Single Pterional Burr Hole Coupled with Coagulation of the Middle Meningeal Artery for Management of a Chronic Subdural Hematoma in a 98-Year-Old Patient: Illustrative Case

Patient: Male, 98-year-old
Final Diagnosis: Chronic subdural hematoma
Symptoms: Headache and vomiting
Clinical Procedure: Burr hole drainage
Specialty: Neurosurgery

Objective: Management of emergency care
Background: Chronic subdural hematoma (CSDH) is more common in older people, for which burr-hole drainage is a standard procedure. Middle meningeal artery (MMA) embolization was first proposed as an adjuvant therapy to prevent recurrence after surgical evacuation of CSDH and subsequently as the primary treatment modality. Disadvantages of MMA embolization include expensive procedural price, increased radiation exposure, and additional labor. MMA embolization also has the disadvantages of slow clinical response and prolonged time for radiographic clearance.

Case Report: A 98-year-old man presented with a symptomatic CSDH. A single pterional burr hole was placed over the origin of the calvarial portion of the MMA, thus allowing for the drainage of the CSDH and coagulation of the MMA. The procedure resulted in immediate cessation of symptoms, decrease of the hematoma size, disappearance of the hematoma at 4 weeks, and no recurrence.

Conclusions: The location where the calvarial portion of the MMA leaves the outer sphenoid wing and enters the cranial vault can be reliably identified by means of external landmarks and confirmed by intraoperative fluoroscopy. Drainage of the CSDH and coagulation of the calvarial branch of the MMA can be achieved with a single procedure performed under local/conscious sedation. This report has shown that in cases of CSDH in the elderly, imaging is important to determine the optimum approach to hematoma drainage, which, in this case, required a pterional burr hole combined with MMA coagulation. This case report demonstrates feasibility of a novel procedure; further studies are needed to ascertain its usefulness.

Keywords: Blood Coagulation • Hematoma, Subdural, Chronic

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Background

Middle meningeal artery (MMA) embolization (MMAE) has been proposed, first, as an adjuvant therapy to prevent recurrence after surgical evacuation of a chronic subdural hematoma (CSDH) [1-3] and, subsequently, as the primary treatment modality [4,5]. MMAE, however, has the disadvantages of slow clinical response and prolonged time for radiographic clearance [6-8]. This report presents the case of a 98-year-old man who underwent a single pterional burr hole coupled with MMA coagulation for unilateral CSDH.

Case Report

A 98-year-old right-handed man described mild deterioration of gait over a period of 3 months. He experienced a sudden onset of vomiting while driving about 3 weeks prior to presentation. Since then, he had experienced intermittent right occipital headaches and occasional nausea. Headache, nausea, and vomiting suggested raised intracranial pressure. The patient had been taking 2 tablets of Advil by oral administration twice daily for headache relief for the 2 weeks prior to presentation. A week prior to admission, the patient slipped and fell at home. He had poor recollection of the details of the fall but did not believe that there had been any loss of consciousness. Up to the onset of the presenting symptoms, the patient had been in excellent general health, living independently, caring for all his affairs, and driving. There were no comorbidities. His only medication had been prophylactic daily 81 mg of aspirin.

On examination at admission, the patient appeared in excellent general health for his age. There was no external sign of injury to the head. The recent fall had resulted in a scab over the left elbow. The patient’s body mass index was 22.1, blood pressure 123/74 mmHg, pulse 85 beats per min, temperature 36.5°C, and O2 saturation 97%.

The patient was oriented to person, time, and place and presented appropriate behavior and affect. The examination of cranial nerves was normal except for mild chronic bilateral hearing loss. There was minor difficulty with gait and imbalance upon turning. He was unable to tandem-walk. Motor and sensory systems were normal. The deep tendon reflexes were present and symmetrical in the upper and lower limbs.

Laboratory test results, including complete blood count with differential, coagulation profile, and basic metabolic profile, were all within normal range.

