



## Review Article

# Toward zero mortality in acute epidural hematoma: A review in 268 cases problems and challenges in the developing country



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## ABSTRACT

**Background:** Epidural hematoma (EDH) is one of the most life threatening lesion in patients with craniocerebral trauma. Traumatic extradural haematoma (EDH) is a neurosurgical emergency and timely surgical intervention for significant EDH is the gold standard. This study aims to determine the incidence and mortality of consecutive patients with traumatic EDH admitted to the Emergency Department (ED) of Dr. Soetomo General Hospital, Airlangga University in Surabaya.

**Material and methods:** Retrospective analysis of prospectively collected data for all consecutive trauma cases admitted through the ED during January 2009–May 2012. EDH was diagnosed by CT in all cases. Both primary and delayed onset EDH were included, as were patients with combined EDH and other intracranial lesions (e.g. subdural haematoma). Age, sex, cause of injury, associated intracranial lesions, skull fracture, Glasgow Coma Scale, pupil reactivity, and clinical outcome were determined.

**Results:** We performed a chart review of 268 patients had complete data admitted to the emergency department with EDH diagnosed by CT scan and surgically treated between January 2009 and May 2012, mean of 15.41 patients per month. Seventy (77%) patients were male, with a mean age of 27.1 years. Sixty (73.86%) patients were from road traffic crashes, 40 (14.92%) sustained falls, 7 (2.61%) had direct head trauma. On admission, 81 (30%) patients were GCS 14–15, 116 (43%) GCS 9–13 and 71 (27%) GCS 3–8. Overall, 79 patients (29%) had anisocor pupils. Thirty-one patients (11.56%) died after neurosurgical operation.

**Conclusions:** Outcome of EDH depends on the several factors, including trauma operation interval, patient's age, clinical status preoperative and associated other extracranial injury.

## 1. Introduction

The incidence rate of TBI in developing countries is generally higher (for example, India is 160 per 100,000 people and Asia is 344 per 100,000) than developed countries and is predicted to surpass many diseases as a major cause of death and disability by 2030 [1]. While in Indonesia, from the data of brain injury in Dr. Sutomos General Hospital for 5 years from 2009 to 2013, the average number of brain injury sufferers was 1178 cases per year, with mortality rates ranging from 6.171% to 11.22%. This figure is higher than the international standard which ranges from 3 to 8%. Based on the severity, the mortality of severe brain injury patients ranged from 25.13% to 37.14%. This figure is relatively high compared to the literature, which is 22%.

Among the major injuries resulting from traumatic brain injury (TBI), the extradural (or epidural) hematoma (EDH) is one of the most

lethal. EDH classically occurs by disruption of the middle meningeal artery, causing arterial bleeding, which dissects the dura from the inner bone plate of the skull. The presence of the hematoma promotes increased intracranial pressure, causing cell lesion and brain damage. Traumatic extradural haematoma (EDH) has been recognised for > 140 years. 100 years ago, the mortality rate of EDH was as much as 86% and traumatic EDH remains a true neurosurgical emergency. Until the late 1970s, when angiography was used for diagnosis [the era before computed tomography (CT)], the mortality rate was 30% or higher [3–6].

The continuous development of means of transport associated with the disregard for traffic laws and an increasingly aggressive society are responsible for the increase in the number of cases of traumatic extradural hematomas, which have a high mortality rate when the diagnosis is performed later. The mortality of patients in the early twentieth

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century was about 80%, thus constituting a true neurosurgical emergency. In the 70s, with the advent of angiography and the improvement of diagnostic methods, the mortality rate was > 30%. The introduction of computed tomography (CT) allowed early diagnosis, leading to a decrease in its mortality and morbidity caused. Currently, EDH represents about 1% to 5.5% of intracranial lesions in patients with traumatic brain injury, its mortality reaching 20%. Despite the small percentage of patients with head trauma developing EDH, the rapid neurological deterioration observed is often dramatic. Early diagnosis and neurosurgical intervention in a timely manner promote the reduction of morbidity and mortality, so it is vital that people who deal with trauma patients are familiar with and trained to manage this type of injury. [7,8]

With the introduction and wide availability of cranial CT, early diagnosis and timely surgical intervention for EDH is an attainable gold standard. Indeed, the treatable nature of EDH has led some authors to suggest that “toward zero mortality” is an achievable target with respect to this condition.

