

Nonoperative management of acute epidural hematomas: A “no-brainer”

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Abstract

Background: Acute epidural hematomas are generally considered to require urgent operation for clot evacuation and bleeding control. It has become increasingly apparent, however, that many epidural hematomas will resolve with nonoperative management. The purpose of the current study was to review our experience with nonoperative management of acute epidural hematomas.

Methods: Patients admitted to our busy urban level I trauma center with an epidural hematoma were identified using our trauma registry. Patients were excluded if they suffered other significant intracranial injury mandating operative intervention. Patient records were reviewed and relevant data collected. Patients who required subsequent craniotomy were compared to those who did not in order to identify risk factors for failure of nonoperative treatment.

Results: Between January 1995 and June 2004, 84 patients were identified. The mean age was 27 ± 1.6 years and 68 (81%) were male. Mean Glasgow Coma Scale in the emergency department was 13.7 ± 0.3 . The most common mechanism of injury was a fall. Fifty-four (64%) patients were initially managed nonoperatively and 30 (36%) were taken directly to the operating room for craniotomy. Nonoperative management was successful in 47/54 (87%) patients. Failure of initial nonoperative management was not associated with adverse outcome. There were no deaths in patients managed operatively or nonoperatively. Seventy-two (86%) patients were discharged to home with excellent neurologic outcome.

Conclusions: Epidural hematomas can be successfully managed nonoperatively in an appropriately selected group of patients. Moreover, failure of initial nonoperative management has no adverse effect on outcome. © 2006 Excerpta Medica Inc. All rights reserved.

Keywords: Epidural hematoma; Extradural hematoma; Nonoperative management

Acute epidural hematomas are common following significant head trauma and classically require urgent operation for evacuation of the blood clot and control of any ongoing hemorrhage [1]. Epidural hematomas frequently present with acute neurologic deterioration leading to emergent craniotomy, and outcome has been linked to early operation prior to onset of brain dysfunction [2,3]. With advances in medical imaging technology, nonoperative management of intra-abdominal solid organ injuries in hemodynamically stable multiply injured patients has become standard practice. With the availability of head computed tomographic (CT) imaging, nonoperative management of neurologically stable patients with small acute epidural hematomas has

become increasingly common [4–6]. This “conservative” approach is predicated on close clinical follow-up and serial CT imaging of the brain. The neurosurgeons at our level I trauma center have embraced this approach and routinely manage selected patients nonoperatively. The purpose of the current study was to evaluate critically our experience with nonoperative management of acute epidural hematomas. Moreover, particular attention was given to identifying risk factors predicting the failure of this approach.

Methods

This study was reviewed and approved by the St. Anthony Central Hospital Institutional Review Board. St. Anthony Central Hospital is a busy urban level I trauma center with 3000 trauma admissions per year, including 600 patients with an Injury Severity Score greater than 15. Patients

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admitted to St. Anthony Central Hospital with an acute epidural hematoma were identified using the trauma registry. Patients were excluded if they suffered other significant intracranial injury that might mandate operative intervention, such as subdural or intracerebral hematomas.

Patients are admitted to the trauma service with neurosurgical consultation. Emergency neurosurgical coverage is provided by 5 experienced neurosurgeons. There are no neurosurgical management protocols in place, and clinical management of the epidural hematoma is at the discretion of the individual attending neurosurgeon. The decision regarding nonoperative management is generally made by the neurosurgeon following patient examination and review of the head CT scan. Patients are placed in the trauma intensive care unit and followed closely for any signs of neurologic deterioration. Head CT scanning is performed on admission and repeated within 12 to 24 hours. Neurologic deterioration prompts immediate repeat head CT scan.

Patient records were reviewed and data collected regarding patient demographics, neurologic findings, CT scan characteristics, need for craniotomy, and outcome. Relevant CT scan findings included the location of the epidural hematoma, the presence of an associated skull fracture, the thickness of the epidural hematoma, and the presence of any midline shift. If nonoperative management failed, the reason was determined. The Glasgow Outcome Scale [7] was used to assess neurologic outcome at the time of discharge (Table 1). A score was assigned to each level of the Glasgow Outcome Scale to facilitate comparisons between patient groups. Patients undergoing delayed craniotomy after initial nonoperative management were compared to those who did not in order to identify risk factors for the failure of nonoperative management. Potential adverse effects related to failure of initial nonoperative management were investigated.

Data analysis was performed using SPSS 13.0 for Windows (SPSS, Inc., Chicago, IL). Continuous data are presented as means \pm SEM. Categorical data are presented as percent of the total. Normally distributed continuous data were compared using Student *t* test, and nonparametric continuous data were compared using the Mann-Whitney *U* test. Categorical data were compared using chi-square analysis or Fisher exact test as appropriate. Statistical significance was assigned for $P < .05$.

