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Methods Article

Technical Nuances in the Perioperative Management of Chronic Subdural Hematoma by Twin Burr Hole Craniostomy: Tips, Tricks, and Tactics

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Abstract

Chronic subdural hematoma (CSDH) remains to be the most common neurosurgical entity usually encountered in the elderly population. With an increasing life expectancy and associated comorbidities, the incidence of CSDH is ever increasing. There is a lack of uniformity among neurosurgeons regarding management of CSDH, but surgical evacuation using twin burr hole craniostomy remains to be the most preferred modality. Other options available are twist drill craniostomy and craniotomy. A conservative approach may be preferred in a thin subdural hematoma with no or minimal neurological deficit or in high operative risk patients. Complications such as pneumocephalus, recollection, or rebleeding may be seen following surgical evacuation of CSDH. Herein we aimed to address the technical nuances associated with twin burr hole evacuation of CSDH to reduce the complications and the overall associated morbidity and mortality.

Keywords
- chronic subdural hematoma
- craniostomy
- burr hole evacuation

Introduction

Chronic subdural hematoma (CSDH) is one of the most common neurosurgical entities encountered in the elderly population. Although conservative management has also been described, surgery forms the mainstay of the treatment. Conservative approach may be preferred in a neurologically stable patient on antiplatelet drugs or with coagulopathy with a small CSDH.[1] A Japanese study reported successful management of 21 consecutive CSDH patients (with less than 10 mm thickness of the bleed and less than 5 mm midline shift with no or minimal neurodeficits) treated with tranexamic acid (TXA, 750 mg Per os [per orem] [PO] daily) until radiological resolution on follow-up computed tomography (CT) scans performed every 3 weeks.[2] TXA purportedly corrects the coagulopathy dynamics within the hematoma leading to thrombosis of the membrane followed by hematoma resorption.

A variety of surgical modalities and techniques have been described and debated upon, yet burr hole craniostomy largely remains to be the preferred choice of treatment worldwide.[3] Other commonly described techniques are craniotomy and twist drill craniostomy with slight modifications. Single burr hole drainage for localized CSDH has also shown satisfactory results.[4] In a small subset of patients middle meningeal artery embolization with polyvinyl alcohol may also be of benefit, especially in those on anticoagulant medications. This eliminates the need to discontinue the drug, thus avoiding a significant percentage of complications resulting either from ischemic events secondary to discontinuation of the drug or hemorrhagic events from inadequate reversal of anticoagulant medication.[5]

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In this article we aim to describe the small nuances in the practice of twin burr hole craniostomy for the management of CSDH and discuss the tips and tricks that help in reducing the mortality and morbidity in these patients.

Preoperative Considerations

General Considerations

Patients admitted should be thoroughly investigated. Complete hemogram with prothrombin time and international normalized ratio (INR) exclude possible bleeding diathesis especially in cases without a definite history of trauma. History of comorbidities helps in tailoring the management for each individual.

Modifiable Risk Factors

- *Alcohol*: Chronic alcoholism predisposes to increased intraoperative bleeding from deranged coagulation profile. It also leads to brain atrophy that causes shearing of the bridging veins that may rupture spontaneously or following trivial trauma and lead to a subdural hematoma. Atrophic brain also creates a potential space for hematoma collection, causing minimal or no compressive symptoms until late stages of the disease accounting for a large number of cases with delayed presentation. Thorough assessment of the coagulation profile and surgical drainage performed after correction of the coagulopathy if the condition permits or under coverage of prothrombin complex concentrates (PCC) or fresh frozen plasma (FFP) if emergent surgery is indicated, are warranted. Injection of Vitamin K (5–10 mg) is also indicated in cases with bleeding due to severely deranged coagulation profile.
- *Coagulopathy*: Patients with deranged coagulation profile from any cause are at an increased risk of intra- and postoperative bleeding. This may require either discontinuation of the anticoagulant with repeat scans in patients who are neurologically stable with a thin subdural hematoma (<10 mm thickness) or, in cases where eventually surgery is necessary, discontinuing the drug and allowing for its metabolization and renewal of platelets. Vitamin K provides for gradual normalization of INR and may be used in cases where surgery may be delayed. In cases where emergent surgery is indicated, FFP or PCC are used, which provide for a faster response.[6] Recombinant activated factor VIIa has also gained popularity for emergency reversal of coagulopathy in patients on anticoagulant therapy requiring urgent surgical intervention even with normalized INR.[7]
- *Hypertension*: Regular monitoring of blood pressure and starting antihypertensive therapy if needed are essential. Hypertension may cause postoperative bleeding and recollection. Amlodipine with or without telmisartan is used in our institute. Depending on the patient profile, other antihypertensives may be used in consultation with the general physician.

Imaging

CT scan allows for rapid image acquisition. Wider availability and cost effectiveness favor its use. Classically, CT scan shows a hypodense concavo-convex lesion localized over the fronto-parietal convexity, which is the most common site for CSDH. Heterogeneous intensity may be seen in cases with an associated acute or subacute component. Calcified CSDH, which may need a craniotomy, can easily be identified on a CT scan.