The objective of this study is to analyze some aspects of epidemiology, clinical presentation and radiological diagnosis of patients with traumatic extradural hematoma who underwent neurosurgical procedure. The aim of this prospective observational study was to determine the incidence, mortality and functional outcome [measured by Glasgow Outcome Scale (GOS and Modified Rankin Scale (mRS)] [2,11–15].

## 2. Methods

We included patients admitted to the Emergency Department (ED) of Dr. Soetomo General Hospital, an Airlangga University in Surabaya during January 2009–May 2012 with a diagnosis of traumatic extradural hematoma by computed tomography (CT) and were surgically treated. The selected patients had their charts reviewed. We evaluated: age, gender, mechanism of injury, neurological status on admission, brain and head injuries diagnosed on CT, location of EDH, hospitalization and neurological status at discharge from hospital. All patients were initially treated according to the protocol of the Advanced Trauma Life Support (ATLS). On admission, neurological status was assessed using the Glasgow Coma Scale (GCS) and at discharge we used the Glasgow Outcome Scale (GOS) and Modified Rankin Scale (mRS). We excluded from this study: patients not undergoing neurosurgical treatment, patients with spontaneous epidural hematoma and patients with medical records lost or which had conflicting information.

## 3. Results

We performed a chart review of 268 patients had complete data admitted to the emergency department with EDH diagnosed by CT scan and surgically treated between January 2009 and May 2012, mean of 15.41 patients per month. Male were more affected than female, seventy seven (77%) patients were male, with a mean age of 27.1 years (Table 1).

Sixty (73.86%) patients were from road traffic crashes, 40 (14.92%) sustained falls, 7 (2.61%) had direct head trauma. On admission, 81 (30%) patients were GCS 14–15, 116 (43%) GCS 9–13 and 71 (27%) GCS 3–8. Skull fractures were observed in 47% of cases, the temporal bone being the most affected. The most common location of EDH was the temporo-parietal region, with 38.05%, followed by temporal region, which represented 9.7% of cases. In 27% of patients there were associated intracranial injuries such as concussion, acute subdural hematoma, subarachnoid hemorrhage and diffuse axonal injury. One hundred twenty patients (44.7%) were discharged less than seven days of hospitalization, 36.5% (98) of patients between 7 and 14 days and 18.8% (50 patients) after 14 days; The mortality in this study was 11.56%. Overall, 79 patients (29%) had anisocor pupils. Thirty-one patients (11.56%) died after neurosurgical operation, this death results

