DOI: 10.5137/1019-5149.JTN.14113-15.2
Received: 19.01.2015 / Accepted: 24.04.2015
Published Online: 25.03.2016

Original Investigation

Endoscopic Evacuation of Subdural Collections

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ABSTRACT

AIM: Intraoperative use of the endoscope is a hot topic in neurosurgery and it gives broader visualization of critical and hardly-reached areas. Endoscope-assisted surgical approach to chronic subdural haematoma (SDH) is a minimally invasive technique and may give an expansion to the regular method of burr-hole haematoma drainage.

MATERIAL and METHODS: Endoscope-assisted haematoma drainage with mini-craniotomy was performed over a 24-month period, and prospectively collected data is reviewed. A total of 10 procedures (8 patients) were performed using the endoscope-assisted technique. Four of them were chronic SDH and six were subacute SDH.

RESULTS: Procedures were extended 20 minutes in average because of endoscopic intervention. There was no extra-morbidity through the study as a consequence of endoscopic assessment.

CONCLUSION: Endoscope-assisted techniques can make the operation safe in selected circumstances with improved intraoperative visualization. It may likewise take into consideration the identification and destruction of neo-membranes, septums and solid clots. In addition, the source of bleeding can be easily coagulated. The endoscope-assisted techniques, with all of these features, can alter the pre- and intra-operative decision-making for selected patients.

KEYWORDS: Endoscope, Subdural Haematoma, Minimally invasive, Craniostomy

INTRODUCTION

Twist drill craniostomy, burr-hole craniostomy, and mini-craniotomy or craniotomy are major methods to locate chronic subdural haematoma (SDH) (8). All of them have different morbidity, mortality, recurrence and cure rates (8,16). Twist drill and burr-hole craniostomy are the first line surgical techniques, though craniotomy is usually preferred as a second line method (8).

During the past 20 years, the general postoperative result of surgical treatment for chronic SDH has not enhanced considerably (2). Present studies only focus on the use of endoscopy for the evacuation of SDH. The use of intracranial endoscopy in neurotraumatology was initially considered as a specialized technique in 1980s (6).

Our aim was to explore the theory that minimally invasive inspection of haematoma cavities is conceivable and might conceivably improve the remedial mediation of burr-hole drainage in chronic SDH. Endoscope-assisted drainage technique with mini-craniotomy was used in a 24-month period, and the prospectively collected data of 8 patients was reviewed.

MATERIAL and METHODS

Over 24 months, total of 10 procedures (8 patients) were performed with mini-craniotomy and endoscopic assistance. The indications for mini-craniotomy surgery are beyond the scope of this article. Six patients had one operation and they were operated on one side, and two patients had two operations and they were operated on at different times and sides. Consent was obtained from the patients.

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All 8 of the patients in this study had computed tomography (CT) scan and/or magnetic resonance imaging (MRI) findings consistent with either a chronic or subacute subdural collection.

A skin incision about 3 cm in length was used (Figure 1A). The mini-craniotomy was placed over the subdural collection at its maximal depth, but then placed over the collection at its rear boundary (Figure 2).

All mini-craniotomies were performed using a high-speed drill. The diameter of each burr-hole was between 20 and 35 mm.

A burr-hole was placed to the back of the mini-craniotomy bone flap (Figures 1A-D, 3). It may be also used to tap if a tap is needed during the follow-up period (Figure 3). We performed cranial tap in two patients.

In order to aid introduction of the endoscope, the authors shaved the inner table of frontal edge (Figures 1B,D, black arrow) and the outer table of back edge of the mini-craniotomy. (Figures 1C,D, White arrow)

After exposure and haemostasis, the dura was incised as linear fashion (Figure 4A-C) and the dural edges were coagulated.

