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# Craniotomy versus decompressive craniectomy: management of acute subdural hematoma post-traumatic at CHU-JRA

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## Abstract

**Background:** Acute subdural hematoma is one of the frequent complications of severe head trauma, it is a neurosurgical emergency. The aim of this study is to determine and evaluate the outcome of patients operated by craniotomy versus decompressive craniectomy.

**Methods:** This is a retrospective and analytical study over two years from January 01, 2019 to December 31, 2020.

**Results:** 73 patients were included in the study including 63 men and 10 women with a sex ratio of 6.3. The average age was 37.84 years old. The traffic accident was the most common in 47.95% of cases. Of the 73 patients, 54 under went decompressive craniectomy and 19 had craniotomy. The predominant initial Glasgow score in the decompressive craniectomy was less than 8 and in the craniotomy between 13-15. The mean hematoma thickness was 9.54 mm for the decompressive craniectomy and 11.07 mm for the craniotomy. The mean deviation from the midline of the decompressive craniectomy was 7.25 mm and 7.21 mm for the craniotomy. The mortality rate found in décompressive craniectomy was 46.30% and 52.63% for craniotomy.

**Conclusions**: There is no consensus in the literature on the surgical technique, so the management of acute subdural hematoma depends on the expertise of the neurosurgeon on a case-by-case. In order to determine a surgical strategy, a prospective study is necessary.

**Keywords:** Cranio cerebral Trauma; Craniotomy; Decompressive Craniectomy; Subdural hematoma; Tomodensitometry

## 1 Introduction

Acute subdural hematoma (ASDH) is defined as a collection of fresh blood between the inner surface of the duraland the arachnoid [1,2]. It is a serious pathology with vital prognosis in the short time, in the long term with the risk of functional disability and a state of dependence [3]. The occurrence of intracranial hypertension is dreadful. It is the result of an overcoming of the physiological compensation mechanisms of an increase in volume of the contents of the cranial box which is a rigid and inextensible container. Improving the compliance of the system by making the container expandable is the rational use of decompressive craniectomy without replacing the bone flap [4]. Decompressive craniectomy has therefore been used for many years in head trauma patients, but many questions persist as to the value

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of its performance in daily practice [5]. Currently in Madagascar, décompressive craniectomy is one of the surgical techniques used in the management of ASDH. This study was undertaken because an increase in the frequency of decompressivecraniectomy has been observed and this technique requires a second intervention for the delivery of the nurse flap or for a possible cranioplasty; while there is a therapeutic alternative such as a craniotomy to evacuate the hematoma with replacement of the bone flap. The main aim of this study is to evaluate the results of patients operated by craniotomy versus decompressivecraniectomy.

## 2 Methods

This study was carried out at the Hospital University Center Joseph RavoahangyAndrianavalona (CHU-JRA) in two different departments, including neurosurgery department and surgical resuscitation department. This is a descriptive and analytical retrospective study over a period of two years: from January 1, 2019 to December 31, 2020. All patients admitted to the two departments presenting with an acute subdural hematomapost-traumatic, operated, of all ages and both genders during the cited period were included. All patients with an ASDH whose files were incomplete, lost to view, discharge were excluded. This allowed us to collect 73 cases. This information was entered in Microsoft Excel 2019 and processed by the EPI INFO version 7 software. This study was carried out by consulting the patient files and by noting the following information on the survey sheets: epidemiological parameters, demographic parameters, history of the trauma, clinical and paraclinical parameters, therapeutic parameters, evolutionary parameters and prognoses. This is a retrospective study with limitations on the parameters that could bias the results and interpretations. The total number of patients in decompressivecraniectomie and craniotomies are unequal which limits the comparison of each parameter. Finally, the total number of patients does not reflect the situation of the whole of Madagascar.

## 3 Results

### 3.1 Epidemiological parameter

In total, 172 cases of ASDH of 2156 cases of head trauma (7.98%), giving an incidence of 86 cases per year. Among the 172 cases of ASDH, 73 cases were operated (42.44%). The average age of our patients was 37.84 years with an extreme of 1 year and 78 years. There was a male predominance found in 63 cases (86.30%) with a sex ratio of 6.3. For the circumstances of the accident, the traffic accident was the most frequent with a rate of 47.95% and the main risk factors were chronic alcoholism in 31.51% of cases (30.14% smelled alcohol at admission) and epilepsy in 8.22%.