**Table 1**  
Patient characteristics.

	No	%
Sex		
Male	206	77
Female	62	23
Mechanism of injury		
Road traffic accident-driver	3	1.11
Road traffic accident-car passenger	1	0.37
Road traffic accident-motorcyclist	178	66.41
Road traffic accident-other	16	5.97
Fall > 2 m	29	10.82
Fall < 2 m	11	4.10
Direct trauma to the head	7	2.61
Pedestrian	21	7.83
Other	2	0.74
Glasgow Coma Score on admission		
14–15	81	30
9–13	116	43
3–8	71	27
Surgery		
Craniotomy	196	73
Craniotomy + ICP monitor insertion	72	27
Age		
1–20	122	46
21–40	94	35
41–60	44	16
60–80	8	3
Pupil reactivity		
Isocore	189	71
Anisocore	79	29
EDH type		
Isolated	192	73
Complex	76	27
Location of EDH		
Frontal	42	15.67
Frontoparietal	13	4.85
Frontotemporoparietal	29	10.82
Temporal	26	9.70
Temporoparietal	102	38.05
Temporoparietoccipital	11	4.10
Parietal	18	6.71
Parieto occipital	18	6.71
Occipital	9	3.35
With other injury		
Fracture spine	4	1.49
Fracture maxillofacial	9	3.35
Fracture ekstremitas	46	17.16
Fracture costae	4	1.49
Combutio	1	0.37
Internal bleeding	4	1.49
Hemothorax	4	1.49
Pneumothorax	1	0.37
Without other injury	195	72.76
Skull fracture		
Fracture (+)	126	47
Fracture (–)	142	53
Clinical course		
Deteriorating conscious level	121	45
Unconscious from onset	95	36
Conscious with focal deficits	0	0
Headache, vomit, no deficits	52	19
Lucid interval		
(+)	20	7
(–)	248	93
Interval: trauma ~ op (h)		
1 h	0	0
1–4 h	12	4.47
4–6 h	24	8.95
6–12 h	111	41.41
12–24 h	57	21.26
> 24 h	64	23.88
Outcome (Glasgow Outcome Scale)		
Category 5: good (no disability)	229	85.44
Category 4: moderate disability	4	1.48
Category 3: severe disability	2	0.74
Category 2: vegetative state	2	0.74

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**Table 1** (continued)

	No	%
Category 1: death	31	11.56
Outcome (modified ranking scale)		
Category 0: no symptoms	220	82.08
Category 1: no significant disability	9	3.35
Category 2: slight disability	2	0.74
Category 3: moderate disability	2	0.74
Category 4: moderately severe disability	2	0.74
Category 5: severe disability	2	0.74
Category 6: death	31	11.56

EDH: extradural haematoma; ICP: intracranial pressure.

**Table 2**

Details of patients who died.

Reason for death	No	%
Mechanism of injury		
Brain injury	19	61.29
Brain injury + Cardiac arrest	4	12.90
Brain injury + Respiratory failure	2	6.45
Pneumonia	6	19.35

from being late in surgery so that the patient's condition worsens and there are complications of postoperative pneumonia while undergoing treatment (Table 2 and Fig. 1).

#### 4. Case report

##### 4.1. Case 1

This 33-year-old woman was transferred to the Dr. Soetomo Hospital 16 h after suffering a closed-head injury with loss of consciousness. On admission, the patient was complaining of syncope, no seizure, and no vomiting.

##### 4.1.1. Examination

The general examination demonstrated a right parietal Scalp Haematoma. Neurological examination showed a severe brain injury with GCS E1V1M4 pupil isocore, no hemiparesis, but was otherwise within normal limits. Plain films demonstrated normal limits.

##### 4.1.2. Course

The patient underwent CT scan on the day of admission, 17 h after accident (Fig. 2).

This revealed a right temporoparietal epidural hematoma associated with a 7.9 mm shift from right to left and volume 60 cc. Because the patient demonstrated neurological deficit and indicated to operative, he was treated operatively. Because patient demonstrated epidural hematoma, subdural hematoma and infarction of brainstem, then do craniotomy and decompression. Repeat CT scan, 6 h after surgery, demonstrated infarction of brainstem, subdural hematoma not enlarged with no shift than noted previously (Fig. 3). The patient was discharged without neurological deficit.

##### 4.2. Case 2

This 43-year-old man was transferred to the Dr. Soetomo Hospital 28 h after suffering a closed-head injury with loss of consciousness when he was worked the tree fallen down and hit his head. On admission, the patient was complaining of unconsciousness after accident, no seizure, and no vomiting.

##### 4.2.1. Examination

The general examination demonstrated a right and left temporoparietal Scalp Haematoma. Neurological examination showed a severe brain injury with GCS E1V1M4 pupil anisocore in left site, no hemiparesis, but was otherwise within normal limits. Plain films demonstrated diastase fracture in left coronaria suture.