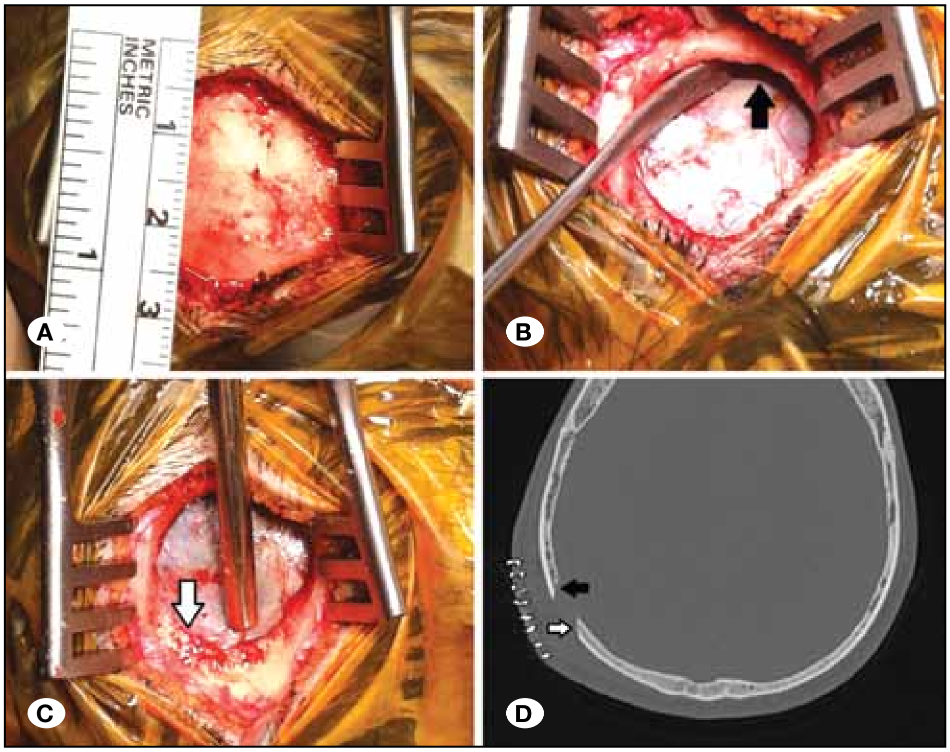

Figure 1: The shape and size of skin incision **(A)** and mini-craniotomy **(B, C)**. The appearance of the mini-craniotomy on brain CT scan **(D)** (**Black arrow**; shaved inner table of frontal edge, **White arrow**; shaved outer table of back edge of the mini-craniotomy).

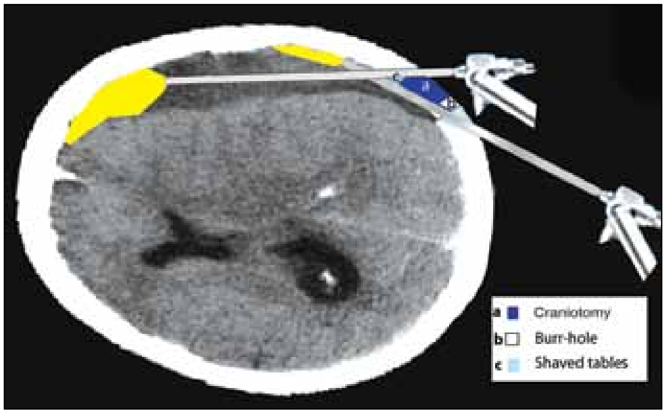

Figure 2: It shows location of mini-craniotomy and burr-hole and how the shaved table aids the initial angulation and introduction of the endoscope. **a:** Mini-craniotomy over the collection at its rear boundary, **b:** Burr-hole placed back of the mini-craniotomy flap, **c:** Shaved inner table of frontal edge and outer table of back edge of the mini-craniotomy.

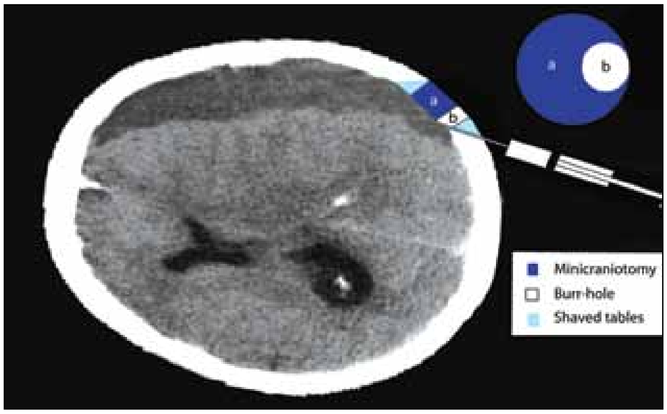

Figure 3: The effect of the shaved outer table of back edge and burr-hole placed back of the mini-craniotomy to tap. **a:** Mini-craniotomy, **b:** Burr-hole.