### 3.2 Clinical parameters

The main functional signs are the notion of initial loss of consciousness, found in 63 patients (86.30% of cases).On admission, 46.58% of cases were classified as severe head trauma with an initial Glasgow score inferior 8. The average initial Glasgow score was 9.47. Before the operation, 16 patients became comatose and switched to a score of less than 8, with an average of 7.68 (Table 1). Pupil examination showed that 36 patients or 49.32% presented equal and reactive pupils and 25 patients (34.25%) had an anisocoria

**Table 1** Glasgow score initial and before surgery

| Glasgow score | Initial: n (%) | Before surgery: n (%) |
|---|---|---|
| 3-8 | 34 (46.58) | 50 (68.49) |
| 9-12 | 20 (27.40) | 16 (21.92) |
| 13-15 | 19 (26.03) | 7 (9.59) |

### 3.3 Paraclinical parameters

On brain CT scan, hematoma thickness was less than 10 mm in 52.05% of cases, with an average of 9.94 mm (Table 2). The mean midline deviation was 7.53 mm (Table 3). Of the 73 patients, 41 cases (56.16%) had cerebral contusions associated with ASDH, 16.44% of epidural hematomas, 8.22% of intracerebral hematoma and 19.18% of cranial fractures.

**Table 2** Distribution according to hematoma thickness

| Hematoma thickness (mm) | Frequency (n=73) | Percentage (%) |
|---|---|---|
| <10 | 38 | 52.05 |
| 10-20 | 29 | 39.73 |
| 20-30 | 6 | 8.22 |

**Table 3** Distribution according to the position of the median line

| Midline deviation (mm) | Frequency (N=73) | Percentage (%) |
|---|---|---|
| <5 | 7 | 9.59 |
| 5-10 | 46 | 63.01 |
| ≥10 | 20 | 27.40 |

### 3.4 Treatment

The time between trauma and surgery was less than 24 hours in 63.01%, between 24 and 72 hours in 23.29% of cases with an average of 42.65 hours. Among the 73 patients, 54 cases (73.97%) underwent décompressivecraniectomy (66.67% of cases were lost flap and 33.33% were nurse flap) and 19 cases (26.03 %) a craniotomy.

### 3.5 Evolution of patients

In this study, 31 cases or 42.46% had a favorable evolution with a mortality rate of 47.94% and 7 cases or 9.59% presented neurological sequel. Surgical complications were: twice then a sero-haematic leak and infection of the operative wound. Infectious complications were: 8 cases of pneumopathy and 3 cases of septic shock.The total duration of hospitalization was 11.86 days with an extreme of 1 to 70 days; the average duration of hospitalization in intensive care was 7.49 days.

### 3.6 Comparative analyzes of surgical techniques between décompressivecraniectomy and craniotomy

In relation to age: the average age for the decompressivecraniectomy was 35.63 years and 44.16 years for craniotomy. The age group comparison for decompressivecraniectomy and craniotomy revealed a non-significant difference with a p=0.12.

Compared to the initial Glasgow score: the mean initial Glasgow score for decompressivecraniectomy was 8.98 and 10.89 for craniotomy. The comparison of the Glasgow scores between the two surgical techniques showed a non-significant difference with a p=0.27.

Compared to the thickness of the hematoma: the average of the thickness of the hematoma was 9.54 mm for the decompressivecraniectomy and 11.07 mm for the craniotomy. The comparison of hematoma thicknesses between the two surgical techniques confirmed that there was no significant difference with p=0.37.

According to midline deviation: among patients who underwent decompressivecraniectomy, 34 cases had a midline deviation between 5 to 10 mm. For craniotomy, 12 cases presented a deviation of the midline between 5 to 10 mm. The average midline deviation in decompressivecraniectomy was 7.25 mm, which was almost identical to that of craniotomy: 7.21 mm. The comparison result showed a non-significant difference (p=0.98).

According to the evolution: the mortality rate for decompressive craniectomy was 46.30% and 52.63% for the craniotomy. Statistically these values did not show any significant difference with a p=0.79.

### 3.7 Comparative analysis of these surgical techniques regarding the mortality

According to the initial Glasgow score: for the Glasgow score between 9 and 12, mortality in craniotomy was high compared to mortality in decompressive craniectomy (40% versus 16%). The comparison of mortality for the two techniques taking into account the initial Glasgow score showed a non-significant difference with p=0.06.

According to the thickness of the hematoma: for a thickness between 20 to 30 mm, the mortality in the craniotomy was 20% and the mortality in the decompressivecraniectomy was 12%. Mortality according to the thickness of the hematoma showed a non-significant difference for the two techniques with a p=0.66.

