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ORIGINAL ARTICLE

Conservative Versus Surgical Management of Cranial Pediatric Epidural Hemorrhage

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Abstract

Background: **Epidural (extradural) hemorrhage (EDH) is a collection of blood between the inner surface of the skull and the stripped-off dural membrane due to traumatic brain injury.**

Aim of the work: **To evaluate the management of cranial epidural hemorrhage in pediatric patients (conservative versus surgical).**

Patients and methods: **This study was a prospective and retrospective study, which was conducted at the Department of neurosurgery in Al-Azhar University Hospitals, National Bank Hospital, and Nasr City Insurance Hospital on 40 pediatric patients, who had epidural hemorrhage. The patients included neonates, infants, and children of both sexes till 14 years old, and in EDH supratentorial or infratentorial. We excluded hemodynamically unstable patients, GCS 3 with dilated fixed pupils and spontaneous EDH.**

Results: **Conservative management was done among those with EDH thickness <0.5 cm (13 cases; 65%) and those ranged between 0.5 and 1 cm (7 cases; 35%), and regarding EDH volume the conservative management was done among cases with volume <15 cm^3 (17; 85%) and ranged between 15 and 30 cm^3 (3; 15%). However, surgical intervention was done among 20 patients with EDH thickness >1 cm and for volume >30 cm^3 (19; 95%) and one case with volume in between 15 and 30 cm^3.**

GCS at admission did not show significant difference among both management groups. However, in the conservative management group majority of patients (70%) were fully conscious in comparison to 40% in the surgical group.

Conclusion: **Conservative management among pediatrics with EDH thickness <1 cm and with volume <30 cm^3 had comparable results with surgical managements regarding GOS.**

Keywords: Epidural hemorrhage, Head injury, Pediatric

1. Introduction

Acute epidural hemorrhage (EDH) in pediatric patients is relatively uncommon, representing 2–3% of all traumatic brain injury in this population. EDH is more common in young people although it does occur in all age groups, but it is rare before the age of 2 years because of tenacious dural attachment to the inner surface of the skull in these age groups.[1] Male-to-female ratio was 4:1. Most EDH occurs in the temporoparietal regions (73%) in the territory of the middle meningeal arteries and veins.[2]

It's presentation is variable. It presented with symptoms of increased intracranial pressure such as headache, vomiting, focal deficit, and change in mental status. Skull fracture is associated with EDH in 65%–90% of patients.[2]

The treatment of choice is emergency craniotomy and evacuation of EDH; it decreases majority of

Abbreviations: CT, Computed tomography; EDH, Epidural hematoma; FFH, Falling from height; GCS, Glasgow Coma Scale; IHT, Isolated head trauma; KOSCHI, King's Outcome Scale for Childhood Head Injury; MMA, Middle meningeal artery; OA, On admission; RTA, Road traffic accident; SAH, Subarachnoid hemorrhage; SDH, Subdural hematoma; TBI, Traumatic brain injuries.

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mortality and are disability related. McLauren and Towbin[3] mentioned: 'the definite treatment of EDH should always be surgical evacuation, and delay of such treatment is unacceptable.' However, conservative management of minor EDH shows perfect outcomes in the pediatric sector.[3]

The main factors to decide whether surgical or conservative treatment of EDH are clinical, neurological status and the presence of midline shift (more than 5 mm). However size alone is not the main indication for surgery.[4]

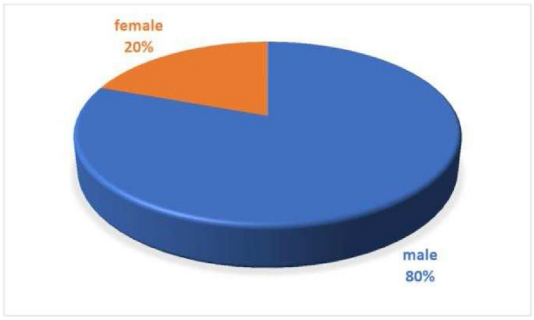

Fig. 1. Pie chart displaying the Sex of the studied group (n = 40).