During the study, the dura was incised as cross line (Figure 4A), (T) (Figure 4B) and linear fashion (Figure 4C). The linear truncation of the dura was seen to be enough to perform the procedure.

First drainage of the haematoma was performed using the standard method and the subdural space was irrigated with warm Ringer's lactate solution (8). The subdural space washed out with water until it was clean. Two patients did not have clear liquid and the source of bleeding in these patients was detected with the endoscope. The bleeding was stopped with bipolar cautery (Figure 5A-D). We did not need to enlarge the mini-craniotomy aperture.

In order to use gravity to provide drainage of the subdural remnants, the head of the bed was angled towards the floor. The bed was returned horizontal or slightly head-up and a 0 or/and 30-degree endoscope introduced under direct vision. (Figures 6 A, B).

Deep regions such as temporal and frontal pole were easily reached (Figure 7A, B).

A 30-degree scope was used to see behind corners and deep region (Figure 7A, B). The arachnoid cyst and septa in two patients were easily detected. The septum was opened and the arachnoid cyst was fenestrated with subarachnoid space (Figures 8A-D, 9A-D).

All of the procedures were documented with photo capture.

Standard care was administered in the post-operative phase. Follow-up films were taken in all patients in the first 24 hours.

■ RESULTS

Over 24 months, a total of 10 procedures were performed with endoscopic assistance. Procedures were extended 20 minutes on average (12-28 minutes) because of endoscopic

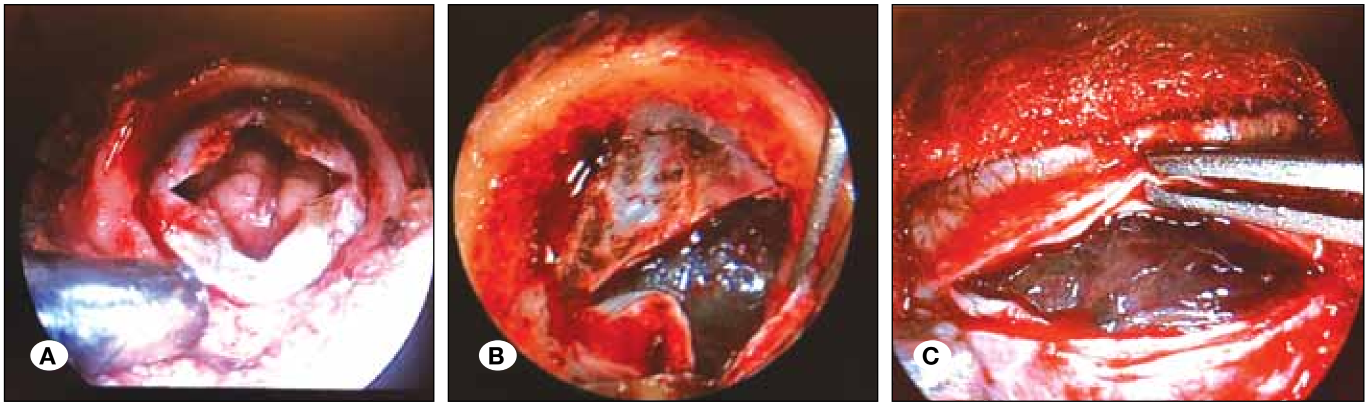

Figure 4: During the study, **A)** The dura was incised as cross line, **B)** T fashion, and **C)** Linear fashion.

