Med. J. Cairo Univ., Vol. 62, No. 1, March: 93 - 99, 1994

Intracranial Pressure Monitoring After Posterior Fossa Surgery

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Abstract

After posterior fossa surgery, hydrocephalus may persist or evolve. Proper management of this complication requires timely detection. Postoperative intracranial pressure monitoring has been used in ten patients harboring posterior fossa tumours. Only two patients ultimately had to be shunted. This tool has proved to be safe and reliable for early detection and management of persistent hydrocephalus following posterior fossa surgery.

Introduction

OBSTRUCTIVE hydrocephalus may persist or evolve after surgery for posterior fossa tumours [1].

Proper management of this complication requires timely detection. Shunting may be necessary prior to definitive tumour surgery in order to reduce dangerously elevated intracranial pressure and improve the patient's general condition [2].

Less attention has been given to the systematic management of evolving postoperative hydrocephalus. A short period of external ventricular drainage may help to identify those patients who will require cerebrospinal fluid diversion. One must otherwise rely on clinical observation or serial radiographic studies. As an alternative we have recently begun to use intracranial pressure (ICP) monitoring to facilitate postoperative management of selected patients who are at risk for developing hydrocephalus, such as those with preoperative ventriculomegaly, those with midline tumours or following subtotal excision. From the stand point of postoperative care, it is desirable to avoid shunts in those patients, whose hydrocephalus has been effectively relieved by tumour removal in order to avoid the general complications of shunts, like shunt malfunction, infection or cerebrospinal fluid ascitis etc. [3].

The most important benefit of intracranial pressure monitoring is derived from the fact that intracranial hypertension com-

monly precedes clinical deterioration. Intracranial pressure monitoring in the postoperative period provides valuable information concerning the pathophysiological changes that occur, how the intracranial tension in this period develops and it allows one to predict and prevent complications long before the classical signs become evident [4].

Monitoring is the only mean by which therapy can be selectively employed for those patients who require it. Monitoring also provides prognostic information, as mortality correlates with the level of intracranial pressure and poor outcome can be predicted when intracranial pressure is unresponsive to therapy [5].

Material and Methods

The study protocol was approved by the Research Review Board of Cairo University Medical School. Written informed consent was obtained from each patient. The study population was composed of ten patients, aged 4-56 years with midline, paramedian or lateral posterior fossa tumours associated with hydrocephalus. No cerebrospinal fluid diversion was done preoperatively. The patient's characteristics are shown in table (1).

Careful neurological examination, routine preoperative anaesthetic evaluation, laboratory investigations as well as radiological studies were performed for each patient. Medical decompression in the form of corticosteroids was given to all patients preoperatively and continued for 48 hours in a dosage of 0.5 mg/kg/day in 4 divided doses. All the patients were nursed in the sitting position.

Preoperative medication that produce sedation or ventilatory depression was avoided in all patients.

Induction of anaesthesia was achieved with drugs that produce rapid and reliable anaesthesia with minimal effects on cerebral blood flow. This goal was achieved with the intravenous injection of thiopental (5 mg/kg) preceded by preoxygenation and voluntary spontaneous hyperventilation. Thiopental was followed by the administration of vecuronium in a dose 0.1 mg/kg.

Intubation of the trachea by direct laryngoscopy was carried out after an adequate depth of anaesthesia as well as complete skeletal muscle paralysis was achieved. Intravenous lidocaine 1.5 mg/kg was administered about 1 minute before beginning direct laryngoscopy to attenuate the increased blood pressure and intracranial pressure which may accompany intubation of the trachea.

Mechanical ventilation of the lungs was instituted after the administration of muscle relaxants with the goal of reducing the arterial partial pressure of carbon dioxide to between 25-30 mmHg.

Anaesthesia was maintained with nitrous oxide 70% and oxygen 30% supplemented by fentanyl in a dose of 5 ug/kg. Halothane was administered in a low concentration (0.5%) to prevent increases in blood pressure related to noxious surgical stimulation.

Mannitol was given in dose of 0.25 gm/kg followed by furosemide in a dose of 0.5 mg/kg to decrease the intracranial pressure during surgery.

Lactated Ringer's solution was given at a rate of 2 ml/kg/hour.

