Characteristics and Distribution of Blast and Firearm Injuries in Thai Military Personnel during Conflict in Southern Thailand

Nusorn Chaiphrom MD*,
Kris Kanchanaroek MD*, Mallika Khumwattana RN*

** Department of Orthopaedic Surgery, Phramongkutklao Hospital and College of Medicine, Bangkok, Thailand*

Background: *The pattern of injury in Thai military personnel had been changed since the conflict in southern Thailand. The increasing number of blast injuries from improvised explosive devices caused more complex injury pattern. The purpose of the present study was to report characteristics of blast and firearm injury and distribution of injuries and body region involvement.*

Material and Method: *The authors retrospectively reviewed the medical records of Thai military personnel injured from conflict in southern Thailand who required admission and then referred to Phramongkutklao Hospital from January 2007 to December 2007.*

Results: *There were 100 victims with 188 body region injuries. All were male. Most of them (55%) ranged from ages 18 to 30 years. Blast injury was the most common injury and affected 71% of the victims. The most common type of blast injury was type II (bomb fragments), 73.24%. Firearm injury was 29%. All firearm injuries were high-velocity gunshot wounds. The most common region of injuries was extremities 51.6 % (blast, 37.8 % and firearm, 13.8%). The torso (chest, abdomen, trunk, pelvis) was the second most injured region, 24.5% (blast 18.1% and firearm 6.4%). The third most affected region was other parts of the head 21.8% (blast 19.7% and firearm 2.1%).*

Conclusion: *Conflict in southern Thailand has increased the number of blast injuries mostly type II in Thai military personnel and the most common affected region was upper and lower extremities due to no protective suit. The rate of injuries of torso and unprotected part of the head was still in the second and third places that should be of concern. The difference of characteristics and distribution of blast and firearm injuries is very important for effective medical treatment and preparing equipment for prevention of injuries in the future.*

Keywords: *Blast injury, Firearm injury, Military personnel*

J Med Assoc Thai 2009; 92 (Suppl 1): S47-52
Full text. e-Journal: *http://www.mat.or.th/journal*

Injuries found in conflict in southern Thailand have increased in the last few years. Many government organizations work alongside to solve the problem. Medical care of Thai military personnel was initially provided by hospitals in the south of Thailand and then all military personnel who required definitive treatment were referred to Phramongkutklao Hospital, which was the tertiary care and medical teaching hospital of the Royal Thai Army Medical Departmaent. The victims received definitive treatment, rehabilitation program and health promotion before return to duty.

The increasing number of improvised explosive devices (IED) used by insurgents and terrorists led to more mass casualty incidents to military units. These attacks resulted in victims sustaining injuries that are more complex and severe than earlier periods. A previous study of terror-related injuries in Israel trauma registry reported 54% by explosion and 36% by firearm or gunshot wound (GSW)[1]. Multiple body-regions injury in a single patient occurred in 62% of

Correspondence to: Chaiphrom N, Department of Orthopaedic Surgery, Phramongkutklao Hospital and College of Medicine, Rajthewee, Bangkok 10400, Thailand. Phone: 0-2354-7600 ext. 93504, Fax: 0-2644-4940. E-mail: c_nusorn99@yahoo.com

explosion victims versus 47% in GSW patients. Explosion and firearm differ in the body region of injury, distribution of severity, length of stay, and inpatient death. Knowledge about difference of characteristics of explosion or blast injuries and firearm injuries is very important for effective medical treatment and preparing equipment for prevention of injuries.

The purpose of the present study was to report characteristics of blast and firearm injuries in Thai military personnel as well as body regions involvement and the anatomic distribution of injuries related to area of protection.

Material and Method

The medical records of all Thai military personnel who were injured in conflict in southern Thailand from January 2007 to December 2007 and referred to Phramongkutklao Hospital, were retrospectively reviewed. Demographic data of patients and the nature of injuries were obtained from the medical records. Medical diagnoses were classified according to International Classification of Diseases (ICD-10)[2]. In-patient survival was also noted.