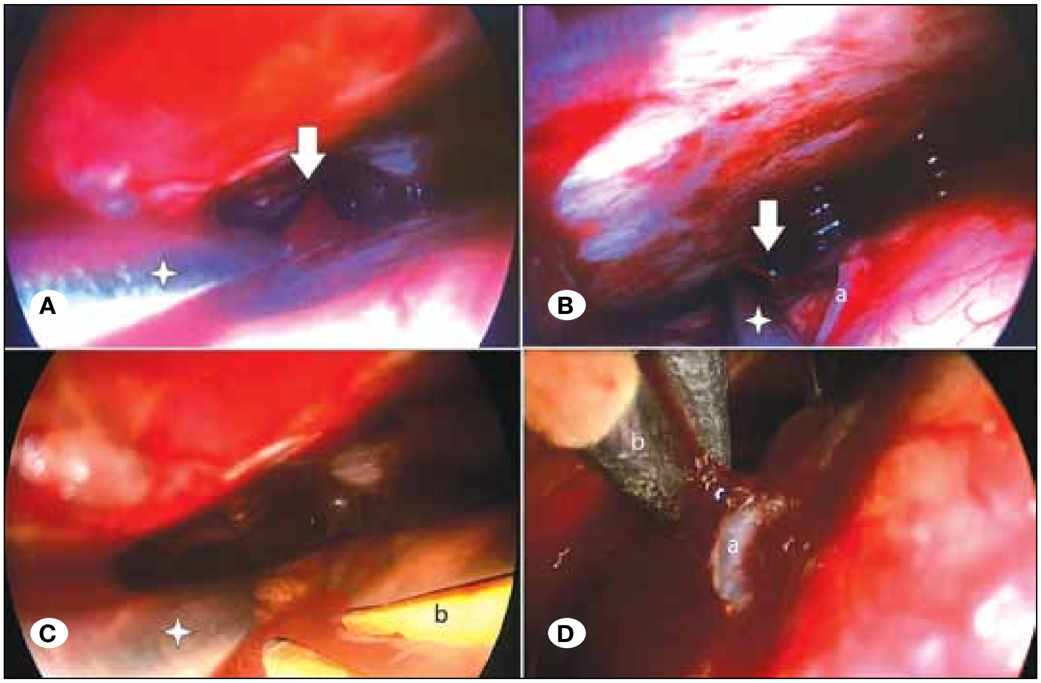

Figure 5: The source of bleeding in two patients **(A and B)** detected with the endoscope, and the bleeding stopped with bipolar cautery **(C and D).** (**a:** Cortical vein, **b:** Bipolar cautery, **D**). ✧: Suction tube, **White arrow:** Source of bleeding).

approach. No extra-morbidity was observed due to use of the endoscope for inspection. Surgeon has the chance to work without changing direction by using mini-craniotomy over the collection at its rear boundary, moreover this was not increased the complication.

We made the internal diameter of the burr-hole at the inner table bigger than at the outer table in order to lessen the angle of introduction. This aided the first angulation and introduction of the endoscope (Figure 2). Also, shaving the outer table of back edge of the burr-hole aided the primary angulation and introduction of the needle when doing tap (Figure 3).

The hematoma and source of bleeding could be easily seen with the endoscope. Hematoma could be evacuated (Figures 6A,B; 5A, B) and bleeding vessel could be cauterized (Figure 5C, D). We did not need to enlarge mini-craniotomy aperture to control bleeding.

Endoscopic inspection of the subdural space was rather simple (Figure 6A, B). The anatomical details were easily seen (Figure 6C, D) and deep regions were easily reached (Figure 7A, B).

Arachnoid cyst and the septa were easily detected, the septa were opened and the arachnoid cyst was fenestrated with subarachnoid space (Figures 8A-D, 9A-D).

Outer membrane of hematoma could be resected endoscopically (Figure 10).

Ongoing bleeding was stopped and detected septa were opened, so the operation could be performed as planned. Thus, the endoscopic inspection altered the peroperative decision-making in 4 procedures.

Although there is a possible risk of cortical damage with endoscope introduction, (7,14) we had not any extra morbidity