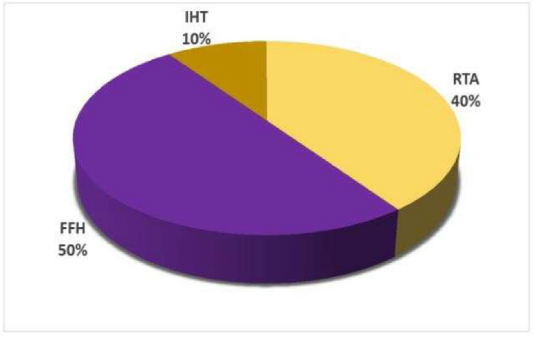

Fig. 2. Pie chart displaying the mode of trauma among the studied group (n = 40).

So, we aimed in this study to evaluate the management of cranial epidural hemorrhage in pediatric patients (conservative versus surgical).

1.1. Patients and methods

This is a prospective and retrospective study, which was conducted (at the department of neurosurgery in Al-Azhar University hospitals and other Neurosurgical centers) on 40 pediatric patients who had epidural hemorrhage.

All patients were subjected to the following protocol: Full detailed history, full neurological examination of patients, full laboratory, radiological evaluation as needed, medical management, surgical procedures, carful follow-up of patients and their neurological status and finally postoperative CT brain for follow-up.

Inclusion Criteria were neonates, infants, children till 14 years old, both sexes, and EDH supratentorial or infratentorial, while exclusion criteria were hemodynamically unstable patients, GCS 3 with dilated fixed pupils, and spontaneous EDH.

2. Results

In this study, the results of 40 pediatric head-injured patients with EDH are presented in the form of figures and tables involving numbers of patients and their ratios Figs. 1–5.

Table 1 shows the source of bleeding in the surgical group; the most common source was middle meningeal artery and bone fissure (45%) and shows that 50% of the children were treated conservatively and 50% were treated surgically, and the methods of bleeding control were 12.5% by gel foam, dural tucking, and bone wax, while 37.5% by bipolar coagulation, dural tucking, and bone wax) Fig. 6.

Table 2 shows that according to GOS, 95.2% of the children showed good recovery (GOS 5); 2.4% had

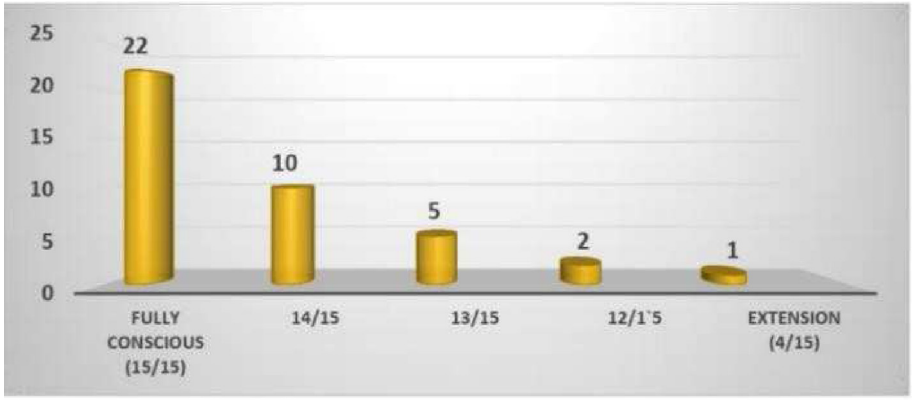

Fig. 3. Bar chart displaying the GCS (on admission) among the studied group (n = 40).