Blast injuries were classified according to those previously described. Type I was primary blast or injuries of the air-containing organs caused by blast waves. Type II was secondary blast or penetrating injuries of organ by flying blast fragments. Type III was tertiary blast or indirect body injury propelled by a shock wave-blast wind, and type IV was the miscellaneous, such as burn[3-7].

Firearm injuries were classified as followed: first, high-velocity gunshot wound (bullet velocity more than 2500 ft/sec) and second, low-velocity gunshot wound (bullet velocity less than 2500 ft/sec)[6].

Body-region injured was classified by 8 body regions as follows: traumatic brain injury (TBI); other head injury; spinal cord and column; chest; abdomen; pelvis and trunk; upper extremities; and lower extremities. Numbers of injuries were recorded according to body regions. The multiple wounds in one region were counted as one injury[1,6].

Results

During the study period, 130 Thai military personnel operating in the conflict in southern Thailand were referred to Phramongkutklao Hospital. Thirty patients were excluded due to conditions not related to terrorist attacks. Altogether a total of 100 patients were included in the present study. All of them were male and their ages ranged from 18 to 50 years. The patient ages between 18 to 30 years were the most prevalent (55%). The majority of patients were blast injury (71%) and the rest were firearm injury (29%), as shown in Table 1.

For blast injury group, 73.24% was type II (bomb fragment injury) and was the most common type. Other was 25.35% for type III (blast wind injury), 1.41% for type I (Blast wave injury) and none for type IV (miscellaneous). Regarding firearm injury groups, only group I (high-velocity GSW) was found in 29 cases, shown in Table 2. Unfortunately, one patient died on the second day after admission which was due to an intracranial blast injury.

Regarding the number of body regions involved, there were 58 patients injured in only 1 body region, 27 patients were injured in 2 body regions and 15 patients were injured in 3 regions. Sub-classification of injury according to the mechanism is shown in Table 3. The total numbers of injuries in 100 victims were 188 injuries of body regions. The most common blast wounds affected other parts of the head region, except the brain, such as wounds of eye, ear, mouth and face and numbered 37 regions (19.68%), lower extremities were 36 regions (19.15%), upper extremities were 35 regions (18.62%). On the other hand, the most

Table 1. Gender, age and mechanism of injuries in 100 patients

	Type	Number
Gender	Male	100
	Female	0
Age (years)	18-30	55
	31-40	9
	41-50	36
Injuries	Blast	71
	Firearm	29

Table 2. Characteristic of injuries

Type of injury	Number	%
Blast injury (n = 71)		
Type I (Blast wave)	1	1.41
Type II (Bomb fragment)	52	73.24
Type III (Blast wind)	18	25.35
Type IV (Miscellaneous)	0	0
Firearm injury (n = 29)		
High-velocity GSW	29	100
Low-velocity GSW	0	0

Table 3. Number of body regions involved (maximum 3 regions)

Number of regions involved	Total (%) (n = 100)	Blast (%) (n = 71)	Firearm (%) (n = 29)
1 region	58 (58%)	36 (50.70%)	22 (75.86%)
2 regions	27 (27%)	21 (29.58%)	6 (20.69%)
3 regions	15 (15%)	14 (19.72%)	1 (3.45%)

Table 4. Number of injury in each body regions (n = 188)

Body regions	Blast (n = 146)	Firearm (n = 42)
Traumatic brain injury	3	1
Other part of head	37*	4
Spinal cord and column	6	1
Chest	10	0
Abdomen	5	7
Pelvis trunk	13	4
Upper extremity	35*	12**
Lower extremity	36*	14**

* Most affected body region of blast injury
** Most affected body region of firearm injury

common firearm wounds affected lower extremities were 14 regions (7.45%), upper extremities were 12 regions (6.38%) and abdomen 7 regions (3.72%), as shown in Table 4 and Fig. 1.

Due to more severe attacks, the military personnel must wear helmets and body armor vests for protection of the head and torso. There was no protection of pelvis, face, eye and extremities. So the area of body-regions injuries was re-grouped to show the relationship between anatomic distribution and the area of protection. The physicians who specialized in medical care of those body regions are also listed in Table 5.

