine surgery's intrinsic risk of total hearing loss is still a drawback for it.[13,14] The surgical access for a hitherto (unresectable lesions) made possible by these and other methods.

Operative methods for tentorial meningioma

1. Subtemporal tumors should be approached subtemporally if they project from the lateral, as well as, middle portions of the tentorium into the supratentorial partition.
2. Suboccipital and retrosigmoid approaches; infratentorial methods are best for tumors located laterally and protruding inferiorly.
3. Presigmoid and posterior subtemporal approaches combined.[15]

Regarding the 35 patients involved in this study, we can say that

1- 17 patients (48.5%) received radiotherapy; of these 17, 14 patients experienced some type of surgical procedure followed by radiotherapy; these patients had astrocytoma, medulloblastoma, brain stem glioma, and some cases of subtotal removal (of meningioma, acoustic neuroma), & secondary metastasis (2 patients); the remaining 3 patients had secondary deposition (Prior to radiation, the other secondaries deposition perished) 2-18 individuals (51.5%) with benign tumors resembling auditory neuromas received no radiation treatment.

The clinical picture of "midline syndrome," a rise in ICP without lateralizing signs, is superimposed onto those signs caused by the destructive and compressive actions of the tumor, even while the neoplasm alone causes symptoms and signs.[15,16]

The precraniectomy shunting for hydrocephalus complicating infratentorial tumors provides the patient a significant margin of safety from the negative effects of cerebral edema, papilloedema, and rapid decompression of both the supra - and infratentorial compartments when the tumor is removed without previous shunting. "Upward herniation" is a real, although very rare (3.0%) complication, and there is no enough statistical verification to support the theoretical concept that "seeding" may occur along the shunting system or that this latter event increases the risk of systemic metastases from medulloblastoma or ependymoma [16]. It is debatable how to manage hydrocephalus when it coexists with a cerebrellopontine angle tumor; it is generally accepted that treatment of the hydrocephalus should begin before definitive surgery. However, there is so much evidence that complete excision of CPA tumors might lead to resolution of hydrocephalus without requiring other methods of CSF decompression.[17] The PCF tumors and brain stem may block the III ventricle, the IV ventricle, or its outlet foramina of Luschka and Magendi, or may obstruct intrinsically, or compress extrinsically, the aqueduct of Sylvius. The quadrigeminal and/or ambient cistern, the main routes of CSF

circulation may be occluded. It is not always possible to ascertain with precision the specific nature of hydrocephalus, or to predict in which patient the hydrocephalus will remain as a permanent condition even after the associated tumor, benign or malignant, is totally removed.

Accordingly, many surgeons have recommended routine placement of a single occipital burr hole prior to opening the posterior fossa, so that the ventricular system could be punctured to decompress the enlarged ventricles. The two obvious disadvantages of this procedure are uncertain decompression and increased risk of subdural bleeding secondary to rapid decompression. With the increase in diagnostic techniques that permit the preoperative diagnosis of the associated hydrocephalus, the neurosurgeons began to suggest the insertion of shunting device before proceeding with a craniectomy directed toward the definitive treatment of the tumor. In this study CSF shunting was the first procedure to be done in patients with infratentorial tumors combined with hydrocephalus.

Several paybacks have been given in support of the use of shunting device before the definitive craniotomy.[16]

1. Compensating the ICP by inserting a shunt allows adequate time for stabilization of the intracranial contents, particularly cerebral blood flow and diminution of cerebral edema secondary to the hydrocephalus.
2. At surgery, the operative field is slack, thus easing the approach to the tumor and eliminating the need for hypertonic solution, steroids, ventricular cannulation, or continuous spinal drainage.
3. It improves the trunk and gait ataxia.
4. It converts an urgent tumor operation to a planned elective procedure.
5. It provides a margin of safety during the first several post operative days, protecting the patient from obstructed hydrocephalus related to swelling in the tumor bed or adjacent cerebellum.[16]

Significant regression of papilloedema was noted several days to 2 weeks after the insertion of the precraniectomy shunt. It may take as long as 2 months for papilloedema to disappear. Shunting should be done in all cases of advanced hydrocephalus due to solid tumors and in all tumors that invade the fourth ventricle, where adequate CSF circulation is unlikely to be established during PCF surgery.[16,17]

In this study, 12 patients were shunted (V-P shunt) (34.6%), some of them were the only surgical procedure.

Corticosteroid therapy with Dexamethasone, or an equivalent drug, has proved to be beneficial in preparing patients with posterior fossa tumors, in performing the actual resection and in managing them postoperatively.

Complications related to surgery within the PCF and CPA may be divided into 2 distinct groups, those occurring during surgery, those occurring during the post-operative period. The complications that occur during surgery (Hypotension, Dysrrhythemia, Hemorrhage, Tension pneumocephalus): Considering hypotension, adoption of the sitting position can impose a considerable disability on the circulating system with impairment of vasomotor stability produced by drugs given before and during anesthesia. Although auto regulation maintains a normal cerebral blood flow in spite of falls in blood pressure, there is a lower limit of arterial pressure below which this mechanism fails. To minimize falls in blood pressure, the sitting position should be adopted gradually.[18,19] This complication has been faced in one case during adoption of sitting position in this study. It was corrected by I.V. fluid and changing anesthetic drugs, and catecholamine treatment. Although air embolism was not recorded in these cases (this is may be explained by the low sensitive monitoring devices used for the detection of it. Still the high sensitive devices pericardial Doppler and trans-esophageal ECG not available in the neurosurgical hospitals).

