

Trauma Team Activation: What do we learn?

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Abstract

Background: The treatment outcome of severe trauma victims can be improved by the early presence of the trauma team under leadership of an expert trauma surgeon in the emergency room. The criteria for trauma team activation was the presence of patients at risk or need critical care. This study aimed to evaluate a trauma team activation criteria after implementation at the Songklanagarind Hospital, a level I trauma center.

Materials and Methods: Adult trauma patients (age ≥ 15 years) who directly came to Songklanagarind Hospital from January to December 2009 and met at least one of the trauma team activation criteria were enrolled. The criteria consisted of (I) penetrating injury to the chest or the abdomen, (II) systolic blood pressure ≤ 90 mmHg, (III) pulse rate > 120 beat per minute, (IV) respiratory rate < 10 or > 30 /min, (V) severe head injury (GCS score ≥ 8) and (VI) trauma arrest. Data were retrieved from the trauma registry and descriptive reports.

Results: One hundred and fifty-three patients met inclusion criteria. The mean age was 33 ± 13 years. The majority of patients were male (85%) and the average ISS was 18. The most common criteria for activation was pulse rate > 120 bpm (37%). The activation occurred in 52 percent of patients who met the criteria and the surgeon presented at resuscitation room in 75 percent. The procedures which commonly performed in the ER were endotracheal intubation and central venous catheterization (43%). Fifty-seven patients (37%) received emergency operation and the most common operation was exploratory laparotomy (23%). Rate of emergency operation was high in patients presented with hypotension (61%) followed by penetrating torso injury (48%). The mortality rate was high in severe head injury patients (43%). All patients who present with cardiac arrest died. The average length of hospital stay was 14 days. One hundred and two patients (67%) survived until discharge.

Conclusions: The majority of severely trauma patients who met the trauma team activation criteria survived until discharge. The activation occurred in about half of them and the surgeon can present in the emergency department in the majority of cases at our hospital. In 2004 the authors organized a regional health care system to develop pre-hospital health care system. Rate of emergency operation was high in patients presented with hypotension or penetrating torso injury. Trauma arrest and severe head injury patients had high mortality rate. Good compliance with the criteria may translate to improved outcomes.

Key words: Trauma team activation criteria, Triage

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INTRODUCTION

Injury is a leading cause of death worldwide. An effective trauma system is likely to improve patient outcome¹. The survival of severe trauma victims can be maximized by the early presence in the emergency room of trauma team under the leadership of an expert trauma surgeon². But the concept of trauma team activation (TTA) cannot be applied liberally because of limited resources. The American College of Surgeons developed the criteria for activated trauma team³ and may be adapted by individual trauma center⁴. These criteria were designed to identify patients who are at risk or need higher level care⁵. The criteria commonly included mechanism of injury, physiology and anatomical area of injury⁶. As an academic level I trauma center in southern Thailand, Sonklanagarind trauma team activation criteria was implemented in October 2008. The objectives of this study are therefore to evaluate processes of care and ultimately patient outcomes.

MATERIALS AND METHODS

Adult trauma patients (age ≥ 15 years) who directly come to Songklanagarind Hospital from January to December 2009 and met one or more of the trauma team criteria were enrolled. The criteria consisted of (I) penetrating injury to the chest or the abdomen (II) systolic blood pressure ≤ 90 mmHg. (III) pulse rate > 120 beat per minute. (IV) respiratory rate < 10 or > 30 /min (V) severe head injury (GCS score ≤ 8) and (VI) traumatic arrest. Trauma patients were triaged by

ER physician or nurse. If any of the criteria is met, the whole trauma team including attending trauma surgeons and trauma chief resident will be activated immediately by direct call. The whole team will be physically presented at resuscitation bay as soon as possible, to take active role in evaluation and resuscitation until patient receives definitive care. Age, sex, mechanism of injury, criteria for activation, injury severity score (ISS), emergency room (ER) procedure, type of operation (excluded orthopedic procedure), hospital length of stay and result of treatment were retrieved from the trauma registry and descriptive reports.