Discussion

Effect of war weapons can be divided into explosive or blast injury caused by artillary, grenade, mortar, bomb, rocket and improvised explosive devices, and firearms injury caused by pistols, rifles and machine guns. The epidermiology study in The World War II showed 64 % by explosion and 33% caused by firearms. The most common cause of blast injury was mortar (19%) and less common 1.4% caused by landmines. In the Vietnam war, the rate of blast and firearm injury was still at the same ratio: 62% and 30%, respectively, but

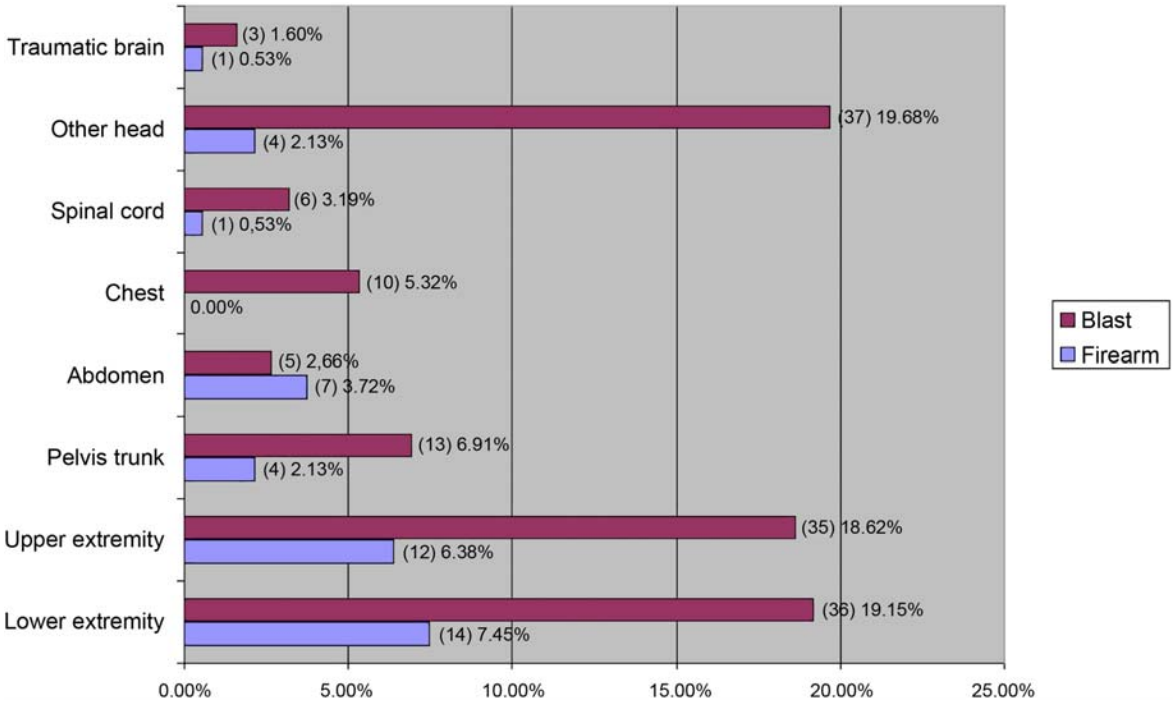

Fig. 1 The percentage of body region injured

Table 5. Distribution of body region of injuries related to area of protection

Body region	Number of injuries	%	Protection	Physician
Brain (n = 4)	Blast 3, firearm 1	2.1	Helmet	Neurosurgeon
Other part of head (n = 41)	Blast 37, firearm 4	21.8	No	Eye, ENT, Dentist, General surgeon
Torso* (n = 46)	Blast 34, firearm 12	24.5	Body armor vest except pelvis	General, Neuro, Colorectal and Orthopedic surgeon
Upper and lower extremity (n = 97)	Blast 71, firearm 26	51.6	No	Orthopedic surgeon

* Chest, abdomen, spine, trunk, pelvis

the rate of anti-personal explosive devices such as landmine or booby trap was increased to 17%[6]. A recent study of terrorist-related injury showed 54% by explosion, 36% by firearm and 10% by other means[1]. In the present study, there were 71% caused by explosion and 29% by firearm.