The following monitoring systems were applied to all patients:

- Routine ECG LII for heart rate and rhythm

- Direct invasive blood pressure monitoring through radial artery cannula.
- Blood gases and serum electrolytes measurements were performed as often as needed.
- Urine output was measured by insertion of a urinary catheter connected to a calibrated urine collection bag.
- C.V.P. monitoring was achieved by the aid of a drum catheter inserted in the right atrium via the right cephalic vein.
- Continuous monitoring of intracranial pressure was done intraoperatively and for 48 hours postoperatively by the following method (Fig. 1):

After the patient was stabilized and prior to positioning (sitting position), a left posterior parietal straight 3 cm long scalp incision was done. The burr hole matched with the site of the extradural bolt to ensure accurate and reliable readings. Several precautionary measures were taken. The burr hole was performed at a right angle to the dura, blood debris or bone dust were removed and proper hemostasis ensured before insertion of the transducer coplanar with the dura. The skin overlying the device was closed in two layers.

The monitoring system was calibrated before insertion. A direct minute to minute digital reading for the measurement of intracranial pressure appeared in mmHg on the screen of an S & W pressure monitor.

The patients were nursed in the neurosurgical intensive care unit during the postoperative period in the semi-sitting position with the head elevated 45° from the horizontal plane for 48 hours under close observation (Fig. 2).

Ambulation was only possible after removal of the transducer. C.T. scans were done postoperatively (Fig. 3) and showed hydrocephalic changes in 3 patients, pneumocephalus in two patients, oedema in one and a small negligible posterior fossa haematoma in the tumour bed in another patient.

The aim of the surgeon was the decompression of the posterior fossa contents with establishment of the cerebrospinal fluid flow, wether total or even subtotal excision was achieved.

Results

In the immediate postoperative period all intracranial pressure recordings were below 8 mmHg and gradually went up in the first 6 to 10 hours to reach a level of 15 mmHg. The pressure remained steady thereafter. Whenever the patient strained, coughed or changed position during nursing manuoevers the pressure rose by about 3-4 mmHg and returned back gradually to the original level. In the second postoperative day the readings did not exceed 20 mmHg, however, in the sitting position a marked drop in the readings reaching down to 3 mmHg occurred (Fig. 4).

Case No. 4 was an example for a midline posterior fossa tumours and preoperative moderate hydrocephalus. Only subtotal excision was achieved with establishment of cerebrospinal fluid from the aqueduct of Sylvius. The recordings reached 20 to 25 mmHg in the first 8 postoperative hours, with the patient remaining fully conscious. Dehydrating measures were given without response. A control C.T. scan showed the presence of both hydrocephalus and pneumocephalus. As soon as the patient showed a deterioration of the level of consciousness an immediate ventricular tap was done and the recordings returned

back to the normal postoperative levels (around 15 mmHg). A ventriculosubgaleal drainage to the cerebrospinal fluid was first resorted to, followed later by a right ventriculoperitoneal shunt (Fig. 5).

The patient No. 8 had a laterally located posterior fossa tumour and moderate hydrocephalus. Inspite of the total excision of the tumour with the C.S.F. flow established the intracranial pressure readings reached 18 mmHg in the immediate postoperative period. The patient was fully conscious, complaining of headache and had repeated vomiting. A follow up C.T. scan revealed persistence of the hydrocephalic changes, same degree as preoperative. This mandated the appliance of a shunt device which was readily available (Fig. 6).

Case No. 6 showed a rise in the intracranial pressure which responded dramatically to medical decompression in the form of corticosteroids. With the intracranial pressure normalizing there was no need for cerebrospinal fluid diversion. C.T. scan showed resolvement of the local oedema in and around the tumour bed (Fig. 7).

Contrary to the previous three patients case No. 7 had normal intracranial pressure recordings with a depressed level of consciousness. On doing a C.T. scan a small posterior fossa haematoma was found in the tumour bed. An urgent ventricular tap revealed normal tension and evacuation of the haematoma did not save the patient. This single mortality was attributable to primary brain stem injury (Fig. 8).

Table (1)

No.	Age (Yrs)	Sex	Site of tumour	Degree of hydrocephalus	Amount of excision	Pathology
1	11	M	Midline	Moderate	Total	Ependymoma
2	13	M	Midline	Mild	Total	Astrocytoma
3	50	F	Paramedian	Mild	Subtotal	Astrocytoma
4	11	M	Midline	Moderate	Subtotal	Ependymoma
5	30	M	Paramedian	Moderate	Total	Medulloblastoma
6	56	M	Paramedian	Moderate	Total	Deposit
7	8	F	Midline	Moderate	Total	Ependymoma
8	35	F	Lateral	Moderate	Total	Medulloblastoma
9	4	M	Midline	Moderate	Subtotal	Medulloblastoma
10	23	M	Lateral	Moderate	Total	Medulloblastoma

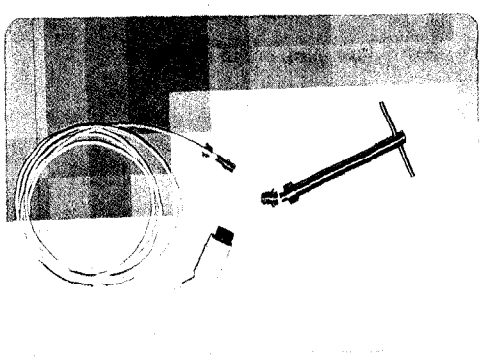

Fig. (1): Showing the different parts of the extradural transducer set used.