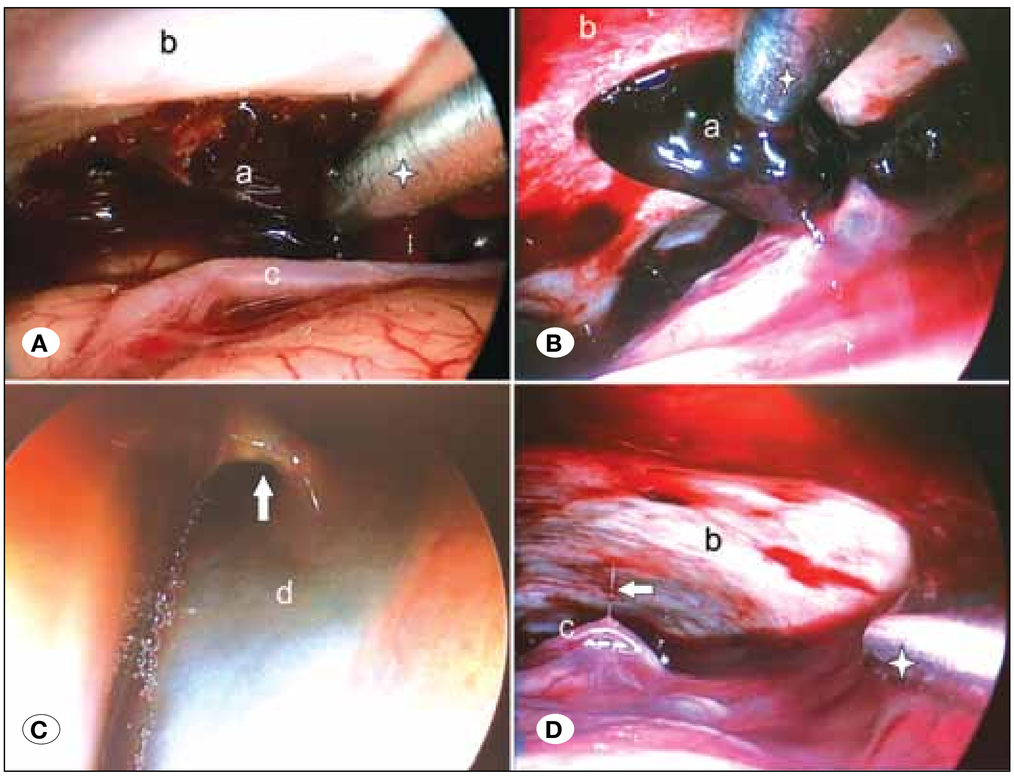

Figure 6: A-D) Endoscopic inspection of the subdural space and anatomical details could be seen. (**a:** Subdural haematoma, **b:** Dura mater, **c:** Cortical vein, **d:** Sagittal sinus; suction tube, **White arrow**; draining vein, **Black arrow**; bridge vein).

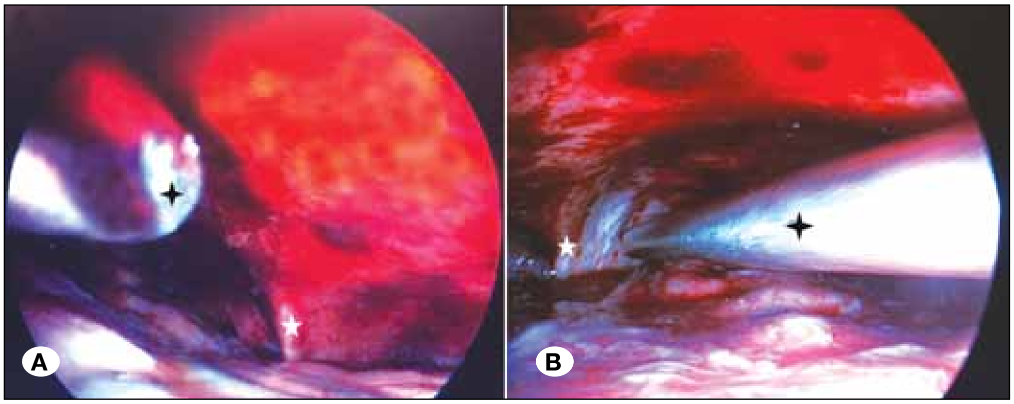

Figure 7: A, B) The deep regions such as frontal and temporal pole were reached easily with endoscope. (**✦:** suction tube, ☆**:** sphenoid ridge).