According to the midline deviation: for a deviation of the midline greater than or equal to 5 mm, the mortality in the craniotomy was 100% and the mortality in the decompressivecraniectomy was 92%. The comparison of mortality in the two techniques, taking into account the deviation from the midline, showed a non-significant difference with a p=0.40.

## 4 Discussions

### 4.1 Epidemiological parameters

In this study, 172 cases of ASDH out of 2156 cases of head trauma or 7.98% were recorded, giving an incidence of 86 cases on average per year.Of the 172 cases of ASDH, 73 cases were operated (42.44%). In the literature, an average of 50 cases per year was found [6]; an incidence between 12 and 29% for some author [7]; in patients admitted with a severe TCE, the incidence was between 10 to 20% [21].

In this study, the age group 30 to 40 years was the most represented in 24.66% or 18 cases. The average age was 37.84 years with an extreme of 1 to 78 years. In the literature, this average age varies from 37.2 to 46.8 years [8, 9, 10, 11] which is comparable to our study. The male predominance is demonstrated both in our study and in the literature [8, 10, 11] indeed the majority of studies of head trauma in the literature proves this thesis. In the literature, traffic accidents vary from 50.0% to 64.1%, it is 47.95% in our study, then falls from 8.8% to 20% and physical attacks from 11, 1% to 21.7% [6, 8, 12, 13,]. As a risk factor found, 31.51% were chronic alcoholics, 34.5% according to Attal M et al [14]. Indeed, chronic alcoholism leads to cerebral atrophy and a coagulation disorder as well as a weakening of the capillaries.

### 4.2 Clinical parameters

In this series, 22 patients or 30.14% smelled an odor of alcohol on admission; 33.6% according to Sawauchi et al [15]. The most common functional sign was a notion of initial loss of consciousness in 86.30% of patients. The study by Moussa D et al [16] found 91.2%.

In this study, 46.58% of trauma victims had a Glasgow score between 3 and 8, in 27.20% of cases between 9 and 12 and in 26.03% of cases between 13 and 15 with an average of 9. 47. In the literature, Kim KH et al [17] reported that 64.8% patients had a Glasgow score ≤ 8 and 35.1% patients had a score ≥ 9. In the study by Li LM et al [ 18] was ≤ 8 in 61%, 9 to 12 in 19% and ≥ 13 in 20% of patients. Anisocoria is a sign of compression, 34.25% in our study and 22% according to Attal M et al [14], while bilateral midriasis is a sign of advanced stage of compression 25.6% in the literature [14] and 10.96% in our series. For the Glasgow score before surgery, no comparative data on the Glasgow score between the initial examination and the surgical intervention was found; too long a period between the trauma and the performance of the surgery is a factor of poor prognosis.

### 4.3 Paraclinical parameters

On brain CT, the mean thickness of the hematoma was 9.94 mm with a mean deviation from the midline of 7.53 mm and in the literature this thickness varies from 11 mm to 17 mm, [10, 12] ; and the midline deviation was 7.8 mm on average according to Yanaka et al [12]. Associated lesions are common and may be subarachnoid hemorrhage, contusion, or intracerebral hematoma [19, 20, 21]. Faced with an acute subdural hematoma, it is necessary to systematically look for the existence of associated cranioencephalic lesions because they could be the cause of an increase in intracranial hypertension.

### 4.4 Treatment

In this study, the time between trauma and surgery was less than 24 hours in 63.01% of cases and an average of 42.65 hours; 24 to 72 hours according to Maintinambo D [6]. In developed countries, this duration is less than 6 hours [17, 22]. For surgical techniques, 73.97% of our patients underwent a decompressivecraniectomy and 26.03% a craniotomy. In the literature, the statistics between craniotomy and craniotomy differ from one study to another, indeed there is no clear recommendation as to the realization of one technique compared to the other [6, 18, 23, 24, 25, 26]. In the case of a decompressivecraniectomy, the cranial flap can be discarded in the absence of means of conservation of the flap or kept in nurseries depending on the state of this because it can be destroyed because of the trauma.

### 4.5 Evolution of patients

In this study, 42.46% had a favorable outcome; the mortality rate was 47.95%. According to Woertgen C et al [27], mortality was 39.9%, only 36.6% of patients obtained a favorable outcome. According to Trevisi G et al [28], 31% of patients died 48 (23%) good recovery; for Ronald H et al [29], a mortality rate of 49.1% in patients operated on for ASDH. In the literature, the average duration of hospitalization was 12-17 days [28, 30], it is 11.86 days in our study.