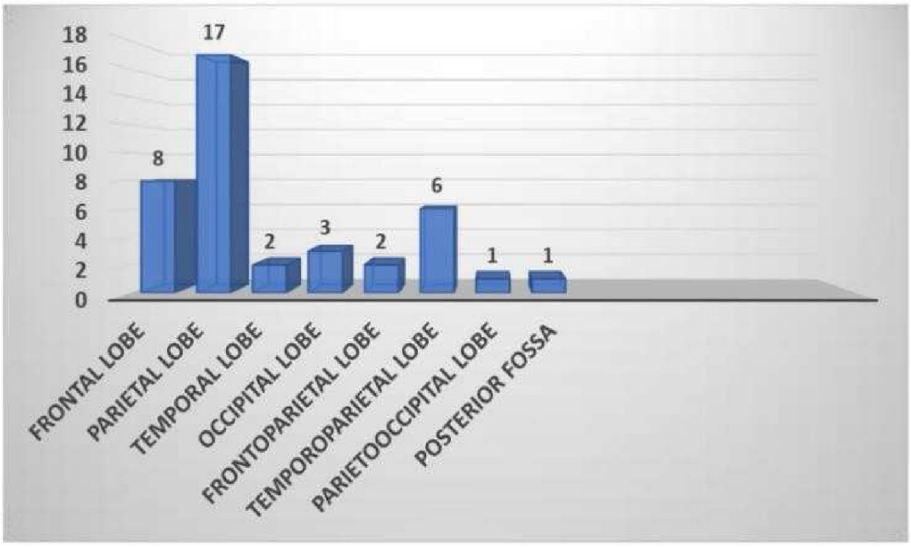

Fig. 4. Bar chart displaying the EDH site among the studied group (n = 40).

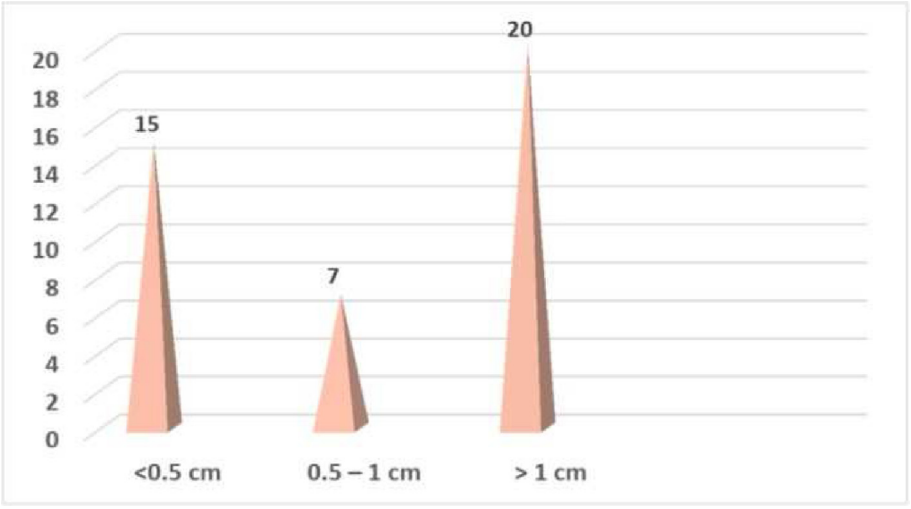

Fig. 5. Bar chart displaying the EDH thickness among the studied group (n = 40).

moderate disability (GOS 4); and 2.4% had died (GOS 1).

*GOS applies to patients with brain injuries for the objective assessment of their recovery in five categories. This predicts the long-term course of rehabilitation.

(Table 3) King's Outcome Scale for Childhood Head Injury.

Table 4 shows no significant difference between conservative and surgical management as regards either age or Sex (P value 0.143 and 0.114, respectively); shows no significant difference between conservative and surgical management as regards the mode of trauma (P value 0.407); and shows no significant difference between conservative and surgical management as regards GCS on admission (P value 0.169).

Table 5 shows a significant difference between conservative and surgical management as regards both EDH thickness and volume on admission (P value < 0.0001, <0.0001, respectively), while there is

Table 1. Source of bleeding and method of bleeding control among the surgical group (n = 20).

	n = 20
Source of bleeding	
Bone fissure	5 (25%)
Middle meningeal artery (MMA)	4 (20%)
MMA and bone fissure	9 (45%)
Depressed bone fracture	1 (5%)
Dural veins and bone fissure	1 (5%)
Method of bleeding control	
Conservative	20 (50%)
Gel foam, dural tucking, and bone wax	5 (12.5%)
Bipolar coagulation, dural tucking, and bone wax	15 (37.5%)

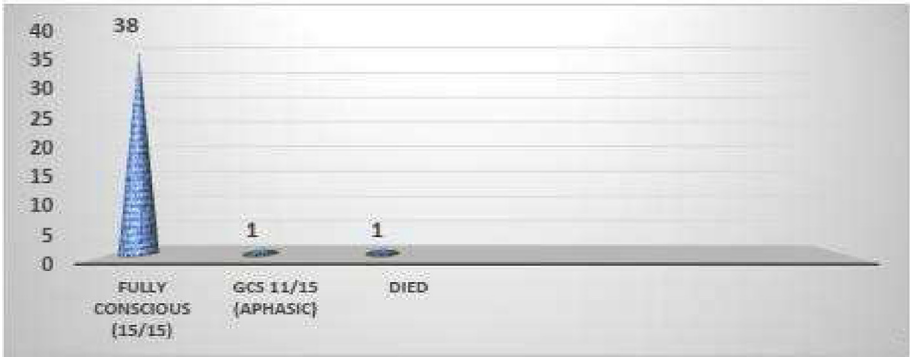

Fig. 6. Bar chart displaying the GCS (on discharge) among the studied group (n = 40).

