Case Report

Injuries of the Thoracolumbar Spine from Tertiary Blast Injury in Thai Military Personnel during Conflict in Southern Thailand

Sompob Poopitaya MD*,
Kris Kanchanaroek MD*

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

Background: *There were higher numbers of tertiary blast injuries from terrorist bombing in southern Thailand. There was no previous report about spinal trauma in tertiary blast injury.*
Material and Method: *Between January 2007 and December 2007, there were 100 Thai military personnel injured in combat and 18 cases were classified to tertiary blast injury (type III). Six patients with spine and back injuries were retrospectively reviewed.*
Results: *Incidence of injury to spine and back region was 6% of total blast injury and 33.3% of total tertiary blast injury. There were 3 fractures of thoracolumbar spine (16.7%) and 3 sprain-strains of the thoracolumbar spine (16.7%). One patient with flexion-distraction type of first lumbar spine and one patient with compression fracture of third lumbar spine received conservative treatment. One patient with fracture-dislocation of L5/S1 with neurological deficit underwent spinal instrumentation and fusion. The back pain score returned to normal in 9.3 weeks in the fracture group and 6 weeks in the back sprain-strain group.*
Conclusion: *The tertiary blast injury affected mostly in the back region. The uncommon flexion-dislocation fracture of thoracolumbar spine with neurological deficit should be treated with spinal instrumentation and fusion with excellent result. Other tertiary blast injury of back region can be treated with conservative treatment.*

Keywords: *Blast injury, Tertiary blast injury, Military personnel, Thoracolumbar fracture*

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Injury from war can be divided into explosive injury such as mortar, bomb, hand grenade, artillery and rocket and firearms injury such as rifle, pistol and machine gun[1]. The common injuries in the Vietnam War were explosive injury by mortar and firearm injury, the same as injuries in Thai military personnel before the conflict in southern Thailand in 2004. The pattern of injuries in Thai military personnel changed after the conflict. The rate of explosive injury was higher mostly from improvised explosive devices (IED) trapped in motorcycle or military convoys attacked with mines. To prevent the injuries to the torso, body armor vests were provided to Thai military personnel which reduced the rate of primary and secondary blast injuries from blast wave and blast fragments (type I and II). But the rate of tertiary blast injuries (type III) was proportionally increased.

The spine and spinal cord trauma was the most serious and disabling part and reported only 4.67% in terror-related injuries in Israel[2] and 4.49% in terrorist bombing in Madrid[3] and there was no previous report of spine trauma from tertiary blast injury in international literature.

The purpose of the present study was to report characteristic, clinical treatment and outcome of thoracolumbar fracture and back region injuries in tertiary blast injury (type III).

Correspondence to: Poopitaya S, Department of Orthopaedic Surgery, Phramongkutklao Hospital and College of Medicine, Rajthewee,Bangkok 10500, Thailand. Phone: 0-2354-7600 ext. 93504, Fax: 0-2644-4940. E-mail: sompob.phu@gmail.com

Material and Method

From January to December 2007, 100 Thai military personnel injured from the conflict of southern

Table 1. Back pain assessment according to criteria of Anderson and Henley

Grade	Criteria	Results
0	No back pain, Full function, No medication	Good
1	Occasional back pain, Full function, No medication	Good
2	Occasional back pain, Interferes with work or recreation, Anti-inflammatory medication	Fair
3	Frequent back pain, Interferes with work, Requires medication, physical therapy	Poor
4	Constant back pain, Unable to work, Requires narcotics	Poor

Thailand were referred to Phramongkutklao Hospital, which is the tertiary care hospital of the Royal Thai Army Medical Department. The location and severity of injuries were recorded and treatment was initially performed by trauma/military medicine team and the special areas were consulted to orthopedic specialists including spinal surgeons.

To classify the type of blast injuries, all the patients were interviewed and re-examined when the patient's condition was stable. Blast injuries were classified into 4 types: Type I was primary blast or injuries of the air-containing organs caused by blast wave. Type II was secondary blast or penetrating injuries of organ by flying blast fragments. Type III was tertiary blast or indirect injury of body propelled by a shock wave and Type IV was the miscellaneous, such as burn[4,5].