### 4.6 Comparative analysis between the two surgical techniques

In our cases, no study parameter is significant. Thus in the present study and according to the literature neither the age, nor the Glasgow score, nor the value of the deviation from the midline, nor the mortality rate constitute a parameter to be taken into account on the technique [23, 24, 26, 31, 32]. The choice and decision to perform a décompressivecraniectomy versus a craniotomy with replacement of the flap to evacuate an acute subdural hematoma depends on the expertise of the neurosurgeon and to be discussed case by case, on the other hand the existence of a discrepancy between the shift and the volume of the hematoma, a shift greater than the volume of the hematoma directs towards a decompressivecraniectomy.

## 5 Conclusion

Acute subdural hematoma is a neurosurgical emergency and a daily practice in the neurosurgery department. The key examination in order to make the diagnosis is the cerebral CT scan without injection of contrast product. In the literature, there is no consensus on the choice of surgical technique to use. Decision-making in the choice of surgical technique was not influenced by age, Glasgow score, and hematoma thickness. The Glasgow score is a very important parameter for a traumatic brain injury. A delay in care is a factor of worsening of the neurological state of the patient, therefore a reduction in the Glasgow score. This study highlighted that patient who had an initial Glasgow score between 9 to 12, a hematoma thickness between 20 to 30 mm and a midline deviation greater than or equal to 5 mm should have be operated by decompressivecraniectomy than by craniotomy. The choice between the techniques depends on the expertise of each surgeon; he would be free to choose the technique that suits him on a case-by-case basis. Thus, a prospective study, at best a randomized study, should be carried out in order to have and write a protocol for the management of patients with traumatic brain injury who present with ASDH.

## Compliance with ethical standards

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*Disclosure of conflict of interest*

There is no conflict interest and no competing interest.

## References

[1] Agrawal A, Coronado VG, Bell JM, Baisakhiya N, Kakani A, Galwankar S et al. Characteristics of patients who died from traumatic brain injury in two rural hospital emergency departments in Maharashtra, India, 2007–2009. Int J CritIllnInj Sci. 2014; 4(4):293–7.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4296331/. Accessed 15August 2022.

[2] Ross AG. Prudent care of head trauma in the elderly: a case report. J Med Case Rep. 2014; 8(1):448.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4307970/. Accessed 15August 2022.

[3] Compagnone C, Murray GD, Teasdale GM, Maas AI, Esposito D, Princi P et al. The management of patients with intradural post-traumatic mass lesions: a multicenter survey of current approaches to surgical management in 729 patients coordinated by the European Brain Injury Consortium. Neurosurgery. 2007; 61(1):232–40.https://pubmed.ncbi.nlm.nih.gov/16331166/. Accessed 15August 2022.

[4] Hase U, Reulen HJ, Meinig G, Schürmann K. The influence of the decompressive operation on the intracranial pressure and the pressure-volume relation in patients with severe head injuries. Acta Neurochir. 1978;45(1-2):1-13.https://pubmed.ncbi.nlm.nih.gov/742427/. Accessed 15August 2022.

[5] Kolias AG, Adams H, Timofeev I, Czosnyka M, Corteen EA, Pickard JD et al. Decompressivecraniectomy following traumatic brain injury: developing the evidence base. Br J Neurosurg. 2016;30(2):246-50.https://pubmed.ncbi.nlm.nih.gov/26972805/. Accessed 15August 2022.

[6] Maintinambo D. Epidemio-clinical aspect of SDH at CHUJRA [Thesis] Human Medecine: Antananarivo, 2018.http://biblio.univ-antananarivo.mg/theses2/rechercheAction.action;jsessionid=EA14DDC250D9CA668CAB48166AE82702. Accessed 15August 2022.

[7] Bullock MR, Chesnut R, Ghajar J, Gordon D, Hartl R, Newell DW, et al. Surgical Management of Acute Subdural Hematomas. Neurosurgery. 1 mars 2006; 58(3):S2-16-S2-24.https://pubmed.ncbi.nlm.nih.gov/26972805/. Accessed 15August 2022.

[8] Khan B, Afridi EAK, Khan B, Khan SA, Khan AA, Khan W. decompressivecraniectomy for acute subdural haematoma with expansileduraplasty versus dural-slits. J Ayub Med Coll Abbottabad. 2016; 28(2):285-288.https://pubmed.ncbi.nlm.nih.gov/28718535/. Accessed 15August 2022.