Table 2. The Glasgow Outcome Score (GOS) among the studied group (n = 40).

		n = 40
GOS*	1 (death)	1 (2.5%)
	4 (moderate in ability)	1 (2.5%)
	5 (good recovery)	38 (95%)

no significant difference between them as regards either EDH side or site (P value 0.535 and 0.107, respectively).

Table 6 shows no significant difference between conservative and surgical management as regards GCS on discharge (P value 0.349).

Table 7 shows a significant difference between conservative and surgical management as regards both EDH size and volume of bleeding during follow-up (P value < 0.0001 and < 0.0001).

Table 8 shows no significant difference between conservative and surgical management as regards GOS on discharge (P value 0.349).

3. Discussion

Traumatic brain injury (TBI) is a common cause of mortality and acquired neurological disability in children. Acute pediatric epidural hemorrhage (EDH) in children is relatively uncommon; it is about 2–3% of all TBI cases in this age group. Pediatric EDH raises a significant diagnostic challenge compared with adult EDH.[5]

Table 3. King's outcome scale for childhood head injury.

1. Death	
2. Persistent vegetative state	Severe injury with prolonged state of unresponsiveness and impairment of higher mental functions
3. Severe disability	Severe injury with permanent need for help with daily living
4. Moderate disability	No need for assistance in everyday life, employment is possible but may require special equipment.
5. Good recovery	A complete recovery with no apparent sequalae from head trauma.

Table 4. Comparison between conservative and surgical management as regard s sociodemographic data, mode of trauma among the studied group, and GCS of the studied group on admission (n = 40).

	Conservative (n = 20)	Surgical (n = 20)	n = 40 P value
Age			
Mean (IQR)	9 (3.5 y–13.75 y)	6.5 (13 m–10 y)	0.143
Sex			
Male	18 (90%)	14 (70%)	0.114
Female	2 (10%)	6 (30%)	
Mode of trauma			
RTA	10 (50%)	6 (30%)	0.407
FFH	8 (40%)	12 (60%)	
IHT	2 (10%)	2 (10%)	
GCS (OA)			
Fully conscious (15/15)	14 (70%)	8 (40%)	
14/15	5 (25%)	5 (25%)	0.169
13/15	1 (5%)	4 (20%)	
12/15	0	2 (10%)	
4/15	0	1 (5%)	

Table 5. Comparison between conservative and surgical management as regards radiologicala findings of the studied group on admission (n = 40).

	Conservative (n = 20)	Surgical (n = 20)	n = 40 P value
Extradural hemorrhage side Right	11 (55%)	9 (45%)	
Left	9 (45%)	10 (50%)	0.535
Posterior fossa	0	1 (5%)	
Extradural hemorrhage site			
Frontal lobe	4 (20%)	4 (20%)	
Parietal lobe	11 (55%)	6 (30%)	
Temporal lobe	2 (10%)	0	
Occipital lobe	2 (10%)	1 (5%)	
Frontoparietal lobe	1 (5%)	1 (5%)	
Temporoparietal lobe	0	6 (30%)	
Parietooccipital lobe	0	1 (5%)	0.107
Posterior fossa	0	1 (5%)	
Extradural hemorrhage thickness (OA)			
<0.5 cm	13 (65%)	0	
0.5–1 cm	7 (35%)	0	<0.0001*
>1 cm	0	20 (100%)	
Extradural hemorrhage volume (OA)			
<15 cm^3	17 (85%)	0	
15–30 cm^3	3 (15%)	1 (5%)	<0.0001*
>30 cm^3	0	19 (95%)	

Table 6. Comparison between conservative and surgical management as regards GCS of the studied group on discharge (n = 40).

	Conservative (n = 20)	Surgical (n = 20)	n = 40 P value
GCS (OD)			
Fully conscious (15/15)	20 (100%)	18 (90%)	
11/15	0	1 (5%)	0.349
Died	0	1 (5%)	

Table 7. Comparison between conservative and surgical management as regards radiological findings of the studied group (follow-up) (n = 40).