RESULTS

One hundred and fifty-three patients met inclusion criteria. The patient characteristics were showed in Table 1. The most common criteria for activation was pulse rate > 120 bpm (37%) (Table 2). The activation occurred in about 52 percent and surgeon can present at ER about 75 percent of them. The procedures which commonly performed in the ER were endotracheal intubation and central venous catheterization (43%) (Table 3). Fifty-seven patients (37%) received emergency operation (Table 4). Penetrating injury to the chest or the abdomen and systolic blood pressure ≤ 90 mmHg were associated with high emergency operation. Severe head injury (GCS score ≤ 8) and trauma arrest were associated with high mortality rate (Table 5). The average length of hospital stay was 14 days. Sixty-seven percent of patients survived until discharge.

Table 1 Patients' characteristics.

Male : Female	130 : 23
Age (year)	33.65 $\pm$ 12.77
Mechanism of injury	
- Motor vehicle crash	19
- Motorcycle crash	61
- Pedestrian hit by car	3
- Gunshot wound	13
- Stab wound	35
- Fall	9
- Body assault	2
- Blast	2
- Other	9
Injury Severity Score (ISS)	18 $\pm$ 14
Hospital stayed (day)	14 $\pm$ 21

DISCUSSION

The trauma team activation is a tool to help sort out patients based on immediate need for treatment

Table 2 Number of patients according to criteria

	N (%)
Criteria for activation	
- Penetrating injury to the chest or the abdomen	34 (22)
- Systolic blood pressure ≤ 90 mmHg	28 (18)
- Pulse rate > 120 beat per minute	57 (37)
- Respiratory rate < 10 or > 30 /min	39 (25)
- Severe head injury (GCS score ≤ 8)	30 (20)
- Trauma arrest	31 (20)

Table 3 Activation criteria and emergency procedures

Criteria	ET tube n (%)	ICD n (%)	CVC n (%)	DPL n (%)	EDT n (%)	CPR n (%)
Penetrating torso injury (n = 34)	10 (30)	14 (42)	14 (42)	1 (3)	3 (9)	6 (18)
SBP $\leq$ 90 mmHg. (n = 28)	11 (39)	11 (39)	13 (46)	7 (25)	1 (4)	0
Pulse rate > 120 bpm. (n = 57)	22 (39)	15 (26)	26 (46)	7 (12)	1 (2)	1 (2)
Respiratory rate <10 or > 30/min (n = 39)	11 (28)	15 (38)	12 (31)	5 (13)	3 (8)	2 (5)
Severe head injury (n = 30)	29 (97)	15 (50)	25 (83)	6 (20)	3 (10)	2 (7)
Trauma arrest (n = 31)	28 (90)	20 (65)	16 (52)	7 (23)	3 (10)	27 (87)

ET tube = Endotracheal tube, ICD = Intercostal drainage, CVC = Central venous catheterization, DPL = Diagnostic peritoneal lavage, EDT = Emergency department thoracotomy, CPR = Cardiopulmonary resuscitation

Table 4 Activation criteria and operating room procedure

Criteria	Laparo- tomy n (%)	Thoraco- tomy n (%)	Cranio/ Craniectiony n (%)	Vascular operation (extremity) n (%)	Neck exploration n (%)	Other n (%)
Penetrating torso injury (n = 34)	13 (38)	3 (9)	0	0	0	2 (6)
SBP $\leq$ 90 mmHg. (n = 28)	10 (36)	4 (14)	0	2 (7)	0	3 (11)
Pulse rate > 120 bpm (n = 57)	9 (16)	2 (4)	4 (7)	1 (2)	2 (4)	7 (12)
Respiratory rate <10 or > 30/min (n = 39)	11 (28)	6 (15)	0	1 (3)	0	2 (5)
Severe head injury (n = 30)	7 (23)	4 (13)	3 (10)	1 (3)	0	1 (3)
Trauma arrest (n = 31)	6 (19)	2 (6)	0	0	0	1 (3)

Table 5 Mortality rate according to criteria

Criteria	Dead n (%)
Penetrating torso injury (n = 34)	11 (32)
SBP $\geq$ 90 mmHg. (n = 28)	7 (25)
Pulse rate > 120 bpm. (n = 57)	9 (16)
Respiratory rate <10 or > 30/min (n = 39)	8 (21)
Severe head injury (n = 30)	13 (43)
Trauma arrest (n = 31)	31 (100)

and available resources. Resources are mobilized and tailored to meet the need of the injured patients. The purpose of triage is to distribute the limited resources in a safe and cost effective way. The criteria for activation are typically categorized into physiologic, anatomic, and mechanism of injury. Several studies have found that combined physiologic and anatomic criteria are useful for triage trauma patients^{1,2}. Mechanism of injury alone does not help in identifying severely injured patients⁷.