[9] Nguyen H, Janich K, Sharma A, Mohit P, Mueller W. To Retain or Remove the Bone Flap During Evacuation of Acute Subdural Hematoma. WNEU. 2016 Novembre; 95: 85 – 90.https://pubmed.ncbi.nlm.nih.gov/27476687/.Accessed 15August 2022.

[10] Alagoz F, Yildirim AE, Sahinoglu M, Korkmaz M, Secer M, Celik H et al. Traumatic Acute Subdural Hematomas: Analysis of Outcomes and Predictive Factors at a Single Center.TurkNeurosurg. 2017; 27(2): 187 – 91.https://pubmed.ncbi.nlm.nih.gov/28718535/. Accessed 15August 2022.

[11] Kalayci M, Aktunç E, Gül S, Hanci V, Edebali N, Çagavi F et al. Decompressivecraniectomy for acute subdural haematoma: An overview of current prognostic factors and a discussion about some novel prognostic parametres. J Pak Med Assoc. 2013; 63(1):38-49.https://pubmed.ncbi.nlm.nih.gov/23865130/. Accessed 15August 2022.

[12] Yanaka K, Kamezaki T, Yamada T, Takano S, Meguro K, Nose T. Acute subdural hematoma : prediction of outcome with a linear discriminant function. Neurol Med Chir Tokyo. 1993; 33(8): 552-8.https://pubmed.ncbi.nlm.nih.gov/9457718/. Accessed 15August 2022.

[13] Tian HL, Chen SW, Xu T, Hu J, Rong BY, Wang G et al. Risk factors related to hospital mortality in patients with isolated traumatic acute subdural hematoma: analysis of 308 patients undergone surgery. Chin Med J Engl. 2008; 121(12): 1080-4.https://pubmed.ncbi.nlm.nih.gov/18706221/. Accessed 15August 2022.

[14] Attal M. Predictive factors of poor prognosis at the initial management of acute subdural hematomas s [Thesis]. Human Medecine : University of Bourbogne, 2017.https://docplayer.fr › 210151197-Annee-2017-facteurs-pr.... Accessed 15August 2022.

[15] Sawauchi et al. Mechanism of injury in acute Subdural hematoma and diffuse brain injury : analysis of 587 cases in the Japan Neurotrauma Data Bank. No ShinkeiGeka, 2007; 35 (7): 665-71.https://pubmed.ncbi.nlm.nih.gov/17633509/. Accessed 15August 2022.

[16] Moussa DD, Youssouf DS, Drissa PK. Président : Pr. DIANGO DjiboMahamaneMembre. Epidemio-clinical study and prognosis of acute subdural hematomas at CHU GABRIEL TOUR [Thesis] 2021 : 98.https://bibliosante.ml/bitstream/handle/123456789/4682/21M115.pdf?sequence=1. Accessed 15August 2022.

[17] Kim K.H, M.D, Ph.D. Predictors for Functional Recovery and Mortality of Surgically Treated Traumatic Acute Subdural Hematomas in 256 Patients. J KoreanNeurosurg Soc. 2009; 45: 143 – 50, DOI: 10.3340/jkns. 2009; 45(3):143-50.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2666115/. Accessed 15August 2022.

[18] Li LM, Kolias AG, Guilfoyle MR, Timofeev I, Corteen EA, Pickard JD et al. Outcome following evacuation of acute subdural haematomas: a comparison of craniotomy with decompressivecraniectomy. Acta Neurochir. sept 2012;154(9):1555-61.https://pubmed.ncbi.nlm.nih.gov/22752713/. Accessed 15August 2022.

[19] Cordobes F, Lobato R, Rivas J, Munoz M, Chillon D, Portillo J, Lamas E. Observations sur 82 patients atteintsd'hématome extradural. Comparaison des résultatsavant et après l'avènement de la tomodensitométrie.JNeurochirurgien. 1981 ; 54(2):179-86.https://pubmed.ncbi.nlm.nih.gov/22752713/https://ajns.paans.org/lhematome-extradural-opere-au-chu-joseph-ravoahangy-andrianavalona-antananarivo-madagascar/. Accessed 15August 2022.

[20] Leitgeb J, Mauritz W, Brazinova A, Janciak I, Majdan M, Wilbacher I. Outcome after severe brain trauma due to acute subdural hematoma. J Neurosurg. 2012; 117(2):324-33.https://pubmed.ncbi.nlm.nih.gov/22631691/. Accessed 15August 2022.