The preoperative computed tomography (CT) scan of the head demonstrated a 13-mm low-attenuation right subdural hematoma covering most of the convexity on this side, compressing the ipsilateral ventricle, and causing no midline shift. There was effacement of the right cortical sulci and changes suggestive of deep small-vessel ischemia (Figure 1).

The patient underwent an evacuation of the right subdural collection, under local sedation. He was placed supine on the operating table, with the ipsilateral shoulder raised over a foam roll. The head rested on a horseshoe headrest. The pterional burr hole was placed at the point where the MMA enters the calvarium at the tip of the greater sphenoid wing. There were 2 steps to identify this middle meningeal calvarial entry point (Figure 2):

1) The use of surface landmark measurements by identifying the point of intersection between a 3.5-cm line from the posterior edge of the superior portion of the zygomatic process of the frontal bone with a 5.5-cm line drawn from the external acoustic meatus (zygomatic-meatal angle). The surface measurements of the zygomatic-meatal angle were initially taken from human skulls, as a preliminary approximation. They helped to locate where the metallic marker was to be placed prior to fluoroscopy, therefore minimizing the amount of radiation exposure. However, because of individual patient’s variations, the location of the MMA needed to be confirmed by fluoroscopy during the procedure.

2) Confirmation of the site by intraoperative oblique lateral fluoroscopy of the skull with a metallic surface marker placed at the tip of the zygomatic-meatal angle: the greater sphenoidal wing and the groove of the MMA and its calvarial entry point can be clearly visualized on the fluoroscopy images. By slightly tilting the fluoroscopy beam, one can separate the contralateral equivalent features from the one identified by the metallic marker.

After suitable sterile preparation and draping of the surgical field, the soft tissues were infiltrated with local anesthesia (half and half combination of 1% lidocaine and 0.25% marcaine), and a 3.5-cm coronal incision was centered at the middle meningeal calvarial entry point. The temporalis muscle fascicles were retracted by blunt separation of its fibers, which were then held by a 2-prong Weitlander 4” self-retaining retractor. A small burr hole was fashioned using a matchstick drill bit, which allowed the visualization of the branches of the MMA bifurcation. The MMA, at the point of its calvarial entry, was then bipolar coagulated and divided as the dura mater was opened.

The evacuation of the hematoma was conducted the standard way. The position of the table could be changed, as needed, to use gravity to assist the drainage of the most distal portions of the hematoma. A red rubber catheter was used to wash off the residual blood using normal saline solution. The entire procedure lasted 70 min (which included splitting of
fibers of the temporalis muscle), and the estimated blood loss was less than 10 mL.

Apart from incisional pain, the patient had no postoperative concerns and was up by himself on the first postoperative day. He was discharged with home care on the second postoperative day. He had assistance with housework and grocery shopping for 2 weeks but took over the management of all his home and personal affairs after that. Family members described that the patient had returned to his “old self”. The neurological examination was normal at 5 weeks after surgery, except for persistence of mild bilateral hearing loss. The surgical incision was hardly visible.

Follow-up CT scans performed at 10 days and 4 weeks after surgery showed a satisfactory appearance, with progressive resolution of the right subdural collection. A third postoperative CT scan was performed at 6 months, as the patient had

Figure 1. Pre- and postoperative imaging: sequential computerized tomography scans of the head (A) before surgery, (B) on the tenth postoperative day, and (C) 4 weeks after surgery, showing progressive resolution of the residual subdural collection (black arrows along the surface of the cerebral hemisphere). The white vertical arrow on image B shows residual intracranial air, a common and desirable feature early after surgical evacuation of a subdural hematoma. (D) Image performed 6 months later after the patient had a fall: the white arrow points to the site of the burr hole.

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another fall. There was no longer any fluid collection in the right convexity subdural space (Figure 1).