The anatomic distribution of wounds in the Vietnam War were head-neck 14%, thorax 7%, abdomen 5% and the most common region was extremities, 74%[6]. In the recent conflict in Israel, there were more injuries of other parts of the head (excluding brain), 22.4% and thorax 12.2%.The rate of extremity injury was 38.4% lower than a conventional war[1]. In the present study, there was a lower number of internal injuries of the body torso, 24.5% and intracranial region, 2.1%. The most injured region was the extremities, 51.6% and other head regions, 21.8%, which may be due to the protective body armor vests and helmets, and no protection of extremities and other parts of the head such as face, mouth, eye, ear and neck.

There are differences of characteristics between blast injury and firearm injury. The initial blast can cause tissue damage, and propelled fragments can cause penetrating injuries. The terrorist bomb in Israel introduced new types of projectiles such as nails, bolts, and other sharp metal objects included in the improvised explosive devices[1]. The same types of objects were found in blast injuries in southern Thailand. These projectiles are propelled in all directions, causing penetrating injuries in many regions and sometimes are difficult to detect.

The first difference is in the number of region involvement; 50.7% of blast injury involved only one region and 49.3% involved more than one region, while 75% of firearm injuries involved only one region. Compared to Israel terrorist related injury, 37.8% of blast injury involved one region and 62.1% involved more than one region while 54.4% of firearm injury involved only one region[1]. These data are important in implications for hospital organization and the patient care team. The treatment of 1 region body involved victims can be handled within the resources of the emergency team based on physicians from general surgery and orthopedic surgery, as well as nursing staff. Management of multiple regions body involvement demand a different organization of the hospital setting, for example in specialist staff, particularly in subspecialty consultation, nursing staff, hospital ward, intensive care unit, diagnosis imaging, and the operation room[7].

The second difference is number of body regions involvement. The most common body region involvement in blast injury was in other parts of the head 25.3%, lower extremities 24.6% and upper extremity 23.9%; while 61.9% of firearm injury involved only upper and lower extremity. Compared to a previous study, there is the same anatomic distribution, blast injury involved in other parts of the head 26.4%, upper extremity 19.1% and lower extremity 18.4%. On the other hand, firearm extremity injury occurred in 40.2%; chest blast injuries were 10.6% in a previous study[1] and 6.8% in the present study.

Conclusion

Conflict in southern Thailand has increased the number of blast injuries, mostly type II; the most common area were upper and lower extremities due the absence of protective suits. The rate of injuries of the torso and unprotected parts of the head is still in second and third places and should be of concern. These findings have implications for treatment and the preparedness of hospital resources and training programs for treatment of the injured victims after terrorist attacks. A tailored protocol for patient treatment should differ between firearm and blast injury.

Acknowledgements

The authors wish to thank Captain Promporn Parassadorn and Mrs. Panjanee Thainukul for their assistance in patient data and medical record collection.

References

1. Peleg K, Aharonson-Daniel L, Stein M, Michaelson M, Kluger Y, Simon D, et al. Gunshot and explosion injuries: characteristics, outcomes, and implications for care of terror-related injuries in Israel. Ann Surg 2004; 239: 311-8.
2. World Health Organization**.** ICD-10: International statistical classification of diseases and health related problems. Tenth revision. Geneva: WHO; 2006.
3. Covey DC. Blast and fragment injuries of the musculoskeletal system. J Bone Joint Surg Am 2002; 84-A: 1221-34.
4. Department of Health and Human Service. Explosions and blast injuries: a primer for clinicians [homepage on the Internet]. Atlanta: Center for Disease Control and Prevention; 2003 [cited 2008 Feb 9]. Available from: http://www.bt.cdc.gov/masscasualties/pdf/explosions-blast-injuries.pdf
5. Bumbasirevic M, Lesic A, Mitkovic M, Bumbasirevic V. Treatment of blast injuries of the extremity. J Am Acad Orthop Surg 2006; 14 (10 Suppl): S77-81.
6. Szul AC, Davis LB, editors, Emergency war surgery. 3rd ed. Washington, DC: Walter Reed Army Medical Center; 2004.
7. DePalma RG, Burris DG, Champion HR, Hodgson MJ. Blast injuries. N Engl J Med 2005; 352: 1335-42.
8. Robert CS, Pape HC, Jones AL, Malkani AL, Rodriquez JL, Giannoudis PV. Damage control orthopaedics: evolving concepts in the treatment of patients who have sustained orthopaedic trauma. Instr Course Lect 2005; 54: 447-62.