The early signs of air embolism are a fall in blood pressure and a rise in pulse rate; treatment must be immediately instituted. Ingress of more air into the circulation should be prevented either by closing the open vein or by flooding the operative site with saline the patient should be given 100 percent oxygen, for in the presence of nitrous oxide an air bubble in the circulation will increase in volume three or four fold. Whilst in theory the patient should be positioned flat and on his left side minimize the danger of air entering the right ventricular outflow tract. If a right arterial catheter is in place air can be aspirated from the heart.[18-20]

Some other problems encountered operatively are due to stimulation of the vital centers caused by retraction of the medulla or mid brain or stimulation by electro coagulation. The cardiovascular center is in the gray matter of the floor of the fourth ventricle, hypertension and bradycardia or other dysrrhythmias may occur when the peri-ventricular gray area is stimulated. This complication mostly occurs when the surgeon is operating near the pons. Direct stimulation of the vagus, will cause severe bradycardia, and stimulation of the trigeminal nerve hypotension [21- 23]. Stimulation of trigeminal nerve leads to trigeminocardiac reflex (TCR), a well-known phenomenon that includes of bradycardia, arterial hypotension, apnoea, and gastric hypermotility, might occur during manipulation of the central part of the trigeminal nerve when performing surgery in the CPA61

The closeness of the tumor near many cranial nerves and to the vital centers of the brain results in operative removal having a high morbidity and mortality.[23,25] The apneustic center (APC) which is the normal inspiratory cut off mechanism and the dorsal group of neurons

responsible for the initiation of rhythmic breathing, are situated near the cardiovascular center.[25] If these are damaged, the patient will not or breathe insufficiently, these effects may be permanent from direct trauma or temporary due to oedema resulting from injury to adjacent tissues. As the two centers are adjacent, any injury to one is likely to affect the other.

A continuous record of pulse rate, BP and ECG is an effective method of monitoring brain stem function during surgery and provides a warning of the brain stem function being compromised.Tension pneumocephalus had occurred in one patient in this series. During surgery, CSF drainage and the combination of steroid, mannitol and hypocapnia reduce brain bulk and thus air enters and replaces the CSF in the ventricles and subarachnoid space.

During the recovery, brain bulk increases due to oedema formation, hypercapnia and reformation of CSF, thus air is trapped between the arachnoid and dura mater comes under increasing pressure. Pneumocephalus may present sometimes after the end of surgery (delayed return of consciousness with some deterioration in neurological state).[24] Respiratory failure is one of the most crucial post operative complications following posterior fossa surgery presenting as complication of chest infection (or aspiration pneumonia) within the few postoperative days, or directly post operative at the same time presented as sudden apnoea. This can be due to a variety of pathological changes which can affect the respiratory center including pressure from oedema and ischemia following trauma to delicate vasculature or the lower cranial nerves IX and X which result in impairment of swelling and loss of protective laryngeal and cough reflexes with increasing risk of aspiration pneumonia and if sever enough, respiratory failure; these complication had occurred in four patients in this study.

The palsy of cranial nerve might develop with significant clinical effects; VII nerve palsy had occurred in 4 patients (12.5%) patients in this study with impairment of eye closure, the eye was protected from ulceration by tarsorrhaphy.

Facial nerve palsy is a recognized complication in surgery on acoustic neuroma and CPA meningioma especially in those with large tumors. It is the result of either anatomical interruption of the nerve or more frequently its contusion. The most widespread microsurgical complication in Voss NF et al review of 40 patients with CPA meningioma managed surgically was facial nerve dysfunction 30.0% and the facial nerve function preservation correlates with tumor size.[18]

It is important to differentiate between anatomical and functional preservation of facial nerve, even when the nerve has been preserved in continuity, it is not uncommon to have complete facial palsy postoperatively. This is a consequence of oedema, traction injury or ischaemia of the nerve [22]. One patient developed CSF collection subcutaneous below the incision wound & was treated successfully by therapeutic lumbar puncture. The overall cases mortality in this study was 6 cases (17.1%) and the operative mortality following suboccipital craniectomy was 5 patient (14.2 %), the most of patients were female about 4 patient, 2 patients were male, higher mortality was encountered in patients with midline lesion (3 patients), 2 patients died with CPA lesions.

Now, with the progressive improvement in diagnosis with MRI and the surgical techniques, it is possible to identify tumors in an early stage, and to remove them with micro neurosurgery with a lower mortality rate and complications.

CONCLUSIONS

There was a female predominance among most of the tumors.

The most common tumors in this series of 35 cases of infra tentorial tumors, in the period Jan 2012_Dec 2013, in a decreasing frequency were acoustic neuronal, secondary.

Higher mortality was encountered among patients with midline tumors. The main cause of death following posterior fossa surgery was respiratory failure in the postoperative period. It is for this reason that the practicing neurosurgeon, whenever it is feasible and appropriate, may adopt other modalities of treatment, such as stereotactic radio-surgery.

CSF diversion as a preliminary procedure prior to sub occipital craniectomy improves the neurological and general conditions of the patient, facilitates surgical planning, and provides comfortable tissue manipulation.

Radical total or subtotal tumor resection followed by conventional radiotherapy is the mainstay treatment modality done in many patients with infratentorial tumors.

Recommendations

Clinical awareness of infratentorial tumors is of highly importance in order to avoid the delay in the management, which in turns will affect the prognosis.

It is recommended that the MRI should be the investigation of choice in infra tentorial lesions.

The medical and nursing team caring for such patients should be aware of the possibility of pre- and post-operative pulmonary complications that may affect the outcome.

CSF diversion as a preliminary procedure prior to sub occipital craniectomy improves the neurological and general conditions of the patient.

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