Discussion

This case report describes the feasibility of a novel treatment for unilateral CSDH by combining the use of pterional burr hole, coupled with coagulation of the MMA.

There has been a marked increase in the incidence of CSDH in the elderly population during the last decades [9]. This likely results from the increased average age of the population, age-related cerebral atrophy, frequency of falls in the elderly, and increased use of anticoagulants [9]. This trend is likely to continue. Therefore, the search for less invasive and less expensive options in the treatment of symptomatic CSDH is a worthwhile pursuit [10].

Surgical drainage of symptomatic CSDH has been historically the most popular treatment, despite presenting multiple challenges [11, 12]. It is highly effective for the immediate relief of symptoms [11, 12]. However, neurosurgeons have disagreed on the best method for the surgical management of CSDH, varying a single burr hole with or without postoperative draining devices to multiple burr holes or extensive craniotomies [11, 12]. Despite the type of surgical procedure, recurrences requiring re-operation have remained relatively high [13-15]. In the procedure described in the present report, the MMA is coagulated under direct inspection and divided before the dura mater is opened: it should follow that the risk of postoperative hemorrhagic complications should be less than that for routine burr hole evacuation.

Mandai et al in 2000 [1] and Takahashi et al in 2002 [2] were the first authors to report on the use of MMAE for the treatment for chronic subdural hematomas refractory to surgical drainage. Satisfactory results of MMAE for recurrent CSDH were later confirmed in 5 cases by Tempaku et al in 2015 [3]. There is disagreement in the literature related to the nomenclature of the branches of the MMA as it enters the calvarium [16-18]. Therefore, we simply refer to it as calvarial MMA in this report.

More recently, the use of MMAE has been proposed as upfront treatment for CSDH, instead of surgical evacuation. Some earlier investigators reported a decrease in number of recurrences as compared with that of open surgery [4], while more recently authors report comparable results [5]. There are presently several prospective studies on the subject [10]. The main disadvantage of the MMAE approach is the delay in clinical response [6, 7] and decrease in size of the subdural collection [8]. However, when used in conjunction with surgical evacuation, MMAE has been shown to decrease the rate of re-operations [2, 3]. Although several recent studies have explored the relative safety and efficacy of MMAE vs burr hole drainage, none of those studies has reached level I scientific rigor. Indeed, there are several ongoing multi-center, prospective, randomized studies being conducted to address the role of efficacy of MMAE [19, 20].

Therefore, it appears logical to combine the 2 interventions, namely (1) burr hole drainage of the subdural hematoma plus (2) ligation of the MMA, into a single minimally invasive procedure. Our clinical case demonstrates the feasibility of placing a single pterional burr hole at the calvarial entry point of the MMA, allowing its bipolar coagulation together with the
drainage of the subdural collection under local sedation. For the rare instances when the subdural collection does not involve the middle meningeal calvarial entry point, the option of the placement of 2 burr holes is always there. Further potential advantages to this procedure include reduction in cost, decreased exposure to radiation, and shortening of follow-up.

Conclusions

The surgical modification described here shows the feasibility of successfully treating CSDH hematomas by a minimally invasive surgical procedure and addresses (1) the immediate evacuation of the subdural collection and decrease in mass effect and (2) coagulation of the calvarial portion of the MMA. This report has shown that in cases of CSDH in the elderly, imaging is important to determine the optimum approach to hematoma drainage, which, in this case, required a pterional burr hole combined with MMA coagulation. This case report demonstrates its feasibility; however, the possible efficacy of this procedure to reduce subdural recurrences requires further studies.

References:


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Declaration of figures’ Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

Abbreviations

CSDH – chronic subdural hematoma; CT – computed tomography; MMA – middle meningeal artery; MMAE – middle meningeal artery embolization.

Units of Measurement

Aspirin dosage: mg; blood pressure: mmHg; temperature: Celsius; O2 saturation/inhalational anesthetics: percentage; anatomical landmarks: cm; blood loss: mL.