Results

Between January 1995 and June 2004, 84 patients were identified who suffered an isolated acute epidural hematoma resulting from blunt trauma and who had records available for review. Selected demographic data are depicted in Table

Table 1
Glasgow Outcome Scale

Score	Outcome	Definition
1	Dead	—
2	Persistent vegetative state	Wakefulness without awareness
3	Severe disability	Conscious but dependent
4	Moderate disability	Disabled but independent
5	Good recovery	Independent and reintegrated

Table 2
Patient demographics

Age, y	27 \pm 1.6
Gender	68 (81%)
Mechanism	
Fall	62 (74%)
Motor vehicle crash	17 (20%)
Motorcycle crash	4 (5%)
Auto-pedestrian injury	1 (1%)
Glasgow Coma Scale	13.7 \pm 0.3
Loss of consciousness	58%
Intubated in field or emergency department	16%
Focal neurologic deficit	9%

2. The mean age was 27 \pm 1.6 years and 68 (81%) were male. The most common mechanism of injury was a fall of some sort, occurring in 62 (74%) patients. Forty-nine (58%) patients had documented loss of consciousness in the field and 13 (16%) were intubated in the field or in the emergency department. The mean Glasgow Coma Scale score in the emergency department was 13.7 \pm 0.3 and only 8 (9%) patients had a focal deficit on neurologic examination.

Characteristics of the epidural hematoma are shown in Table 3. Temporal (27%) and frontal (26%) hematomas were the most common. The hematoma involved more than one anatomic location in 21 (25%) patients. An associated skull fracture was present in the majority of cases (82%). Midline shift secondary to the hematoma was common, occurring in 24 (29%) patients. The basilar cisterns were open in 69 (82%) patients.

Fifty-four (64%) patients were initially managed nonoperatively and 30 (36%) were taken directly to the operating room for craniotomy. Age and gender were not significantly different between patients managed nonoperatively and those managed operatively (Table 4). Although not shown, the mechanism of injury did not influence the decision to manage a patient with or without an operation. Loss of consciousness and the presence of an associated skull fracture were not different between patients managed operatively or nonoperatively. Although patients managed by primary craniotomy were more likely to be intubated in the field or emergency department, this difference did not reach statistical significance. Patients managed nonoperatively had a higher Glasgow Coma Scale score in the emergency department, a thinner hematoma with less midline shift, and no focal deficit on neurologic examination.

Table 3
Characteristics of epidural hematoma

Characteristic	No. of patients (%)
Location	
Frontal	22 (26)
Temporal	23 (27)
Parietal	9 (11)
Occipital	8 (10)
Multiple areas	21 (25)
Midline shift	24 (29)
Open cisterns	69 (82)
Associated skull fracture	69 (82)

Table 4
Selected patient data stratified by type of management

	Primary nonoperative	Primary operative	P value
Age, y	27 ± 2	28 ± 2	.82
Gender	78% male	87% male	.65
GCS in ED	14.6 ± .1	11.9 ± .9	.002
Thickness of EDH, mm	10 ± 1	20 ± 1.5	.04
Associated skull fracture	87%	92%	.71
Cisterns open	98%	75%	.003
Midline shift	8%	71%	< .0001
Focal neurologic deficit	1.5%	24%	.002
Loss of consciousness	67%	73%	.78
Intubated	11%	26%	.09
Mortality	0	0	—
Ventilator days	.13 ± .1	.62 ± .2	.026
ICU length of stay, days	1.74 ± .2	2.5 ± .3	.029
Hospital length of stay, days	4.69 ± .4	5.87 ± .6	.09
Glasgow Outcome Scale	4.87 ± .1	4.69 ± .1	.19

GCS = Glasgow Coma Scale; ED = emergency department; EDH = epidural hematoma; ICU = intensive care unit.

Initial nonoperative management was successful in 47 (87%) patients. There were no deaths in either group of patients (Table 4). Patients managed without surgery spent less time on the ventilator and fewer days in the intensive care unit as well as in the hospital. Neurologic outcome was excellent in all patients regardless of the treatment approach.

All 7 patients who failed initial nonoperative management did so within 36 hours. Two patients were taken to the operating room because of a decline in mental status. Three patients had progression of the epidural hematoma on repeat CT scan with increase in the thickness of the hematoma or worsening midline shift. The remaining 2 patients reported debilitating, progressive headache that prompted operative decompression of the hematoma.

Failure of nonoperative management did not lead to any clinically significant adverse consequences (Table 5). Factors associated with failure include motor vehicle mechanism of injury, presence of a focal neurologic deficit and increased thickness of the epidural hematoma on CT scan. Age, gender, Glasgow Coma Scale score in the emergency

department, and intubation status did not affect the success of nonoperative management. Surprisingly, the presence of midline shift on CT scan also did not affect the success of nonoperative management.