There were 6 patients injured in the back region. Three cases were thoracolumbar fractures from attacks of military convoy. They received initial treatment at the hospital in southern Thailand and then transferred to Phramongkutklao Hospital by plane within 48 hours after injury. Spine specialists were consulted for definitive treatment. Back pain and function were assessed according to the criteria of Anderson and Henley[6] as shown in Table 1. Kyphotic angulation was determined on standard lateral radiograph taken at the time of injury and at follow-up.

There were 3 sprain-strains of the back region which received conservative treatment by general orthopedic and trauma surgeons.

Results

From January and December 2007, there were 100 Thai military personnel injured during the conflict in southern Thailand and were referred to Phramongkutklao Hospital. Eighteen cases were classified into tertiary blast injury. Among the tertiary type, injury to the back region was the most common and affected 6 in 18 patients (33.3%). There were 3 cases of thoracolumbar spinal fracture and 3 cases of back sprain-strain. The other diagnoses are shown in Table 2.

Case 1

A 42 year-old soldier was attacked by a mine during military convoy in Narathiwas province. The injury was tertiary blast type in a closed vehicle. He had severe back pain without neurological deficit. The principal diagnosis was flexion-distraction fracture of first lumbar spine. There were associated scalp laceration and contusion at the flank. The plain radiograph and magnetic resonance imaging (MRI) are shown in Fig. 1 and Fig. 2.

The patient was treated with thoracolumbosacral orthosis for 12 weeks. He could walk comfortably at the 3rd week after admission. The back pain was assessed once a week as shown in Table 3. The Anderson and Henley grading showed good result (grade 0) at the 10th week after the injury. Flexion-extension radiograph of the spine was perform and showed no progression of kyphotic angle and no sign of instability at the 4th week and 24th week after injury.

Case 2

A 48 year-old soldier was attacked by mine explosion during military convoy in Pattani. The injury was tertiary blast type III in a closed vehicle. He had

Table 2. The diagnoses of tertiary blast injury in Thai military personnel

Diagnosis	Number	%
Fracture of Thoracolumbar spine	3	16.7
Back sprain-strain	3	16.7
Fracture of cervical spine	1	5.5
Fracture rib	5	27.8
Fracture calcaneus	1	5.5
Fracture metacarpal	1	5.5
Hip dislocation	1	5.5
Abrasion-contusion skin	3	16.7

back pain and leg pain. The principal diagnosis was compression fracture of the third lumbar spine without neurological deficit. The other diagnosis was closed fracture shaft of tibia. The initial plain radiography of lumbosacral spine is shown in Fig. 3.

The patient was treated with thoracolumbosacral orthosis for 3 months and the back pain assessment is shown in Table 3. The kyphosis angle progressed from 25 degrees to 30 degrees at 12th week. However, the patient could walk well and back pain score assessment returned to normal after removal of the spinal orthosis at the 12th week. The residual kyphosis was hardly seen on physical examination as shown in Fig. 4.

Case 3

A 43 year-old soldier was injured by improvised explosive landmine during the operation. He had severe back pain and dyspnea. The principal diagnosis was fracture-dislocation of L5-S1 with radiculapathy of L4, L5 and S1. The associated injury was pneumothorax. The plain radiograph is shown in Fig. 5.

He received treatment with open reduction and pedicular screw fixation from L4 to S1 with fusion (Fig. 6). Back pain score was recorded weekly. The patient recovered from L4-, L5 radiculopathy at the 12th week as shown in Table 3.