ลักษณะและตำแหน่งการบาดเจ็บจากกระเบิดและกระสุนปืนในทหารที่ปฏิบัติงานในจังหวัดชายแดนภาคใต้

นุสรณ์ ไชยพรหม, กฤษณ์ กาญจนฤกษ์, มัลลิกา ขุมวัฒนา

***ภูมิหลัง**: ลักษณะการบาดเจ็บในทหารที่ปฏิบัติงานในจังหวัดชายแดนภาคใต้ได้เปลี่ยนแปลงโดยมีจำนวนการบาดเจ็บจากกับระเบิดแสวงเครื่องมากขึ้น ซึ่งทำให้เกิดความซับซ้อนในการรักษา จุดประสงค์ของรายงานนี้เพื่อศึกษาลักษณะของการบาดเจ็บจากกับระเบิดและกระสุนปืนและตำแหน่งการบาดเจ็บและอวัยวะส่วนที่ได้รับบาดเจ็บ*

***วัสดุและวิธีการ**: ศึกษาเวชระเบียนของผู้ป่วยทหารที่ได้รับบาดเจ็บขณะปฏิบัติงานที่จังหวัดชายแดนภาคใต้ และทุกรายได้รับการส่งกลับมารักษาที่โรงพยาบาลพระมงกุฎเกล้าระหว่างเดือนมกราคม พ.ศ.2550 ถึง เดือนธันวาคม พ.ศ.2550*

***ผลการศึกษา**: มีผู้ได้รับบาดเจ็บจำนวน 100 ราย และ เป็นการบาดเจ็บที่ 188 ตำแหน่งร่างกาย ผู้บาดเจ็บทุกรายเป็นเพศชาย ผู้บาดเจ็บร้อยละ 71 ได้รับบาดเจ็บจากกับระเบิด โดยเป็นบาดเจ็บจากระเบิดชนิด type II มากที่สุด คือ ร้อยละ 73.24 ผู้บาดเจ็บร้อยละ 29 ได้รับบาดเจ็บจากกระสุนปืนสงคราม ตำแหน่งที่บาดเจ็บมากที่สุดคือ แขนขา ร้อยละ 51.6 โดยแบ่งเป็นกับระเบิดร้อยละ 37.8 กระสุนปืนร้อยละ 13.8 ตำแหน่งที่บาดเจ็บอันดับสองคือ ลำตัว (ทรวงอก หน้าท้อง หลัง และเชิงกราน) ร้อยละ 24.5 โดยแบ่งเป็นกับระเบิดร้อยละ 18.1 กระสุนปืนร้อยละ 6.4 ตำแหน่งที่บาดเจ็บเป็นอันดับสามคือ ส่วนศีรษะที่ไม่ใช่ส่วนสมองร้อยละ 21.8 โดยแบ่งเป็นกับระเบิดร้อยละ 19.7 และ กระสุนปืนร้อยละ 2.1*

***สรุป**: สถานการณ์ปัญหาชายแดนภาคใต้ทำให้มีการบาดเจ็บจากกับระเบิดเพิ่มมากขึ้นและส่วนใหญ่เป็นการบาดเจ็บชนิด type II บริเวณแขนขาได้รับบาดเจ็บมากที่สุดเนื่องจากเป็นส่วนที่ไม่มีเสื้อเกราะป้องกัน การบาดเจ็บบริเวณลำตัวและศีรษะบริเวณใบหน้ามีสถิติเป็นอันดับสองและสามซึ่งเป็นเรื่องที่ผู้รักษาต้องตระหนักในความสำคัญ การศึกษานี้พบความแตกต่างของลักษณะการบาดเจ็บจากกับระเบิดและกระสุนปืนซึ่งจะช่วยในการจัดเตรียมทีมทางการแพทย์และอุปกรณ์เพื่อการป้องกันและรักษาการบาดเจ็บได้อย่างเหมาะสม*