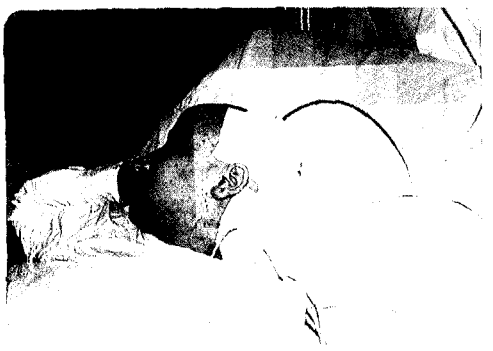

Fig. (2): Showing the patient in the post-operative period with the ICP monitor applied.

Fig. (3): Showing a postoperative scanogram of a control C.T. scan. The extradural transducer in place with evident pneumocephalus and the craniectomy.

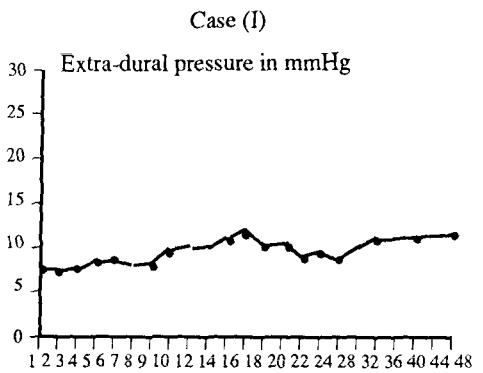

Fig. (4): Normal curve of intra-cranial pressure in the post-operative period

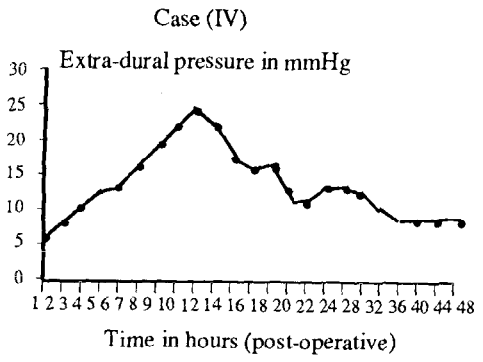

Fig. (5): The curve shows high pressure and the CT scan showed hydro-pneumocephalus.

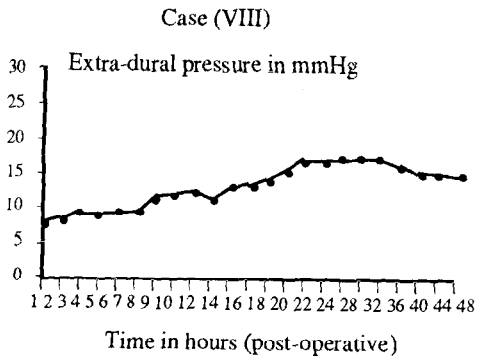

Fig. (6): The curve was steady high with repeated vomiting CT scan revealed persistent hydrocephalus.

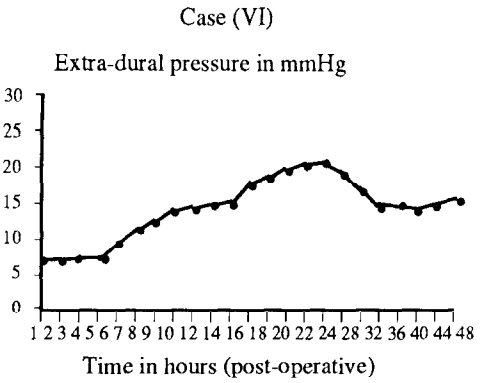

Fig. (7): High intra-cranial pressure curve and CT scan showed brain oedema.