Magnetic resonance imaging (MRI) is helpful in diagnosis of bilateral isodense CSDH, which may be easily missed out on a CT scan.[8] It also helps to detect multiple loculations, neomembranes, and fresh bleed, and in noting the size and thickness of the membranes. Thick membranes, solid hematoma, or multiple loculations on MRI may require a craniotomy with membranectomy instead of burr hole craniostomy for better evacuation of CSDH and removal of all neomembranes.[9] Contrast-enhanced CT or MRI scans can detect primary or metastatic dural disease that may be seen in association with CSDH.[10]

Intraoperative Considerations

All patients with a CSDH of more than 10 mm thickness and a midline shift of more than 5 mm with or without any neurological deficit are managed by surgical evacuation. Two burr hole evacuations under sedation with local anesthesia (LA) are usually preferred over other methods in our institute.

Anesthesia

CSDH, being a disease of the elderly, is usually accompanied with comorbidities. Burr hole evacuation under LA has benefits of reduced intensive care unit stay, ventilator usage, exhaustion of neuro-critical care resources, and overall hospital stay, with results similar to that of general anesthesia or even better. General anesthesia in our institute is usually limited to uncooperative, claustrophobic, or those patients with psychiatric illnesses. Burr hole craniostomy performed under LA with adequate sedation dampens the pain, calms the patient, and is an equally efficient procedure for CSDH evacuation.[11] In our institute, after assessing all the parameters as age, renal/cardiac profile, and other comorbidities, usually a combination of midazolam, propofol, dexmedetomidine, and fentanyl are used for sedation and analgesia.

World Health Organization Surgical Safety Checklist

From patient identification to displaying of image, surgical safety checklist as guided by the World Health Organization before induction of anesthesia and skin incision is an important step and should be universally practiced. At this time adequate strapping of the patient to the operating table should be ensured. Preoperative shot of an antibiotic, an antiepileptic, and 1 g of TXA is sine qua non.

Patient Positioning

Patient is placed supine with the head turned to the opposite side of CSDH, positioned in a Mayfield holder. In the absence

of Mayfield holder, head may also be positioned on a head ring or a horseshoe headrest.

Operative Steps

- *Incision*: Two 4 cm linear scalp incisions are made over the frontal and parietal regions in a fronto-parietal CSDH after infiltration with local anesthetic (commonly 2% lignocaine with adrenaline) at surgical site and scalp block. The incisions in the scalp are made such that they can be improvised into a trauma flap craniotomy under circumstances if there is either torrential bleed difficult to be managed through a small craniostomy, in case of inability to evacuate the acute component, or in case of multiple thick membranes. In case of bilateral CSDH, the side with large collection is operated first.
- *Burr Holes*: After making the skin incision and separating the underlying periosteum over the frontal and parietal regions, burr holes are made over the frontal and parietal regions using a Hudson brace hand drill or an electric drill. Burr holes of approximate 3×3 cm sizes are made over the thickest part of the hematoma. It is important to secure all hemostasis before opening the dura to avoid spillage of blood and its products into the subdural space.
- *Durotomy*: The bare dura is coagulated with diathermy and a cruciate opening is made in the dura to gradually decompress the hematoma. Dura may be nicked with a no. 11 blade and extended using sharp fine-tip Metzenbaum scissors. Frontal durotomy is done first. Parietal durotomy if performed first causes evacuation of the subdural component from the dependent part and re-expansion of the brain, which may result in trapping of a subdural pocket within. Rapid decompression may lead to fresh bleeds due to sudden removal of the pressure effect causing shearing of the bridging veins and bleeding. Hence gradual decompression is advocated.
- *Care of Neomembranes*: On opening the dura, classically dark-colored motor oil consistency fluid drains out under pressure. The dural edges are then diathermized using bipolar cautery with special care to cauterize the undersurface of the dural edges that are susceptible to bleed in the operative field and in the immediate postoperative period. This prevents neomembranes from bleeding where neo-angiogenesis is an ongoing pathological process.

Identification, subsequent opening, and coagulation of all neomembranes and septae formed within a CSDH are essential as the rigid membrane may tether the brain preventing its expansion back to normal position, creating a potential dead space that may lead to hematoma recurrence.