##### 4.2.2. Course

The patient underwent CT scan on the day of admission, 28 h after accident (Fig. 4).

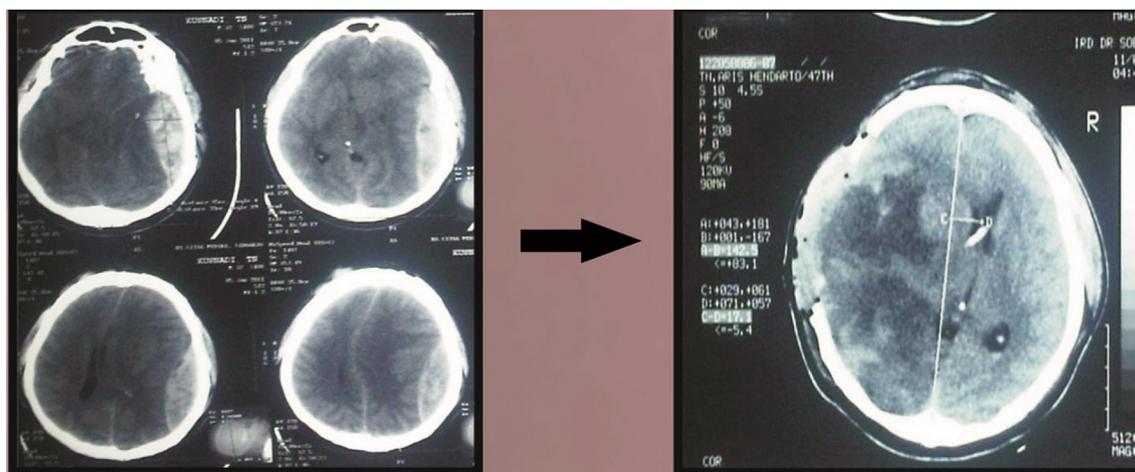
This revealed a left frontotemporoparietal epidural hematoma associated with a 13.5 mm shift from left to right and volume 100 cc. Because the patient demonstrated neurological deficit and indicated to operative, he was treated operatively. Because patient demonstrated severe brain injury, then do craniotomy and ICP Monitor. The patient was discharged without neurological deficit.

##### 4.3. Case 3

This 62-year-old man was transferred to the Dr. Soetomo Hospital 2 days after suffering a closed-head injury with loss of consciousness. On admission, the patient was complaining of syncope, no seizure, and no vomiting.

##### 4.3.1. Examination

The general examination demonstrated a left parietal Scalp Haematoma. Neurological examination showed a severe brain injury with GCS E1V1M5 pupil anisocore in left site, right hemiparesis, but