Comments

The classic description of a patient with an acute epidural hematoma is that of a head injury with loss of consciousness, followed by a lucid interval, and then a sudden, dramatic deterioration in mental status. It is well recognized, however, that a minority of patients demonstrate this classic progression [1]. Regardless, many patients do present with an acutely deteriorating neurologic examination and require urgent operative decompression. For this reason, diagnosis of an acute epidural hematoma has generally been considered an indication of craniotomy [8]. As CT scanning became more widely available and routinely used, this dogma has been questioned [5,8–10]. It became clear that there were patients with epidural hematomas that were asymptomatic [8]. This recognition led some investigators to explore nonoperative management in selected patients with an acute epidural hematoma. Subsequent case reports began to appear in the literature documenting the success of this approach [11–14]. In fact, the percentage of patients managed nonoperatively in reported clinical series has steadily increased, exceeding 60% in some series [5,11]. Sixty-four percent of our patients were managed nonoperatively with an 87% success rate, confirming the efficacy of this approach in appropriately selected patients.

Some authors continue to advise caution regarding the use of conservative management in patients with an epidural hematoma [5,15,16]. Several studies suggest that rapid evacuation of all acute epidural hematomas is the only way to obtain the best possible outcome [1]. It has been argued that failed nonoperative management resulting in delayed evacuation of the hematoma may compromise patient outcome [2]. Our findings do not support this contention. Patients who failed initial observation exhibited similar outcomes to patients managed with immediate craniotomy as well as to patients successfully managed without operation.

Table 5
Selected patient data stratified by outcome from nonoperative management

	Successful	Failed	P value
Age, y	27 ± 2	27 ± 7	.92
Gender	79% male	71% male	.65
Motor vehicle crash	26%	57%	.03
Glasgow Coma Scale score in ED	14.6 ± .1	14.8 ± .2	.51
Focal neurologic deficit	0	14%	.009
Thickness of the EDH, mm	9.4 ± 1	15.2 ± 2	.04
Associated skull fracture	87%	86%	.9
Midline shift	6.5%	14%	.5
Intubated	11%	14%	.78
Ventilator days	.11 ± .1	.29 ± .2	.07
ICU length of stay, days	1.57 ± .2	2.86 ± .3	.03
Hospital length of stay, days	4.4 ± .4	6.6 ± .3	.05
Glasgow Outcome Scale	4.9 ± .04	4.6 ± .3	.3

In fact, patients managed nonoperatively spent less time on the ventilator, fewer days in the intensive care unit, and fewer days in the hospital.

The rational therapeutic approach to the patient with an acute epidural hematoma depends on both clinical and radiographic findings. Clinical findings of neurologic deterioration, such as decreased level of consciousness, pupillary dilation, and hemiparesis, usually mandate operative intervention regardless of the size of the epidural hematoma. Head CT scan findings can guide therapeutic decisions in patients who are clinically stable. Several studies document that the thickness of the epidural hematoma, the degree of midline shift, and the patency of the cisterns are important prognostic factors obtainable from the CT scan [8,9]. Other factors that have been associated with epidural hematoma progression include the presence of a fracture over a major venous sinus or the middle meningeal artery and the location of the hematoma [11]. Our data confirm previous findings that a focal neurologic deficit and thickness of the hematoma are significant risk factors for failure of the nonoperative approach. However, our results do not show any association between failure of observation and associated skull fractures, location of the epidural hematoma, patency of the basilar cisterns, or presence of midline shift. These are criteria frequently used to select patients for initial conservative therapy. Therefore, it is not unexpected that these factors would not further discriminate between successful and unsuccessful nonoperative management. We also noted that motor vehicle mechanism of injury was associated with failure of the nonoperative approach. This has not been reported previously.

Sullivan et al [6] reported that intubation and neuromuscular blockade were protective against hematoma progression. They postulated that this is related to improved control of head movement, blood, and intracranial pressure. We found no association between intubation and outcome from conservative management.

The appropriate length of observation in patients managed nonoperatively is an unresolved issue. Servadei et al [17] recommended close observation in an acute care neurosurgical hospital for 15 days. Other reports suggest that a shorter observation period is safe [9,18]. Sullivan et al [6] documented epidural hematoma enlargement in 25% of the patients managed conservatively. The mean time to progression was 8 hours, with all instances of enlargement occurring by 36 hours. These findings suggest that a shorter observation period is appropriate as well. In the present series, patients managed nonoperatively were hospitalized an average of 5 days. In light of our data, it seems that an in-hospital observation period of 5 to 7 days is appropriate. We generally keep these patients in the intensive or intermediate care unit with frequent neurologic examinations for the first 72 hours.

In conclusion, acute epidural hematomas can safely be managed nonoperatively in an appropriately selected group of patients. Risk factors for failure of this approach include motor vehicle mechanism of injury, the presence of any focal neurologic deficit and larger size of the epidural hematoma. These factors should be carefully considered when contemplating nonoperative management in these patients.