	Conservative (n = 20)	Surgical (n = 20)	n = 40 P value
Extradural hemorrhage thickness (follow-up)			
<0.5 cm	13 (65%)	0	
0.5–1 cm	7 (35%)	0	<0.0001*
>1 cm	0	0	
Completely evacuated	0	20 (100%)	
Extradural hemorrhage volume (follow- up)			
<15 cm^3	16 (80%)	0	
15–30 cm^3	4 (20%)	0	<0.0001*
>30 cm^3	0	0	
Completely evacuated	0	20 (100%)	

Table 8. Comparison between conservative and surgical management as regards the Glasgow Outcome Score (GOS) among the studied group (n = 40).

	Conservative (n = 21)	Surgical (n = 20)	n = 40 P value
GOS			
1 (death)	0	1 (5%)	0.349
4 (moderate disability)	0	1 (5%)	
5 (good recovery)	20 (100%)	18 (90%)	

The widespread use of computed tomography (CT) as a standard diagnostic tool provides prompt and accurate detection of EDH. However, it remains challenging to choose whether surgical or conservative management is better in special patients.[6] So, we aimed in the current study to evaluate the management of cranial epidural hemorrhage in pediatric patients (conservative versus surgical).

We enrolled 40 pediatric patients who had epidural hemorrhage. 20 of them were treated conservatively and 20 were treated surgically.

The mean ± SD age of the studied pediatric patients was 7.56 ± 5.04 years in the current study. This is in line with Umerani et al.[7] study as EDH was the most common among the school going age (5–14) years and with the Binder et al.[5] study, where the median age of the patients was around 8 years.

Infants were reportedly rare in many series, which was 2.7% in the Umerani et al.[7] study because of tight dural adherence to the inner surface of the skull in this age group. Jamous et al.[6] reported that pediatric EDH is more common in children and toddlers due to the decrease of fibrovascular attachments between the dura and the skull as compared with infants where EDH is rare.[6]

The majority of our participants were males (32, 80%) compared with 8 females (20%), in accordance with many studies such as te Ali and Anand[8] study, who observed that out of 45 patients, 29 are males while 16 are females.

Regarding mode of injury in the present study, 50% of our patients had EDH due to fall from height,

40% due to road traffic accident (RTA), and 10% due to isolated head trauma.

This is in harmony with the Al-Mamoori[9] study as accidental falling comprises the highest incidence (47.1%), followed by RTA as the second highest incidence (24.8%) of the causative mechanisms of injury in this study.

In the current study, the most common site of EDH is parietal lobe (42.5%) followed by frontal lobe (20%).

This is in line with Al-Mamoori,[9] where parietal EDH was found in 36% followed by frontal EDH in 23% of all cases of EDH. This is consistent with other studies in which regional preponderance toward the parietal region is found as in the Gerlach et al.[10] study.

Infratentorial (posterior fossa) EDHs account for only 9% of all cases of EDH in Al-Mamoori[9] study. However, in our study it was found only in one case (2.5%). This may be because of tight dural adherence in the posterior cranial fossa in comparison with anterior and middle cranial fossae.[9]

Among our patients, EDH was found in 50% on the right side, 47.5% on the left side, and only in one case in the posterior fossa. This is in comparison with Al-Mamoori[9] as more than half of all EDHs present on the right side (53%) whereas the left side constitute 43%, and (4%) were bilateral EDHs. In the same line, Gerlach et al.[10] reported that right parietal region contributes more than half of cases, which is consistent with our study. In contrast, Nath et al.[11] found that left side is commonly affected than the right side.

Different associated injuries were reported among studies as in our study; one case has EDH and compound depressed fracture. One case has both EDH and SDH. In the Al-Mamoori[9] study, skull fracture is the most common associated pathology (92.2%) of all cases, of which linear fractures have the highest incidence (55%), followed by depressed fracture (22%). In the Umerani et al.[7] study, 48 (66.7%) out of 72 EDH had scalp hematoma or lacerations.

The source of bleeding in the surgical group in the present study was middle meningeal artery and bone fissure (45%), bone fissure (25%), and middle meningeal artery (20%). Middle meningeal artery and/or vein are identified as a source of bleeding in half of operative EDH cases in Al-Mamoori[9] study in agreement with our findings. The rest of cases constitute 22.7% from diploic veins, 15.5% from small dural vessels, and 11.8% from dural venous sinuses.