**Fig. 1.** One patients who died with extradural haematoma (EDH), after surgery with several infarcts.

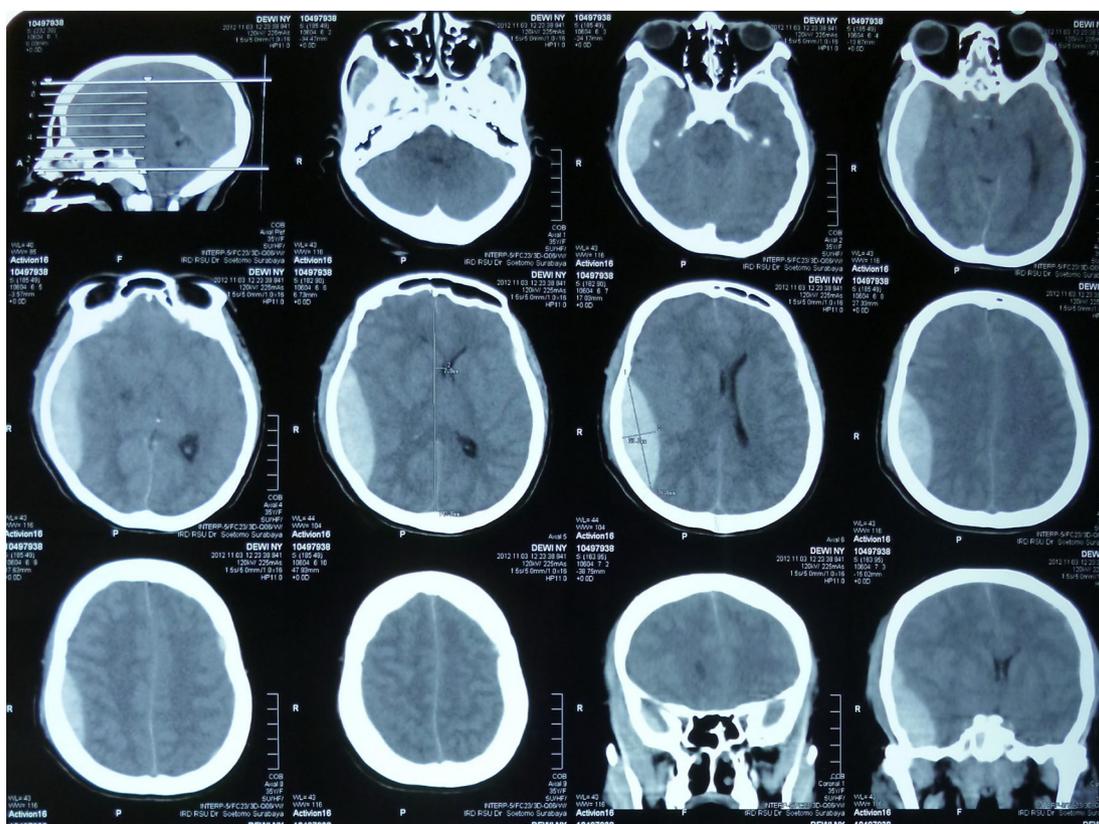


Fig. 2. Initial CT scan.

was otherwise within normal limits. Plain films demonstrated linear fracture in left parietal.

#### 4.3.2. Course

The patient underwent CT scan on the day of admission, 2 days after accident (Fig. 5).

This revealed a left parietooccipital epidural hematoma associated with a 4 mm shift from left to right and volume 103 cc. Because the patient demonstrated neurological deficit and indicated to operative, he was treated operatively. Because patient demonstrated epidural hematoma, then do craniotomy. Repeat CT scan, 6 h after surgery, demonstrated ventriculomegaly with no shift than noted previously (Fig. 6). The patient was discharged without neurological deficit.

## 5. Discussion

Traumatic epidural hematomas are neurosurgical lesions of greater severity, as affected by them presented with death hazard. The delayed diagnosis and treatment of EDH are related to increased mortality and worse functional outcome [1,2]. In our department we observed that EDH is more prevalent in male patients, suggesting a greater exposure of men to traumatic injuries such as road traffic crashes and falls. The most affected age group in our study was the second decade of life. These results are in agreement with literature data. These patients have a higher exposure to risk situations such as driving at high speed without the use of safety belts or riding motorcycles without a helmet, making them more vulnerable to head injuries and epidural hematomas. In elderly patients EDH is less frequent because of strong adhesion of the dura to the skull, hampering the detachment and accumulation of blood. In children, as the osseous groove that houses the middle meningeal artery is not yet fully formed, injury of this artery is less frequent.

The main mechanism of injury found in our study was the fall from

height, which is justified by the pathogenesis of epidural hematoma, most often associated with mild or moderate trauma, such as road traffic crashes, falls and other. On admission, most patients had GCS between 9 and 13, demonstrating that the epidural hematoma is often a consequence of low-energy trauma, with little effect on the brain parenchyma. In patients with EDH, about 27% are in coma on admission or immediately before the operation. The classic “lucid interval”, described as loss of consciousness followed by a lucid period and the quick deterioration into coma, was observed in 7% of patients. The majority of patients presents with no apparent neurological deficits on admission, making the proper assessment of trauma patients extremely important, as they may be affected by this neurosurgical emergency. Skull fractures were present in 47% of cases, the involvement of the temporal region in most cases being worth mentioning; this confirms the importance of the anatomical relationship between the middle meningeal artery and the temporal bone in the pathophysiology of EDH.