[21] Karibe H, Hayashi T, Hirano T, Kameyama M, Nakagawa A, Tominaga T. Surgical Management of Traumatic Acute Subdural Hematoma in Adults: A Review. Neurol Med Chir(Tokyo). 2014; 54(11):887 94.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4533344/. Accessed 15August 2022.

[22] Brian P, Arjun K, Churl-Su K, Westley H, Brian V, Jean-Valey C. Time interval to surgery and outcome following the surgical treatement of acute traumatic subdural hematoma. J ClinNeurosci. Décembre 2014; 21 (12): 2107 – 11.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4250331/. Accessed 15August 2022.

[23] Chen S-H, Chen Y, Fang W-K, Huang D-W, Huang K-C, Tseng S-H. Comparison of Craniotomy and DecompressiveCraniectomy in Severely Head-Injured Patients With Acute Subdural Hematoma. Journal of Trauma: Injury, Infection & Critical Care. déc 2011;71(6):1632-6.https://pubmed.ncbi.nlm.nih.gov/22027888/. Accessed 15August 2022.

[24] Kwon YS, Yang KH, Lee YH. Craniotomy or Decompressive Craniectomy for Acute Subdural Hematomas: Surgical Selection and Clinical Outcome. Korean J Neurotrauma. 2016;12(1):22.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4866560/. Accessed 15August 2022.

[25] Kolias AG, Scotton WJ, Belli A, King AT, Brennan PM, Bulters DO et al. Surgical management of acute subdural hematomas : current practice pattern in the UK and the Republic of Irland . Br J Neurosurg. 2013 ; 27(3):330-3.https://discovery.dundee.ac.uk/en/publications/surgical-management-of-acute-subdural-haematomas-current-practice. Accessed 15August 2022.

[26] Ahmed N, Greenberg P, Shin S. Mortality Outcome of Emergency Decompressive Craniectomy and Craniotomy in the Management of Acute Subdural Hematoma: A National Data Analysis. The American Surgeon. mars 2021;87(3):347-53.https://pubmed.ncbi.nlm.nih.gov/32972240/. Accessed 15August 2022.

[27] Woertgen C, Rothoerl RD, Schebesch KM, Albert R. Comparison of craniotomy and craniectomy in patients with acute subdural haematoma. Journal of Clinical Neuroscience. août 2006;13(7):718-21.https://pubmed.ncbi.nlm.nih.gov/16904897/. Accessed 15August 2022.

[28] Trevisi G, Sturiale CL, Scerrati A, Rustemi O, Ricciardi L, Raneri F et al. Acute subdural hematoma in the elderly: outcome analysis in a retrospective multicentric series of 213 patients. Neurosurgical Focus. oct 2020;49(4):E21. https://pubmed.ncbi.nlm.nih.gov/33002873/. Accessed 15August 2022.

[29] Ronald H, Frederick JA, HoevenHvd, Edwards M, Prokop M. Midline shift in relation to thickness of traumatic acute subdural hématoma predicts mortality. BMC Neurology. 2015; 15(1): 220.https://pubmed.ncbi.nlm.nih.gov/26496765/;Accessed 15August 2022.

[30] Diallo O, Alliez JR, Ndoye N, Diani N, Coulibaly Y, Mounkoro R, Alliez B. Priseen charge des hématomes sous durauxaigus à l'hôpitalnord de Marseille. A propos de 100 cas. J. Neurosurgery. 1995 ; 82(6) :961-965.https://docplayer.fr/83547834-Prise-en-charge-des-hematomes-sous-duraux-aigus-a-l-hopital-nord-de-marseille-management-of-acute-subdural-hematoma-at-the-north-hospital-of-marseille.html. Accessed 15August 2022.

[31] Altaf I, Shams S, Vohra AH. Role of surgical modality and timing of surgery as clinical outcome predictors following acute subdural hematoma evacuation. Pak J Med Sci [Internet]. 12 févr 2020 [cité 1 oct 2021];36(3). Disponible sur: https://www.pjms.org.pk/index.php/pjms/article/view/1771; Accessed 15August 2022.

[32] Vilcinis R, Bunevicius A, Tamasauskas A. The Association of Surgical Method with Outcomes of Acute Subdural Hematoma Patients: Experience with 643 Consecutive Patients. World Neurosurgery. mai2017;101:335-42.https://pubmed.ncbi.nlm.nih.gov/28216211/; Accessed 15August 2022.