Management of chronic subdural haematoma: burr hole drainage, replacement with Hartmann's solution, and closed-system drainage

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Although the treatment of chronic subdural haematoma by burr hole drainage has been performed in the past with or without using a closed drainage system, the problem of intracranial air entrapment still persists and can cause a deterioration in the level of consciousness or seizures in the postoperative period. Cerebral infarction may also develop a few days after surgery because of the intracranial hypotension that occurs during the drainage procedure. In an attempt to minimise these complications and to prevent cerebral infarction and its attendant morbidity, we have developed a technique of treating chronic subdural haematoma—namely, performing burr hole drainage, irrigation and replacement of the haematoma with Hartmann's solution, and closed-system drainage of the subdural space with a silicone catheter. The blood pressure is closely monitored and maintained by the infusion of fluids throughout the procedure. An illustrative case using this technique is presented in this paper.

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Key words: Chronic disease; Drainage/methods; Hematoma, subdural/therapy; Irrigation; Treatment outcome; Trephining

Introduction

Chronic subdural haematoma is one of the most common problems observed in neurosurgery, especially in elderly patients. Typically, elderly patients are often frail and malnourished. The goal of evacuating the haematoma thus often conflicts with the goal of minimising anaesthetic and surgical risks. Several approaches involving simple burr hole drainage with or without subsequently performing closed-system drainage have been used, with variable results.[1-3] The main problem after surgery is the intracranial accumulation of air, which causes compression of the brain or rehaemorrhage. Attempts to drain chronic subdural haematomas by endoscopic means or by the inflation of the subdural space with carbon dioxide have also been described and have achieved good results.[1,3]

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Methods

Patients

From July 1996 to June 1998, 50 elderly Chinese patients with chronic subdural haematoma underwent surgery in the Neurosurgical Division of the Department of Surgery at Princess Margaret Hospital. They were followed up for 3 months. All patients had given a definite history of falling on level ground and sustaining head trauma. The mean duration from the injury to the detection of chronic subdural haematoma was 1 month and varied from 3 weeks to 3 months.

Operative technique

All patients underwent surgery in the supine position irrespective of where the burr hole was made. In general, two burr holes were drilled if the haematoma was unilateral, and three to four burr holes were drilled if bilateral haematomas were detected. After straight scalp incisions in the frontal and occipital regions had been made, burr holes were successively drilled with a craniotome (3M Health Care, Irvine [Calif], United States). Dura in the frontal burr hole was opened to decompress the haematoma slowly; the dura in the occipital burr hole was then opened. It was very

important to inform the anaesthetist prior to performing the drainage that the blood pressure should be closely monitored and maintained at normal levels while infusing normal saline during surgery. The rate of infusion was adjusted as required to prevent hypotension from occurring.

A Silastic catheter of 2.5-mm outer diameter and 2-mm inner diameter (Maliphant International Sales Ltd., Hong Kong, China) was introduced into the subdural space through the frontal burr hole, and the space was irrigated with Hartmann's solution until the return fluid from the occipital burr hole became clear. The catheter was then brought out through a stab scalp incision that was made approximately 2.5 cm posterior to the frontal scalp incision, and a three-way stopper was connected. While irrigation with Hartmann's solution was continued, the occipital scalp wound was closed in two layers using an inner suture of 2-O poly(glycolide-lactide) and an outer suture of 3-O nylon. The irrigation system was then elevated above the level of the head and the frontal scalp wound was closed in two layers. In this way, air that was trapped in the subdural space could be expelled until the last scalp stitch was inserted. The three-way stopper was then closed and connected to a simple chest-drainage bag.

Postoperatively, the patient was restricted to bedrest in the supine position with the head resting on one pillow. The chest-drainage bag was hung above the head and the three-way stopper was opened towards the drainage bag to dispel any residual air, which might have been trapped in the subdural space with the subdural fluid. The drainage bag was then brought down to the level of the bed after 12 hours; it was removed within 48 hours of the operation. The patient was then allowed to sit out of bed and walk or commence physiotherapy.