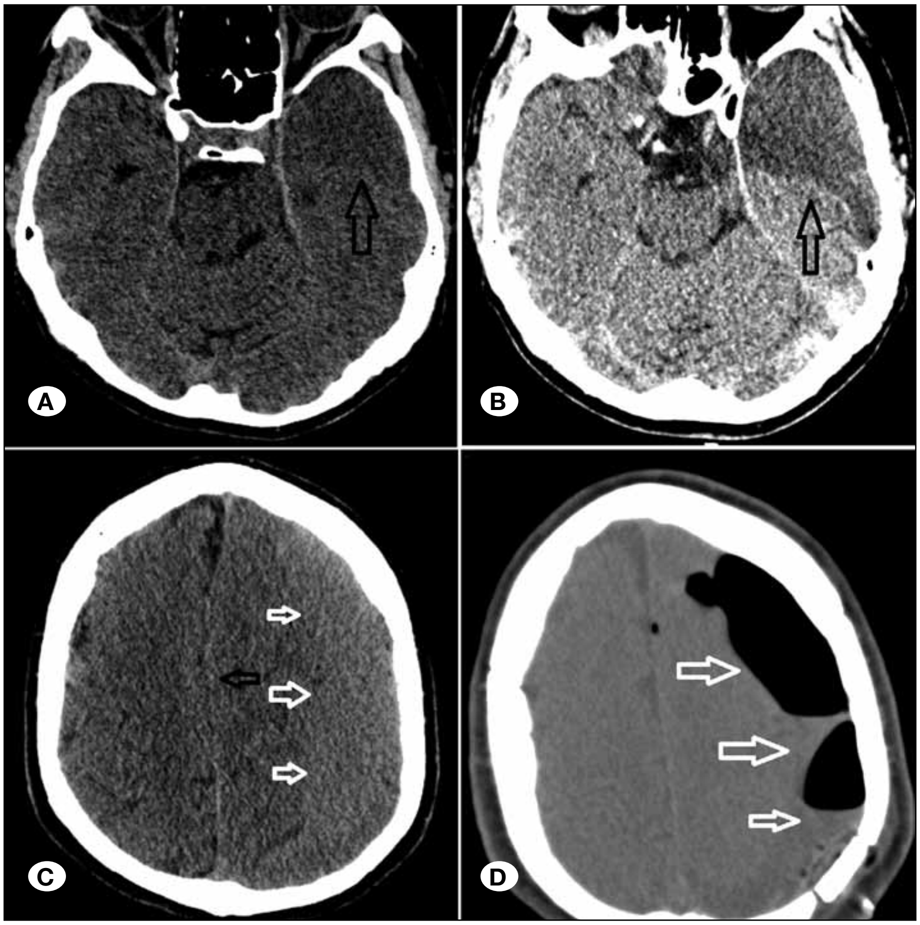

Figure 8: A) On CT scan shows left arachnoidal cyst at inferior temporal fossa (arrow), **B)** On CT scan shows left arachnoidal cyst at inferior temporal fossa (arrow), **C)** On CT scan shows left early subacute subdural hemorrhage (moderate hyperdense) (white arrows). Also CT shows right subfalcine herniation (black arrow), **D)** On CT scan shows left craniostomy and intracranial postoperative changes and air (arrow).

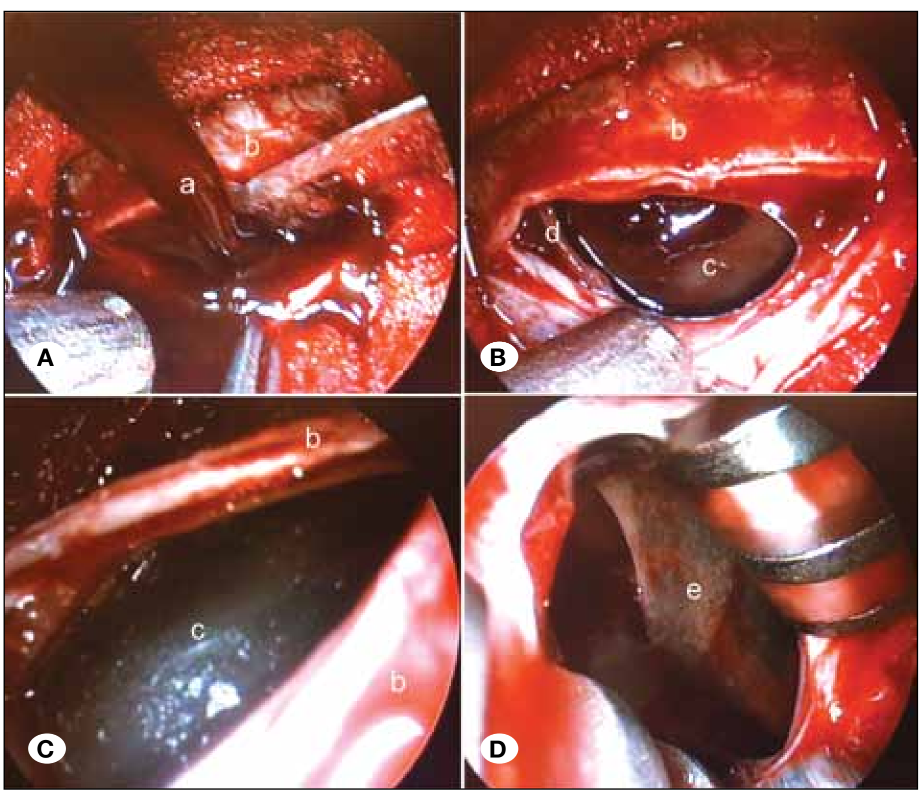

Figure 9A-D): a: Hematoma coming out under pressure, **b:** Dura mater, **c:** Septum, **d:** External capsule (neo-membrane) **e:** Arachnoid cyst.