The EDH may result from injury to the middle meningeal artery, middle meningeal vein, diploic veins or dural venous sinuses. Historically, bleeding from the middle meningeal artery has been considered the main source of EDH. However, it was only possible to identify a source for arterial bleeding in less than half the cases of EDH, which shows an important role of the venous origin [9,10].

Consistently with other series, the most common location of EDH was temporo-parietal and temporal. This fact is mainly due to the susceptibility of these regions to external traumas and due to their close anatomical relationship with the middle meningeal artery.

The length of hospital stay was less than seven days in 44.7% of cases and, at the time of discharge, about 87.67% of patients were in satisfactory clinical condition, with minimal or no neurologic deficits. The most important factors for good functional outcome of treatment of EDH are: GCS, age, pupillary abnormalities on admission, presence of associated intracranial lesions and time between neurological deterioration and surgery. In our study, most patients were young adults

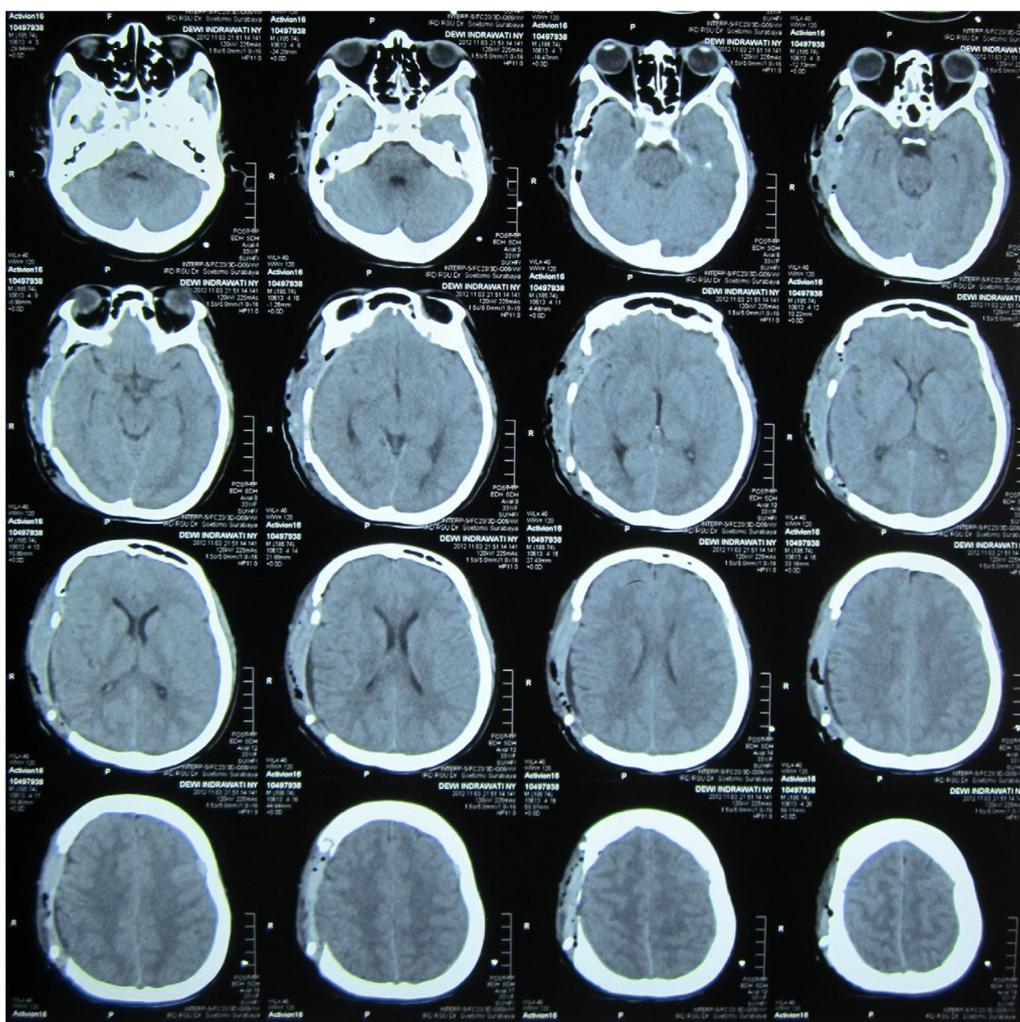


Fig. 3. CT scan control 6 h post craniotomy.

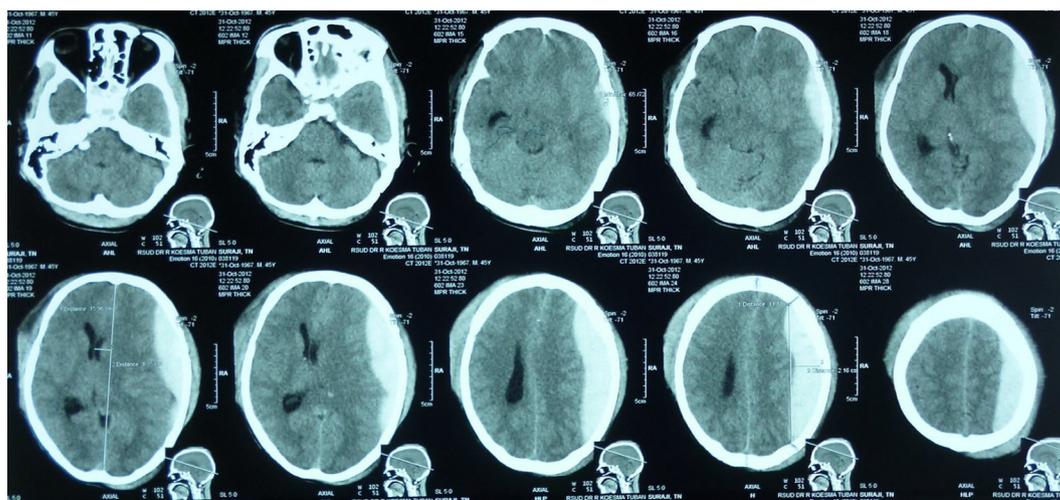


Fig. 4. Initial CT scan.

with mild TBI operated early, explaining the good results [11–15].

### 6. Conclusion

Survival from traumatic EDH was 87.67% of survivors had a Glasgow Outcome Score of 4 or 5 (good or moderate). The combination

of anisocor pupils and GCS < 8 suggests severe primary brain injury. Mortality and morbidity were more among those who operated after 48 h of occurrence and patient with multitrauma case. So this study revealed that the early surgery is more life saving than the late surgery. We believe that knowledge of the epidemiology of traumatic epidural hematoma can assist in developing public health measures aimed at