Results

Twenty-nine men and 21 women were admitted to the Department of Surgery at the Princess Margaret Hospital with chronic subdural haematoma during the 2-year study period. Their mean age was 62 years (range, 54-72 years). Thirty patients presented with subdural haematoma of grade 3 on the Markwalder chronic subdural haematoma scale (Box).[1,4] The condition of 20 (67%) of the 30 patients improved to grade 1 and that of 10 (33%) patients improved to grade 2 immediately after surgery. After 2 weeks of active rehabilitation, the condition of all patients was reclassified as grade 1 or grade 0, and all patients were discharged home. Of the 12 patients who presented with grade 2 subdural haematoma at the time of hospital admission, the condition of eight (67%) patients improved to grade 1 and that of four (33%) patients improved to grade 0. The remaining eight patients had grade 1 subdural haematoma, which was reclassified as grade 0 after treatment (Table). None of the 50 patients had seizures before or after surgery, and no prophylactic anticonvulsants were given to any of the patients. In general, the condition of all the patients improved by one or two grades compared with their preoperative status, and none of them had fluid recollection or required subsequent surgery. Postoperative computed tomography was performed 1 week and 6 weeks after the surgery (Fig).

The Markwalder chronic subdural haematoma scale[4]

Grade 0	Patient neurologically normal
Grade 1	Patient alert and orientated; absence of mild symptoms such as headache, or mild neurological deficit such as reflex asymmetry
Grade 2	Patient drowsy or disorientated, or variable neurological deficit such as hemiparesis
Grade 3	Patient stuporous but responding appropriately to noxious stimuli; severe focal signs such as hemiplegia
Grade 4	Patient comatose with absent motor responses to painful stimuli; decerebrate or decorticate posturing

Discussion

Chronic subdural haematomas are encountered in 10% of elderly patients who present with head trauma (unpublished data, 1998). The methodology of management varies between different centres. In patients older than 50 years, the mass of the brain is reduced

Table. Outcome of burr hole and closed-system drainage of 50 patients with chronic subdural haematoma

Preoperative grade on Markwalder scale	Patients No. (%)	Sex M : F	Postoperative grade on Markwalder scale
1	8 (16)	4 : 4	0
2	8 (16)	5 : 3	1
	4 (8)	2 : 2	0
3	20 (40)	12 : 8	1
	10 (20)	6 : 4	2

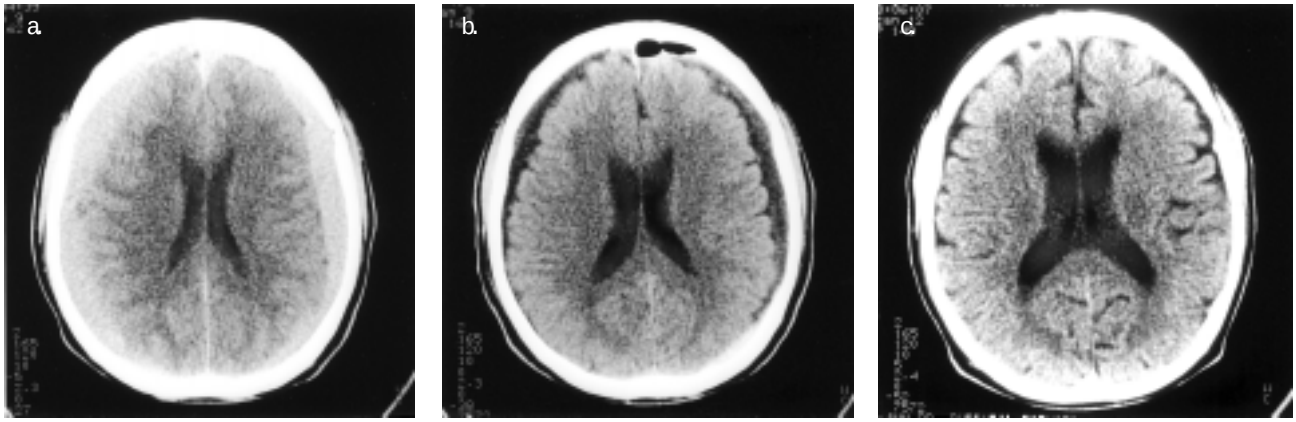

Fig. Axial computed tomography scans of a patient with left chronic subdural haematoma
(a) note the significant midline shift before the drainage procedure; (b) scan at 1 week after surgery showing symmetry of the cerebrum and the minimal accumulation of air; (c) scan at approximately 6 weeks after burr hole drainage