Importantly, failure of a period of observation was not associated with adverse neurologic outcome.

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Discussion

Clay Cothren, M.D. (Denver, CO): This is a retrospective 9½-year review of all trauma patients sustaining isolated epidural hematomas at a level I trauma center. This descriptive study reviewed a total of 84 patients, of whom 54 were initially managed nonoperatively. Of these, 7 failed nonoperative therapy. Those patients with epidural hematomas measuring greater than 10 mm and with focal neurologic findings appear to be more likely to fail expectant management. The authors maintain, however, there is a specific population of head injured patients that can be managed successfully with "watchful waiting" and that any need for delayed operation did not impact the long-term neurologic function. My first question is time-related: What is defined as an "urgent" versus a "delayed" craniotomy? How many hours after either injury or admission? And

within that categorization, what was the time-frame to failure in those 7 patients that failed nonoperative therapy—was this hours, days, or weeks following initial injury? Secondly, who specifically constitutes the group selected for nonoperative management? For example, is it those patients with less than 10 mm of epidural hematoma, no evidence of midline shift, who are neurologically intact? In those patients that fit those specific nonoperative group characteristics, would the authors advocate not consulting a neurosurgeon for these patients, and hence primarily manage such patients? If so, how does your risk management department feel about this? Finally, I find it interesting, that a trauma/critical care surgeon is presenting a paper on a subspecialist's area of expertise, namely, neurosurgery. Does this reflect your group's practice? In other words, what is the role of today's trauma surgeon in managing patients with isolated epidural hematomas? And how should we as general surgeons use this paper's findings in our daily practice? I would like to thank the Congress for the opportunity to discuss this paper.

Fred Moore, M.D. (Houston, TX): I would like to focus on the concept that the neurosurgeons are using this as an excuse not to get out of bed. At our institution, there is a definite variability in who is going to get an operation that night. Additionally, the decision not to operate may suddenly change at 7 AM. So how many of these are 7 AM failures? The other temporizing move is "we are going to repeat the CT scan in 2 hours." Well, if it is 4 AM, the repeat scan is done at 6 a.m. and is available for the neurosurgeon to make a decision at 7 AM.

Reg Francoise, M.D. (Vail, CO): Do you think this is safe to do without neurosurgical backup? We frequently have people with these small isolated epidurals that we send to a level I trauma center. Transport time is significant and we are asked to intubate patients who are awake and alert. Can you give us criteria for who should be intubated or not?

Patrick J. Offner, M.D., M.P.H. (Denver, CO): Regarding what constitutes a delayed craniotomy, we defined that based on initial management rather than on time to operation. If a clinical decision was made to manage the patient nonoperatively and they subsequently went to craniotomy, we considered that to be a delayed craniotomy. Concerning patients who failed nonoperative management, all of them failed within 48 hours; there were no late

failures. Regarding selection criteria for nonoperative management, this was left to the discretion of the neurosurgeon. When we compared the groups who had an operative versus nonoperative management, we saw some of the significant differences between those 2 groups—giving us a clue as to the selection criteria used by the neurosurgeons. There is not a formal protocol and it varies somewhat from neurosurgeon to neurosurgeon. In general, it appears patients are selected based on the mental status, the presence of a focal neurologic deficit and the size of the epidural hematoma. In addition, lack of a midline shift and patency of the basilar cisterns on CT scan seem to influence the decision. And then lastly, you ask about our practice at our institution. We are the house staff for the neurosurgeons and it does get irritating at times, because they are getting paid to be on call. Since we are in-house, we generally manage all patients with traumatic brain injury—even those with essentially isolated injury.

Dr. Moore, I think we see a lot of that same temporary behavior, but it is hard to quantify from a retrospective chart review. Certainly we do see patients that I think are being managed from home, never having seen the CT scan, only talking to the radiologist on the phone, then calling in to the ICU and saying "give mannitol, give this, give that"—never having seen the patient. There is one particular neurosurgeon who will show up at 9 o'clock the next morning and all of a sudden, there is this flurry of activity on something that is changed, we've got to go to the OR. And quite frankly, I have referred more than one patient to our QI process because of that kind of behavior. And really is neurosurgeon-dependent. It is unfortunate, but it is there.

Unfortunately, I am not sure if I have the answer Dr. Francoise. The need for intubation question is a matter of judgment. It is also based on weather conditions, whether you are talking about a two hour transport time by ground or whether you are talking helicopter transport, whether you have an ICU transport team that can intubate the patient if necessary or not. As far as the data, unfortunately, I do not think I have enough data to really help answer your questions. In my heart of hearts, if I have a patient with a small epidural, I would feel very uncomfortable keeping them up in the mountains where there is no available neurosurgeon.