Conservative management was done among those with EDH thickness<0.5 cm (13 cases; 65%) and those ranged from 0.5 to 1 cm (7 cases; 35%), and regarding EDH volume the conservative management was done among cases with volume <15 cm^3 (17; 85%) and ranged from 15 to 30 cm^3 (3; 15%). However, surgical intervention was done among 20 patients with EDH thickness >1 cm and for EDH volume >30 cm^3 (19; 95%) and one case with volume in between 15 and 30 cm^3.

In our study, GCS at admission did not show significant difference among both management groups. However, in the conservative management group majority of patients (70%) were fully conscious in comparison to 40% in the surgical group.

Studies confirmed that extradural posttraumatic hematoma with a volume of less than 30 ml can be efficiently managed by conservative management.[12] It has been suggested by Zakaria et al.[13] that a large extradural hematoma, which has a volume of more than 30 cm^3 should be managed by surgical evacuation in higher GCS.

Another study by Mehmet Bülent et al.[14] confirms that conservative treatment for extradural hematoma should be applied in small size hematomas and those with higher GCS or unchanged neurological condition. Although spontaneous resolution is observed in many mild cases, conservative treatment in unchanged neurological condition had shown good outcomes in terms of higher Glasgow Outcome Score (GOS).

In the Al-Mamoori[9] study, surgical intervention is done for 110 cases of EDH and the rest 100 cases have been managed conservatively by careful neurological monitoring and serial follow-up CT scans during their hospitalization. In this study, two reliable categories for doing surgery are used: (1) clinical evaluation—GCS score lower than 8 and presence of neurological deficits and (2) CT-scan findings: EDH of more than 15 mm thickness and midline shift of more than 5 mm.

Regarding outcome by comparing both modalities, the results were comparable; we did not report significant difference between conservative and surgical management as regards GOS on discharge. In the conservative group, no deaths were reported; however, in the operative group only one mortality case was reported (5%) and one case with disability (5%).

We found no significant difference between conservative and surgical treatment as regards age or Sex, mode of trauma, and GCS on admission as well as discharge.

In the Al-Mamoori[9] study, GOS has been applied to assess the outcome of their patients after trauma. Good recovery with no disability is reported in 69%

of patients, which included 38% of operative cases and 31% of conservative cases; most of them were conscious at the time of presentation. Moderate disability reported in 18.1% of patients, which included 8.1% operative cases and 10% of conservative cases. Severe disability is reported in 4.8% patients, which included 1.4% operative cases and 3.3% conservative cases. In their study, high incidence of death, persistent vegetative state, and moderate and severe disability are reported in conservatively managed cases; they can explain by the fact that all of these cases have associated intracranial and/or extracranial pathologies and were comatose on presentation.

Regarding prognostic factors of outcome Al-Mamoori[9] reported that associated intracranial and/or extracranial pathologies have detrimental effects on general neurological status and final recovery. Bullock et al.[15] reported worse outcomes in EDH cases who undergo surgical intervention in association with SDH and/or parenchymal lesions.

Ali and Anand[8] concluded that the location of hemorrhage, volume of the hematoma, and GCS on admission has significant influence on the prognosis of the extradural hematoma.

In the current study, mortality was reported only in one case among the operative group (2.5% of all patients) that was lower than many studies.

Regarding Binder et al.,[5] the hospital mortality rate was 5% and the overall mortality in Al-Mamoori[9] study is 6.7% (n = 14); all of them were unconscious at the time of presentation and had associated intracranial and/or extracranial pathologies. Mortality is less in operative cases (2.4%) as compared with conservatively managed cases (4.3%).

Mortality rate in the Umerani et al.[7] study was 8.3% and was strongly associated with male patients, none of the female patients died. The West China hospital study reported that 66% of patients were male and majority of the death were due to fall from height.

The discrepancy between results may contributed to the difference in characters of included participants, associated injury of them and their GCS.