for the rest of the study as a result of endoscopic inspection (Figure 11A). Also, during the examination of the deep regions, the bridge veins should be considered. Because the rear part of the suction tube that at this time we can not see, can cut off a bridge vein while moving from side to side (Figure 11B).

The optimum diameter of the scope should be 4 mm. Otherwise it might prevent other instruments to get involved into the operation.

All of the procedures could be document with photography capture.

DISCUSSION

Chronic SDHs can be cured operatively by twist drill craniostomy, burr-hole craniostomy or craniotomy (8). The best method providing the lowest morbidity and mortality has been discussed. In comparison to a craniotomy, the burr-hole treatment is mostly assumed as more reliable. Craniotomy should be reserved for solid consistency and repeated recurrence of the subdural haematoma, space-occupying brain oedema of the engaged hemisphere and the lack of re-expansion of the shifted brain tissue (17).

Weigel et al. showed that craniotomy has a higher morbidity level comparing to twist drill or burr-hole craniostomy. But still craniotomy has the least recurrence level among the other surgical approaches (16). Smely et al. brought that; twist-drill trephination with the insertion of a specific subdural catheter over burr-hole craniotomy has better clinical results (13). Hamilton et al. found no change in results between burr-hole versus craniotomy (3).

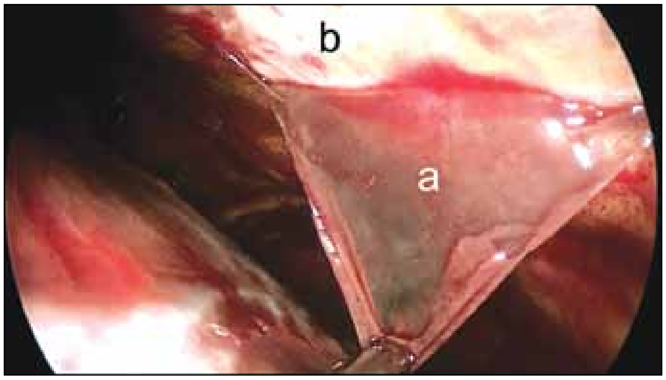

Figure 10: a: External capsule (neo-membrane), **b:** Dura mater.

Sambasivan supported the use of craniotomy with subtemporal marsupialisation over drainage with multiple burr-holes. They found a recurrence rate of 0.35% versus 21.5% respectively. They also reported a mortality rate of 0.5% versus 4% respectively (11). Hennig and Kloster showed the advantages of non-stop irrigation over burr-hole drainage with passive drainage (without irrigation), and also over craniotomy (5).

Re-accumulation of the haematoma is a post-operative complication that is commonly seen and caused by surgical evacuation of a chronic SDH, although residual fluid is exposed so often on postoperative CT scanning up to 80% (1), recurrence rate of the symptoms is about 8% to 37% (15). Explanation to the growth of a chronic SDH is recurrent bleeding from the haematoma capsule (12).

Hellwig et al. demonstrated that endoscopic operative method combined with a closed drainage system should be used rather than craniostomy-membranectomy (4). They used endoscopy and resection of neo-membranes in the treatment of 13 out of 14 patients successfully who had had burr-hole drainage and no recurrence occurred.

Treating non-septated chronic SDHs can be easy with burr-hole evacuation and washout (8). Sometimes treating the septated form of SDH can be more difficult with high rate of recurrence because of poor washout and division of neo-membranes (8). Rocchi et al. recommended preoperative contrast-enhanced MRI to discover thick and extensive neo-membrane of the SDH or solid clot tissue within the SDH (9), allowing for immediate craniotomy without initially performing drainage by burr-hole. Preoperative MRI provides different appearance than the CT scans in cases of recurrent chronic SDH, or improvement of some parts of the haematoma and its membranes after contrast (8,9). As we have shown in our study, the septa were easily detected and opened. This may prevent insufficient washout and division of neo-membranes and this may facilitate the treatment.

