Original Article

Risk Factors for Cervical Spine Injury in an Obtunded Blunt Trauma Patient

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Background: In Thailand, many hospitals cannot send every obtunded blunt trauma patient for cervical spine CT scan because of the socioeconomic status. Knowing about the risk factors for cervical spine injury in an obtunded blunt trauma patient would help the clinician monitor for cervical spine injury.

Objective: To identify the risk factors of cervical spine injury in an obtunded blunt trauma patient.

Materials and Methods: The present study evaluated 400 obtunded blunt trauma patients with a GCS of less than 15, in the trauma center of Srinagarind Hospital between January 2015 and December 2019. The patients were chosen from the patient's registry for the present retrospective cross-sectional study. A univariate analysis was fulfilled with potential risk factors such as age, gender, mechanism of injury, GCS, associated injury, and intracranial lesion. Then, multivariate analysis was used to identify the risk factors of cervical spine injury in obtunded blunt trauma patients.

Results: Four hundred patients were included in the present study. Eighty-eight (22%, 95% CI 18.04 to 26.38) had a cervical spine injury. The mean age was 40.04 years, 73% were males with a male to female ratio of 2.7 to 1. For the mechanisms of injury, 66% of injuries resulted from motorcycle accidents, 15% from car accidents, and 14% from falls. From univariate analysis, age older than 60 years had significant higher odds of cervical spine injury than age younger than 60 years (OR 1.93, 95% CI 1.05 to 3.54). Thoracic spine fracture had significant higher odds of cervical spine injury than other associate injuries (OR 6.2, 95% CI 1.45 to 26.5). From multivariate analysis, age older than 60 years had significant higher odds of cervical spine injury than age younger than 60 years (aOR 1.99, 95% CI 1.07 to 3.68). Thoracic spine fracture had a significantly higher odds of cervical spine injury than the other associated injuries (aOR 6.4, 95% CI 1.48 to 27.63). In patients age older than 60 years, 42% of cervical spine injuries occurred from fall.

Conclusion: From the present study, age older than 60 years and thoracic spine fracture are the significant risk factors of cervical spine injury in obtunded blunt trauma patients.

Keywords: Cervical spine injury; Risk factors; Obtunded blunt trauma patient

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Head injured patients are at increased risk of cervical spine injury compared with victims of non-head-injured blunt trauma patients. The reported incidence of cervical spine injury after a clinically significant head injury has ranged from 1.7% to 8%[1]. Identifying such high-risk patients may be particularly useful given that diagnosing and managing cervical spine injuries in head-injured patients are problematic due to altered level of consciousness and the overall critical nature of their injuries. Despite advances in imaging technologies and screening protocols, cervical spine injury may go undetected even in optimum circumstances. Failure to recognize unstable cervical spine injuries during initial evaluation can result in severe neurological outcome.

The principles of the advanced trauma life support (ATLS) course from the American College of Surgeons advocate assuming a cervical spine injury until proven otherwise in all trauma patients who present after blunt trauma. In the alert, examinable patient, the main clinical tools that traumatologists have used to clear the cervical spine clinically, without the need for imaging, include the National Emergency X Radiography Utilization Study (NEXUS)[2,3] and the Canadian C-spine rules (CCR)[4]. Both represent clinical decision-making tools used by clinicians in the emergency department to assess the cervical spine without the need for imaging study.

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In contrast to the alert patient, cervical spine clearance in the unexaminable patient or obtunded blunt trauma patient using Glasgow coma score (GCS <15), is an ongoing area of controversy. Following the 2015 version of the Eastern Association for the Surgery of Trauma (EAST) guidelines[2], axial computed tomography (CT) was recommended for the evaluation of the cervical spine in patients with altered mental status (GCS <15).

In Thailand, many hospitals do not send for cervical spine CT scan every obtunded blunt trauma patient because of their socioeconomic status. If the clinician knew about the risk factors for cervical spine injury in an obtunded blunt trauma patient, then they only need to closely monitor for cervical spine injury the patients who have significant risk factors.