Penetrating injury to the chest or abdomen is a common mechanism and anatomical criteria for activation. In our study, rate of performed emergency

operation and mortality were high in this group of patients.

Tachycardia and tachypnea are common criteria for activation in our study but the rate of emergency operation or mortality is low. Some study suggested that tachycardia and tachypnea are criteria for low level of activation (partial team activation)¹.

Hypotension is the strongest predictor of mortality in several studies^{1,8,9}. Our study demonstrated that patients who presented to the emergency department with single episode had high rate of emergency operation but not associated with the mortality.

Severe head injury (GCS score $\leq$ 8) has been shown to predict mortality¹. Severe traumatic brain injury with hypoxia and hypotension are bad combination and caused poor result. We believe that rapid assessment and adequate resuscitation by expert trauma surgeon in the resuscitative phase may improve outcome.

Traumatic arrest patients had highest mortality rate¹⁰. Most trauma center could not include trauma arrest in the criteria due to very low chance of survival¹. We still keep traumatic arrest in the criteria because we try to improve the performance and also teach the

residents on it.

The impact of trauma surgeon presence at resuscitation room during the initial resuscitation has been studied previously. Our study could not demonstrate the impact of trauma surgeon on resuscitation time at ER, times to incision for emergency operations and mortality due to limitation of our trauma registry and study design. But value on staff, if they come to resuscitation bay, are to teach the resident, medical student and nurses which can maintain consistency, quality of care, and improve performance status.

Compliance with criteria is the most important factor for process improvement. Our study demonstrated that about 52 percent of all patients who met activation criteria were correctly activated. We hope that compliance with team activation criteria will be better in the near future by using process improvement team.

In conclusion, rate of performing emergency operation was high in patients with hypotension and sustained penetrating injury to the chest or abdomen. Traumatic arrest and severe head injury patient had high mortality rate. Good compliance with the criteria may translate to improved outcomes.

REFERENCES

1. Cherry RA, King TS, Carney DE, Bryant P, Cooney RN. Trauma team activation and the impact on mortality. *J trauma* 2007; 63:326-30.
2. Rainer TH, Cheung NK, Yeung JH, Graham CA. Do trauma teams make a difference? A single centre registry study. *Resuscitation* 2007; 73:374-81.
3. Committee on Trauma of American College of Surgeons. Resources for optimal care of the injured 1993. Chicago, IL: American College of Surgeons, 1993.
4. Smith J, Caldwell E, Sugrue M. Difference in trauma team activation criteria between hospitals within the same region. *Emerg Med Australas* 2005; 17:480-7.
5. Demetriades D, Sava J, Alo K, Newton E, Velmahos GC, Murray JA, et al. Old age as a criterion for trauma team activation. *J Trauma* 2001; 51:754-6.
6. Franklin GA, Boaz PW, Spain DA, Lukan JK, Carrillo EH, Richardson JD. Prehospital hypotension as a valid indicator of trauma team activation. *J Trauma* 2000; 48:1034-7.
7. Boyle MJ, Smith EC, Archer F. Is mechanism of injury alone a useful predictor of major trauma? *Injury* 2008; 39:986-92.
8. Esposito TJ, Offner PJ, Jurkovich GJ, Griffith J, Maier RV. Do prehospital trauma center triage criteria identify trauma victims? *Arch Surg* 1995;130:171-6.
9. Tinkoff GH, O'Connor RE. Validation of new trauma triage rules for trauma attending response to the emergency department. *J Trauma* 2002;52:1153-8.
10. Chuathong A, Sangthong B, Thongkhao K, Vasinanukorn P. Survival after emergency room thoracotomy in trauma patients. *Songkla Med J* 2007;25:431-6.