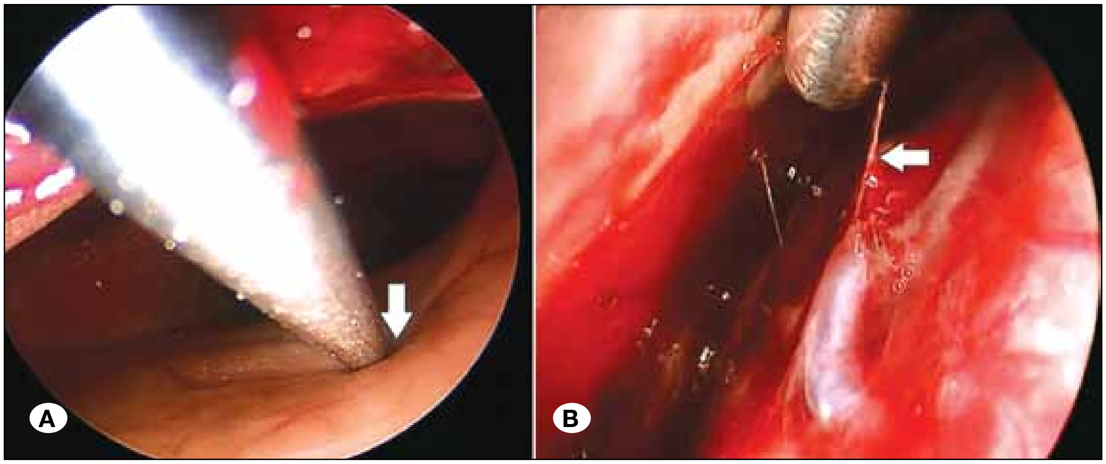

Figure 11: A) Cortical damage (white arrow), **B)** Cut off a bridge vein (white arrow).

Rather than using regular “blind” method, the potential to image separate septum formation and multi-loculation has more advantages. Several methods have been described with the demarcation of more solid haematomas or neo-membranes, together with continuous (and postoperative) irrigation (5) and craniotomy for membranectomy.

Rodziewicz et al. performed endoscopic removal of organized chronic SDH in 2 patients through a small craniectomy (10). In our series, among the 11 patients, 9 were appropriate for the use of endoscopic technique. In one case, endoscope could not be used because of a rapid re-expansion of the brain following decompression. In the other case, thick subdural membrane with minimal loss of subdural fluid caused the failure with the same reason. Possible outcomes of the method are a reflection of the enriched visualization of the subdural plane. In one of our patients, after the first drainage the brain re-expansion was rapid so endoscopy was not available because of inadequate working space.

Hamilton et al. (3) states that it is claimed via some surgeons that craniotomy is superior and safer opportunity to sufficiently operate the haematoma, its membranes, and incidental problematic bleeding. Various surgeons have utilized a subdural catheter, in order to wash out the subdural space during the first surgical attempt. However, endoscope-assisted surgery can also contribute to the washing of subdural space by positioning of the subdural catheter. This technique prevents the cortical laceration during surgery (8).

Confirming the absence of clot and membrane formation is vital for surgeon where hygroma is possible and also it gives the patient a visual help to focus on post-operative problems like recurrence.

The most possible risk of rigid endoscope is the damage on the cortical surface of the brain, because some surgeons may not feel comfortable working in a 2D environment while using endoscope (7,8,14). But, in our series, there was no extra-morbidity as a result of endoscopic inspection (Figure 11A). The corridor to introduce endoscopy should be suitable and surgeons must use both hands on the endoscope to avoid plunging into the cortex.

Adding that, it can be considered as a waste of time to arrange endoscopy devices and the visualization tools because burr-hole craniostomy is a short procedure mostly. But with a wholistic vision, it gives the chance to save time due to eliminating pre-operative MRI.

■ CONCLUSION

A mini-craniotomy for drainage of chronic subdural hematoma provides sufficient space to introduce the endoscope along with other instruments. Endoscopic visualization is beneficial for use with chronic SDH mini-craniotomy drainage in terms of endoscopy-guided destruction and removal of solid clots or neo-membranes, cauterization of bleeding vessel, safely subdural catheter insertion for subdural washout, recording and medico-legal documentation.

■ ACKNOWLEDGEMENT

We thank Cemil Ozan Ceyhan for his contribution in editing the manuscript.

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