Case 4, 5 and 6

There were 3 soldiers who had back sprain and muscle contusion at the back region. The mean

Table 3. Summary of back pain score assessment in thoracolumbar spine fracture

Week	Case 1	Case 2	Case 3
1	4	3	3
2	4	2	3
3	3	2	2
4	3	1	2
5	3	1	1
6	2	1	1
7	2	1	0
8	2	1	0
9	1	1	0
10	1	1	0
11	0	1	0
12	0	1	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0

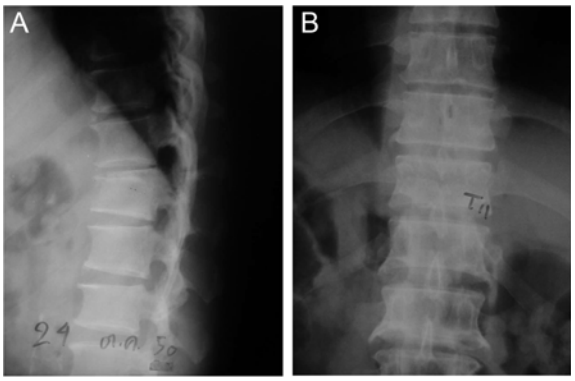

Fig. 1 X-ray showed the typical flexion-distraction injury of L1 with transverse fracture through L1 body and increased interspinous distance of T11-T12

Fig. 2 MRI showed injury of interspinous 1igament T11-T12 extend through the bone marrow of L1 without intervertebral disc injury

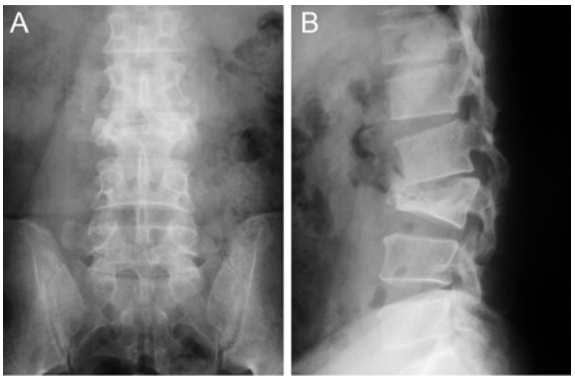

Fig. 3 X-ray showed compression fracture involved 50% of anterior column of L3 with intact of middle column. The kyphotic angle was 25 degree

Fig. 4 Appearance of patient at 12th week

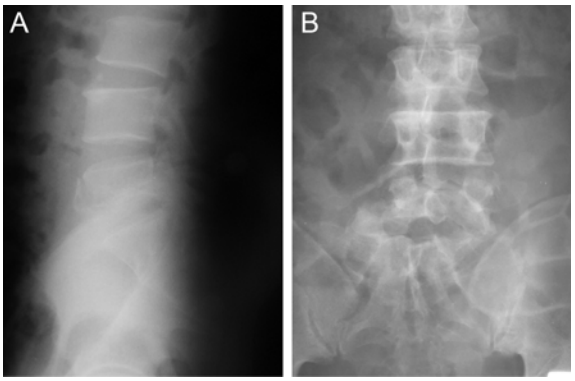

Fig. 5 X-ray showed minimal lateral listhesis of L5 on S1 and avulsion fracture at anterior part of L5

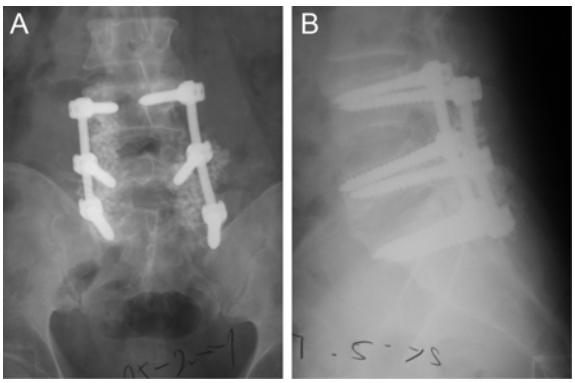

Fig. 6 Showed good reduction of L5/S1 facet joint after pedicular screw fixation and fusion

age was 47 years. The associated injury was hematuria in 1 patient, otologic injury with sensorineural hearing loss in 1 patient and laceration of scalp in 1 patient. The back pain score assessment was initially fair (score 2) and after conservative treatment the pain score returned to good (score 0) at the 6th week.