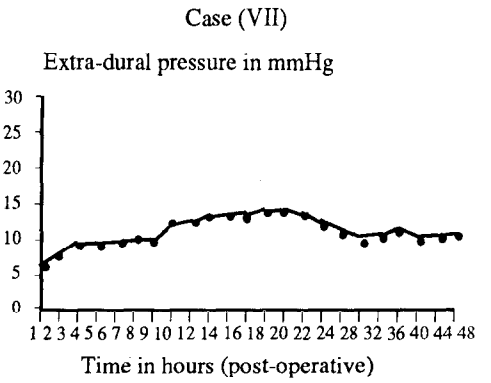

Fig. (8): Normal intra-cranial pressure curve. CT scan showed small posterior fossa haematoma and hydro-pneumocephalus.

Discussion

This study has proved that intracranial pressure monitoring is a very effective tool for the early recognition and management of evolving postoperative hydrocephalic changes which is a potential problem following posterior fossa surgery.

Albright and Riegel found that 8 out of 47 children undergoing posterior fossa tumour surgery required a shunt before leaving the hospital [6]. This experience has been shared by other authors with 19-23% of patients requiring a shunt for hydrocephalus following tumour surgery [7,8].

Three of our patients showed a rise in the intracranial pressure recording 6-8 hours postoperatively. One resolved by medical decompression while the other two ultimately had to be shunted.

From the standpoint of postoperative care, we believe it is desirable to avoid shunts in those patients whose hydrocephalus has been effectively relieved by tumour removal.

The use of external ventricular drainage has been mentioned. A major disadvantage of this technique is that it can only be used for a limited period postoperatively [2].

In our series we resorted to a prolonged temporary sterile method of cerebrospinal fluid diversion to the subgaleal space to tide the patient over the critical period until the availability of a permanent shunt [9].

If one chooses not to place shunt routinely in such patients then some means of postoperative monitoring is desirable [3].

As an alternative we have begun to use intracranial pressure monitoring. This has facilitated the postoperative management by correlating the intracranial pressure readings with clinical status and radiological findings.

A similar study was done by Chapman and Coworkers in 1984 where intracranial pressure was measured postoperatively in eight patients harboring posterior fossa lesions as a tool for proper management of hydrocephalus and its timely detection [3].

In our study the intracranial pressure monitoring was of value in differentiating between primary and secondary brain stem affection. In the former the intracranial

pressure was normal while in the latter a significant rise was evident. These findings were similar to those of Gobiet and his co-workers [10].

In conclusion intracranial pressure monitoring is a safe and reliable tool for the early detection and management of hydrocephalus following posterior fossa surgery.

References

1- PACKER R.J., SCHUT L., SUTTON L.N. and BYUCE D.A.: Brain tumours of the posterior cranial fossa in infants and children. In Youmans Neurological Surgery 3rd edition W.B. Saunders Company, pp. 3017-3039, 1990.

2- PAPO I., CARUSELLI G. and LUONGO A.: External ventricular drainage in the management of posterior fossa tumours in children and adolescents. Neurosurgery, 10: 13-15, 1982.

3- CHAPMAN P.H., COSMAN E. and ARNOLD M.: Telemetric ICP monitoring after surgery for posterior fossa and third ventricular tumours. Technical Note J. Neurosurg. 60: 649-651, 1984.

4- BEKS J.W.F., JAUNEE H.L., ALBARDA S. and FLANDERIJN H.: The significance of ICP monitoring in the postoperative period. Intracranial pressure V. Berlin Spring-Verlag pp. 251-254, 1972.

5- NARAYAN R. K., KISHARE P. R. S. and BERKER D.P.: Intracranial pressure to monitor or not to monitor. J. Neurosurg., 56: 650-659, 1982.

6- ALBRIGHT L. and RIEGEL D.H.: Management of hydrocephalus secondary to posterior fossa tumours. J. Neurosurg., 46: 52-55, 1977.

7- PARK T.S., HOFFMAN H.J., HENDRICK E.B., et al.: Medulloblastoma: Clinical presentation and management. Experience at the Hospital for Sick Children, Toronto, 1950-1980. J. Neurosurg., 58: 543-552, 1983.

8- SHALIT M.N., ARI Y.B. and AYNAN N.: The management of obstructive hydrocephalus by the use of external continuous ventricular drainage. Acta Neurochir., 47: 161-172, 1979.

9- ZOHDI A.: Ventriculo-subgaleal cerebrospinal fluid drainage. (A prolonged temporary aseptic technique) under publication.

10- GOBIET W., BOCK W. J., LIESEGONG and GORTE W.: Treatment of acute cerebral oedema with high dose of dexamethazone. Intracranial pressure. Berlin Springer Verlag, pp. 231-235, 1972.