by approximately 200 g, which results in an increased extracerebral volume of up to 11%.[5] This extra volume can be occupied by the haematoma before a considerable rise in intracranial pressure occurs. In addition, a slowly progressing haematoma allows the brain to adjust to the new situation by compressing the venous channels, thus providing further space for the haematoma to expand.[5] Once the subdural membrane is well developed, a new chain of events determines the outcome. The outer membrane produces a layer of thin-walled sinusoidal vascular channels. Because of the presence of loose cell junctions, the membrane is liable to bleed. The membrane also functions to absorb subdural fluid. As long as there is a balance between the expanding and absorptive forces, the size of the haematoma remains constant and the patient remains asymptomatic. Any factor that disrupts the pressure gradient between the sinusoidal channels in the capsule and haematoma's cavity can encourage further bleeding. Such factors include sustaining repeated trauma or changing, from the horizontal or sitting positions to the upright position. A transient reduction in intracranial pressure following a Valsalva manoeuvre can lead to an expansion of the haematoma.[6] In addition, the activation of the kallikrein-kinin cascade, increases vascular permeability and may cause blood extravasation and plasma exudation from the capillaries into both the outer membrane and the haematoma cavity, thereby enlarging the haematoma.[7]

To manage symptomatic chronic subdural haematoma, several methods have been adopted—namely, burr hole drainage without the insertion of a catheter,[2] or more invasive procedures such as craniotomy and excision of the subdural membrane. After performing a burr hole evacuation followed by the irrigation of the subdural cavity with saline, the rate of reoperation varies between 2.7% and 30%.[4,5,8-11] A non-surgical treatment of chronic subdural haematoma using osmotherapy with 20% mannitol has been described in the literature.[12] However, it may be imprudent to give this treatment to patients who have severe dehydration; furthermore, mannitol cannot eliminate the mass lesion.

When a reservoir is inserted to aspirate a recurrent subdural haematoma, the infection rate is 2.1%.[13] Craniotomy and membranectomy were previously reserved for those instances when the subdural haematoma reaccumulated or when the haematoma remained solid and not yet liquefied.[14-17] From our early observations when performing burr hole drainage without inserting a catheter, sudden decompression of the brain, especially due to drainage from the occipital burr hole, sometimes results in a reduction in blood pressure and substantial postoperative cerebral infarction and convulsions (unpublished data, 1998). Subdural tension pneumocephalus (the Mount Fuji and air-bubble signs) sometimes develops following surgery for chronic subdural haematoma, and the patient's condition can deteriorate postoperatively.[18-22] The endoscopic removal of the organised and multiloculated chronic subdural haematoma has been performed with local anaesthesia in frail patients with some success.[23,24] Recurrent bleeding and mass effects, such as a midline shift, have been reported when oxygen or carbon dioxide have been used to replace the haematoma following single–burr hole drainage and sealing of the burr hole site with bone wax.[1]

The technique that was adopted in this study is simple and physiologically acceptable in view of the existence of the limited extracerebral space and the course of development of chronic subdural haematoma in the elderly. Filling the extracerebral space that was previously occupied by the liquefied haematoma

with Hartmann's solution or xanthochromic fluid, and allowing the brain to expand with a minimal or no introduction of air in the postoperative period results in a good recovery. Flushing out air from the subdural space during surgery and elevating the drainage bag above the head level during the 48-hour postoperative period also minimises the amount of air in the intracranial cavity and eliminates the problems of subdural tension pneumocephalus. Keeping the brain in the milieu of physiological solution rather than introducing air facilitates earlier expansion of the cerebrum, as the absorption coefficient of air containing 21% oxygen and 0.04% carbon dioxide is lower than that of the fluid used. Nagata et al[25] have reported a correlation between the volume of air remaining in the haematoma cavity with the time required for the disappearance of the haematoma cavity. The volume of air is large among cases showing recurrence. Monitoring the blood pressure and maintaining it by introducing fluids after the dura is opened, and gradually draining the chronic subdural haematoma from the frontal and especially the occipital burr holes can prevent the development of postoperative cerebral infarction or convulsion.[26]

In conclusion, a good understanding of the ageing brain and the development of chronic subdural haematoma in elderly patients can minimise or eliminate postoperative complications. The morbidity encountered in these elderly patients is quite significant and expends human and financial resources. Hence, we recommend this simple burr hole drainage procedure for the treatment of chronic subdural haematoma to avoid postoperative complications in elderly patients.

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