Discussion

The severity of indirect blast injury of thoracolumbar region from improvised explosive device varied. There are many factors which affect the severity including: the power of the bomb, position of the victims, the velocity and direction of car during injury, the weight of military suit and equipment and others.

The incidence of flexion-distraction thoracolumbar spinal injuries varies from 5 to 15% of total thoracolumbar trauma in previous studies[6-8]. Flexion-distraction thoracolumbar spinal injuries represent a failure of both the posterior and middle columns under tension[7,8]. Flexion injuries with the initial fulcrum on the seat belt across the abdomen is classically a horizontally-oriented fracture through the spinous process, laminae, pedicles, transverse processes or extension into the posterior aspect of the vertebral body (chance fracture). However, the force can pass through the soft tissues of the three columns or combined bone and soft tissues at different levels. The most common cause of injury was falling from a height; this is an acute flexion injury of the spinal column that occurs on impact with the ground. The second most common cause was motor vehicle crashes; these injuries are usually caused by wearing only a lap seat belt when the crash took place[9]. Liu reported 23 civilian flexion-distraction injuries, the most common mechanism of civilian injuries 12/23 (52.17%) caused by falling from a height[10].

These injuries can be classified as bone or ligamentous. Purely ligamentous injuries do not heal well; consideration should be given to primary instrumentation with posterior or posterolateral fusion. When these injuries extend entirely through the bony posterior elements and into the vertebral body (chance fracture) without intervertebral disc involvement, prognosis for healing is good, and patients can be treated with a hyper-extension cast or a total contact thoracolum-brosacral orthosis (TLSO) for 3 months. However, in the series of Liu[10], operative treatment was used in the five patients with chance fractures for the advantage of early mobilization. An MRI showed the fracture occurred through bone that could heal well without surgery. Conservative treatment with

thoracolumbosacral orthosis resulting in improved kyphosis and pain score. In this present study, the mechanism of flexion-distraction injury maybe from 2 forces: firstly, from the thrust of the bomb under the vehicle; secondly from reaction force due to impact of helmet or head with the vehicle. There was 1 of 18 tertiary blast injuries (5.55%) and 1 of 6 (16.67%) of the total thoracolumbar spine trauma from tertiary blast injury. There was a combination of ligamentous injury and fracture of the body of the lumbar spine, confirmed by plain radiography and MRI. The patient recovered very well with conservative treatment and returned to normal 10 weeks after treatment.

Compression fracture results from failure of the anterior part of the spinal body by axial load applied to the spine; radiograph will demonstrate a wedge-shaped defect of vertebral body with varying degrees of kyphosis. Neurologicallly-intact patients with kyphosis less than 30 degrees and less than 50 % loss of vertebral height can be treated with orthosis. In the present study, the patient had 25 degrees kyphotic angle and 50% loss of anterior body height, which was the borderline indication for surgery. However, after conservative treatment with thoracolumbosacral orthosis for 12 weeks, there was only a mild degree of residual kyphosis and good outcome with the same result as previous reports in civilian trauma[11,12].

Fracture-dislocation was the common injury in the thoracic spine. This type of injury involved all three spinal columns and was associated with a spinal cord injury in up to 90 % of cases. But the fracture-dislocation of the fifth lumbar on sacrum is uncommon. Tsirikos reported 2 cases of a high-energy accident with traumatic lumbosacral dislocation. There was 1 case of LS/S1 traumatic spondylolisthesis with facet fracture comparable to the present study. The treatment was an open reduction and anteroposterior spinal arthrodesis with instrumentation, which had excellent results[13]. Vialle reported 11 cases and 8 cases resulting from multiple trauma. Only 2 cases had associated radicular deficit. All patients were treated with posterior osteosynthesis and fusion[14]. In the present study, there was fracture-dislocation fracture of L5 on S1 with multiple radiculopathy. After open reduction and pedicular screw fixation from L4 to S1 with fusion, the pain and function returned to normal within the 6th week.

The patients with back sprain-strain were improved rapidly with medication and rehabilitation, but the associated injuries were the important factors of concern. There was one case with kidney contusion and one case of sensorineural hearing loss that needed specific treatment by other specialists.