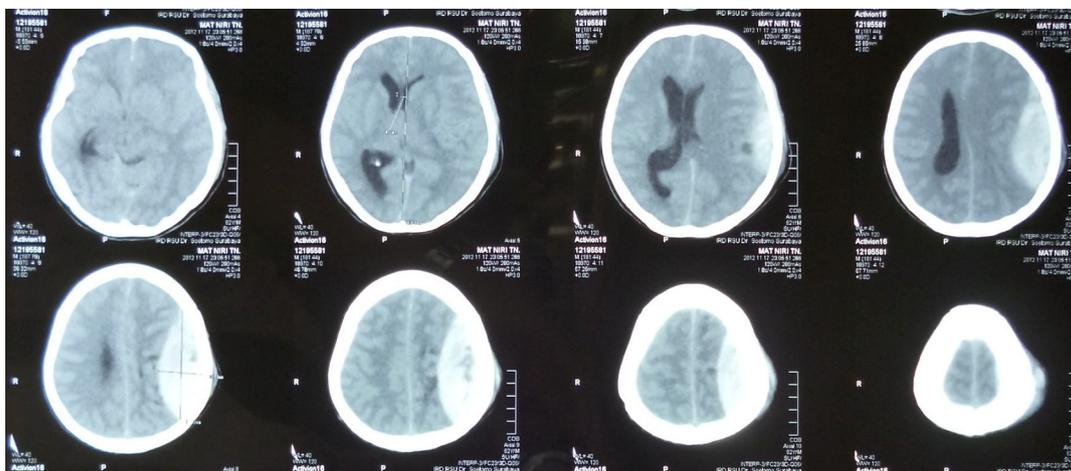


Fig. 5. Initial CT scan.

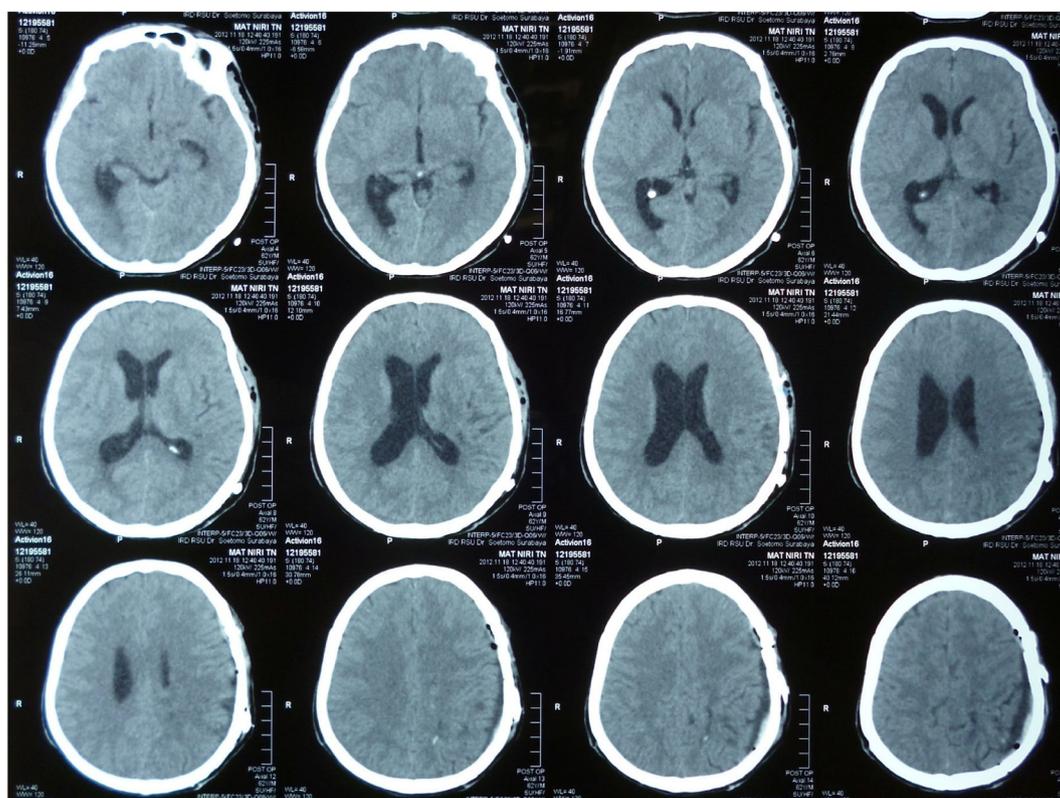


Fig. 6. CT scan control 6 h post-craniotomy.

prevention and early identification of this disease in the population.

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