- *Dural Biopsy*: It is mandatory in cases of recurrence or repeated collections to rule out primary or metastatic dural diseases.[10]
- *Evacuation*: The cavity is now washed with tepid saline till return of clear fluid is visible. Operation table is rotated (by 15–20 degrees) to either side (both left and right) and also the head end in upward and downward directions while washing with saline to achieve better gravity-assisted evacuation of the CSDH. Strapping of patient to the table keeps the patient stable and prevents any falls or deviation of the patient from operative positioning while rotating the table.
- *Hemocoagulase*: At our institute, routine local use of hemocoagulase (1 International Unit [IU]) is also done. After removal of CSDH and thorough toileting of the cavity with saline, hemocoagulase mixed with saline in a concentration of 1:10 is filled in the cavity before closure is begun.
- *Drain*: Closed suction drainage, most commonly subgaleal minivac suction drain for a period of 48 to 72 hours, is advocated over the parietal burr hole to reduce the incidence of recurrence.[12,13] Subdural drain or Jackson Pratt drain is not advocated and may even be detrimental.[14] Mohanty[15] believes that residual subdural space reduction by the application of subgaleal drain placement is the single most important factor determining recurrence.
- *Closure*: Hemostasis is achieved at the dural margins and the parietal burr hole is closed in layers using vicryl in galea and silk/nylon for skin. After closure of the parietal incision, the frontal burr hole is positioned at the highest point of the skull, achieved by elevating the head end of the patient. The cavity is filled with hemocoagulase mixed saline through the frontal burr hole to remove any air trapped within the cavity. This prevents pneumocephalus, a small volume of which is present in almost all operated cases of CSDH and if large, may cause pressure symptoms or be responsible for recurrence of CSDH. The use of closed drainage system also helps in removing any residual air in the intracranial cavity. Multilayered closure of the frontal incision is then done.[16,17]

Postoperative Considerations

- *Head Positioning*: Supine position or a 30 degrees head-up position soon after operation in CSDH does not significantly affect the outcome and recurrence.
- *Mobilization*: Early mobilization after surgery helps to prevent postoperative pneumonia, deep vein thrombosis, and urinary tract infection without increasing the risk of recurrence in elderly patients aged 65 years or more.[18]
- *Monitoring*: Regular blood pressure monitoring and its management is necessary as persistent hypertension can cause bleeding.
- *Imaging*: CT scan is done within 24 hours to look for possible residual collection, pneumocephalus, or fresh bleeding, which may prompt for a second evacuation procedure.
- *Pneumocephalus*: Some volume of pneumocephalus is almost always present and may not require any intervention unless it causes pressure symptoms. High-flow oxygen through mask and good hydration are adequate management steps.
- *Residual Collection/Recollection*: Chances of residual collection are more in cases of severely atrophic brain

as seen in elderly, which is the common age group for CSDH, and in cases with reduced pulsations of the brain.[19] A neurologically stable patient with recollection on postoperative CT scan and with a midline shift of less than 5 mm is managed conservatively and is followed up with weekly repeat CT scans. In our institute, we keep all patients on TXA 500 mg twice daily for 4 weeks or till CSDH resolves. If midline shift increases, or the patient deteriorates neurologically, the patient is taken up for a second surgery. In cases where there is recollection or the patient is not neurologically stable and requires a second evacuation procedure, choice can be made between rewashing of the cavity and conversion to a trauma flap craniotomy.

- *Rebleeding*: Rebleeding in the subdural space may be seen on follow-up scans in certain cases, which may be either from dural edges, membranes, or fresh parenchymal bleed, which may occur following removal of the pressure effect over the cortex leading to a sudden increase in cerebral flow within the fragile cerebral vessels or due to defective vascular autoregulation.[20] The follow-up scans will show acute component in the subdural space and depending on the neurological status and the midline shift the patient may be taken up for trauma flap craniotomy or rarely may be managed conservatively with follow-up CT scans.

Discharge and Follow-Up Considerations

- Patient may be discharged 4 to 5 days postsurgery with advice for stitch removal on 10th day.
- Antiepileptic drug prophylaxis is given to the patient in the immediate postoperative period. Patients with lower Glasgow Coma Scale (GCS) on admission are at an increased risk of seizure. Mortality is higher in patients with postoperative seizures, which mandates its continuation.[21] In our institute, usually phenytoin or levetiracetam or a combination of both in higher-risk patients such as those with history of multiple seizure episodes is continued for a period of 12 months followed by gradual withdrawal over 3 months.
- Management of hypertension and routine monitoring of blood pressure are essential to prevent any bleeding in the late postoperative period.
- Two more follow-ups are advised at 1 and 3 months after which the patient is discharged from follow-up with advice regarding danger signs and immediate consultation if required. At 1-year follow-up, gradual withdrawal of antiepileptics is advised over next 3 months.
- In long-standing cases of CSDH, postoperative expansion of brain may take time and the potential space may have some collection that gets absorbed in due course of time. Follow-up every month with repeat CT scans is done till resolution of hematoma occurs in such cases.

Conclusion

CSDH is a common neurosurgical entity the management of which is practiced with slight variations, tailoring the operation to patient's individual characteristics but largely also depending on surgeon's choice, expertise, and confidence. Religiously following the steps according to protocols practiced, individualized to different hospitals/institutes, and meticulous performance of small steps in perioperative management of these cases have shown excellent outcome. Small tips, tricks, and tactics mentioned in this article will further help in the successful management of these cases with better outcome.

Conflict of Interest
None.

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