Conclusion

Tertiary blast injuries affected mostly the back region. The mechanism of spine fracture in tertiary blasts was different from civilian trauma; severe spinal fracture did occur in terrorist attack on a closed military vehicle. The uncommon flexion-dislocation fracture of thoracolumbar spine with neurological deficit should be treated with spinal instrumentation and fusion, giving excellent result. Other types of thoracolumbar fracture and sprain-strain of the back region can be treated by conservative remedies. Associated-injuries in the non-fracture group such as otologic blast injury and hematuria need specific treatment by specialists.

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การบาดเจ็บบริเวณกระดูกสันหลังส่วนอกและเอว เนื่องจากแรงดันจากกับระเบิดในทหารที่ปฏิบัติงาน ในจังหวัดชายแดนภาคใต้

สมภพ ภู่พิทยา, กฤษณ์ กาญจนฤกษ์

***ภูมิหลัง**: ได้พบว่ามีการบาดเจ็บจากการก่อการร้ายในจังหวัดชายแดนภาคใต้ในแบบการบาดเจ็บจากแรงดันระเบิดเพิ่มมากขึ้น และจากการค้นคว้ายังไม่มีรายงานการบาดเจ็บด้วยแรงดันระเบิดต่อกระดูกสันหลัง, ข้อและกล้ามเนื้อส่วนหลัง*

***วัสดุและวิธีการ**: ระหว่างเดือน มกราคม พ.ศ. 2550 ถึง ธันวาคม พ.ศ. 2550 มีทหารบาดเจ็บจากการปฏิบัติงานในจังหวัดชายแดนภาคใต้จำนวน 100 นาย ซึ่งเป็นการบาดเจ็บจากแรงดันกับระเบิด (type III) จำนวน 18 ราย ได้ทบทวนผลการรักษาในผู้ป่วย 6 รายที่บาดเจ็บที่กระดูก, ข้อและกล้ามเนื้อส่วนหลัง*

***ผลการศึกษา**: อุบัติการณ์การบาดเจ็บกระดูก, ข้อและกล้ามเนื้อส่วนหลังเป็นร้อยละ 6 ต่อการบาดเจ็บทั้งหมด และเป็นร้อยละ 33.3 ของการบาดเจ็บจากแรงดันกับระเบิด มีผู้ป่วย 3 รายที่กระดูกสันหลังหักที่ส่วนอกและเอว คิดเป็นร้อยละ 16.7 และ 3 รายมีอาการแพลงและฟกช้ำของหลังคิดเป็นร้อยละ 16.7 ผู้ป่วยที่มีกระดูกสันหลังหักชนิด flexion-distraction และ compression fracture ได้รับการรักษาแบบไม่ผ่าตัด ผู้ป่วยที่กระดูกสันหลังหักแบบ fracture-dislocation L5/S1 ได้รับการผ่าตัดเชื่อมข้อกระดูกสันหลัง การประเมินค่าการปวดหลังในกลุ่มกระดูกสันหลังหักกลับสู่ปกติใน 9.3 สัปดาห์ และ ในกลุ่มข้อแพลงและฟกช้ำกลับสู่ปกติใน 6 สัปดาห์*

***สรุป**: การบาดเจ็บจากแรงดันกับระเบิดจะมีผลต่อร่างกายส่วนของหลังบ่อยที่สุด การบาดเจ็บที่รุนแรงและพบไม่บ่อยคือกระดูกสันหลังหักชนิด flexion-dislocation และมีการบาดเจ็บร่วมของระบบประสาทไขสันหลังซึ่งแนะนำให้รักษาด้วยการผ่าตัดยึดกระดูกสันหลังด้วยโลหะดามกระดูกและเชื่อมข้อสันหลัง การบาดเจ็บในแบบอื่น ๆ ทั้งที่มีกระดูกหักหรือ เป็นการแพลงฟกช้ำสามารถรักษาได้ด้วยการไม่ผ่าตัด*