Both surgical and conservative treatments should have excellent outcome if they were accomplished on a solid basis. Clinical and neuroimaging evaluations have a fundamental role in optimal therapeutic decision-making. Conservative management need close neurological observation and periodic CT examinations with volumetric analysis of EDH; for that reason, it should be achieved in specialized neurosurgical centers. Judicious surgical intervention based on clear clinical and neuroimaging indications can result in excellent long-term outcome. In borderline cases (EDH thickness 10–15 mm, midline shift <5 mm, GCS score 9–12 with mild neurological deficits, and in cases of posterior fossa EDH with mild mass effect and mild dilated ventricles), surgical evacuation of epidural hematomas in optimal circumstances may decrease the hospital stay time with better cost–benefit ratio than conservative treatment.[9]

3.1. Conclusion

Conservative management among pediatrics with EDH thickness <1 cm and with EDH volume <30 cm^3 had comparable results with surgical managements regarding GOS.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

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Conflicts of interest

The authors declared that there were no conflicts of interest.

References

1. Greenberg MS. *Handbook of Neurosurgery*. seventh ed. New York: Thieme Medical Publishers; 2010:894–896.
2. Blumbergs PC. Neuropathology of traumatic brain injury. In: Richard Winn H, ed. *Youmans Neurological Surgery*. sixth ed. Philadelphia: Elsevier Saunders; 2011:3294–3296.
3. Chen TY, Wong CW, Chang CN, et al. The expectant treatment of asymptomatic supratentorial epidural hematomas. *Neurosurgery*. 1993;32:176–179. https://doi.org/10.1227/00006123-199302000-00004.
4. Bejjani GK, Donahue DJ, Rusin J, et al. Radiological and clinical criteria for the management of epidural hematoma in children. *Pediatr Neurosurg*. 1996;25:302–308. https://doi.org/10.1159/000121144.
5. Binder H, Majdan M, Tiefenboeck TM, et al. Management and outcome of traumatic epidural hematoma in 41 infants and children from a single center. *Orthop Traumatol: Surg Res*. 2016;102:769–774. https://doi.org/10.1016/j.otsr.2016.06.003.
6. Jamous MA, Abdel Aziz H, Al Kaisy F, et al. Conservative management of acute epidural hematoma in a pediatric age group. *Pediatr Neurosurg*. 2009;45:181–184. https://doi.org/10.1159/000218200.
7. Umerani MS, Abbas A, Aziz F, et al. Pediatric extradural Hematoma: clinical assessment using King's outcome scale

for childhood head injury. *Asian J Neurosurg*. 2018;13:681–684. https://doi.org/10.4103/ajns.AJNS_164_16.
8. Ali A, Anand A. Management and factors predicting outcome of traumatic epidural hematoma in pediatric population in North East India. *Int J Pharm Clin Res*. 2021;13:226–235.
9. Al-Mamoori MJ. Management of epidural hematoma in the pediatric age group. *Med J Babylon*. 2019;16:276–285. https://doi.org/10.4103/MJBL.MJBL_47_19.
10. Gerlach R, Dittrich S, Schneider W, et al. Traumatic epidural hematomas in children and adolescents: outcome analysis in 39 consecutive unselected cases. *Pediatr Emerg Care*. 2009; 25:164–169. https://doi.org/10.1097/PEC.0b013e31819a8966.
11. Nath PC, Mishra SS, Das S, et al. Supratentorial extradural hematoma in children: an institutional clinical experience of 65 cases. *J Pediatr Neurosci*. 2015;10:114–118. https://doi.org/10.4103/1817-1745.159192.
12. Maugeri R, Anderson DG, Graziano F, et al. Conservative vs. surgical management of post- traumatic epidural hematoma: a case and review of literature. *Am J Case Rep*. 2015;16: 811–817. https://doi.org/10.12659/ajcr.895231.
13. Zakaria Z, Kaliaperumal C, Kaar G, et al. Extradural haematoma to evacuate or not? Revisiting treatment guidelines. *Clin Neurol Neurosurg*. 2013;115:1201–1205. https://doi.org/10.1016/j.clineuro.2013.05.012.
14. Önal MB, Civelek E, Kircelli A, et al. Re- formation of acute parietal epidural hematoma following rapid spontaneous resolution in a multitraumatic child: a case report. *Ulus Travma Acil Cerrahi Derg*. 2012;18:524–526. https://doi.org/10.5505/tjtes.2012.91129.
15. Bullock MR, Chesnut R, Ghajar J, et al. Surgical management of acute epidural Hematomas. *Neurosurgery*. 2006;58(3 suppl l). S7–15. discussion Si-iv.