The primary objective was to identify the risk factors of cervical spine injury in an obtunded blunt trauma patient. The secondary objective was to identify the incidence of cervical spine injury in an obtunded blunt trauma patient.

Materials and Methods

The present study evaluated 400 obtunded blunt trauma patients with a GCS of less than 15, in the trauma center of Srinagarind Hospital between January 2015 and December 2019. The patients were chosen from the patient's registry for the present retrospective cross-section study. The patients younger than 18 years old were excluded. Brain pathology and cervical spine fracture were measured from the CT images using the measurement tools of the workstation by a single investigator.

Cervical spine injury was defined as a fracture of the cervical vertebral column with/without mention of spinal cord injury, cervical vertebra dislocation, and cervical spinal cord injury without evidence of spinal bone injury.

Statistical analysis performed with descriptive analysis was fulfilled by demographic variables. A univariate analysis was fulfilled with potential risk factors such as age, gender, mechanism of injury, GCS, associated injury, and intracranial lesion. Then, multivariate analyses were used to identify the risk factors of cervical spine injury in obtunded blunt trauma patients. The p-values of less than 0.05 were considered statistically significant. Odds ratio (OR) of cervical spine injury in obtunded blunt trauma patients and corresponding 95% confidence interval (CI) was calculated. Adjusted odds ratio (aOR) was also calculated. Statistical analysis was performed using Stata, version 10.1 (StataCorp LP, College Station, TX, USA).

Results

Four hundred patients were included in the present study. Eighty-eight (22%, 95% CI 18.04 to 26.38) had cervical spine injuries. The proportion of upper cervical spine injury was 65.91% (50/88). The most frequent cervical spine fracture was C6 level (34.09%), followed by C5 level (21.59%) and C7 level (18.18%). A neurosurgical procedure was performed on 19.32% (17/88, 95% CI 11.68 to 29.12) of patients with a cervical spine injury.

Characteristics of the study sample

Characteristics of the study sample (n=400) are shown in Table 1. Among these obtunded blunt trauma patients, the mean age was 40.04 years, 73% were males with a male to female ratio of 2.7 to 1. Sixty-six percent of injuries resulted from motorcycle accidents, 15% from car accidents, and 14% from falls. Pedestrian accidents, bicycle accidents, assault, and sport injuries were rare. Median GCS was 14. Among these obtunded blunt trauma patients, 21% had facial fracture, 19% had chest injury, 18% had limb fracture, 6% had abdominal injury, 2.5% had pelvic fracture, and 2% had thoracic spine fracture. For intracranial lesions, 45% had cerebral concussion, 23% has subdural hematoma, and 22% had traumatic subarachnoid hemorrhage.

Risk factors of cervical spine injury

Univariate analysis is shown in Table 2. Age older than 60 years had significant higher odds of cervical spine injury than age younger than 60 years (OR 1.93, 95% CI 1.05 to 3.54). Thoracic spine fracture had a significantly higher odds of cervical spine injury than other associate injuries (OR 6.2, 95% CI 1.45 to 26.5). Gender, mechanism of injury, GCS, and intracranial lesion were not significant risk factors.

Multivariate analysis is shown in Table 3. Age older than 60 years had a significantly higher odds of cervical spine injury than age younger than 60 years (aOR 1.99, 95% CI 1.07 to 3.68). Thoracic spine fracture had a significantly higher odds of cervical spine injury than other associate injuries (aOR 6.4, 95% CI 1.48 to 27.63). From Table 4, In patient who were older than 60 years, 42% of cervical spine injuries occur from fall (OR 1.45, 95% CI 0.47 to 4.49).

Discussion

From the present retrospective and single-center

Table 1. The characteristics of the study sample

Variable	Total (n=400); n (%)	Cervical spine injury; n (%)		p-value
		Negative (n=312)	Positive (n=88)	
Sex				0.307
Female	108 (27)	88 (28.21)	20 (22.73)	
Male	292 (73)	224 (71.79)	68 (77.27)	
Age (years)				0.032
≤60	342 (85.5)	273 (87.5)	69 (78.41)	
>60	58 (14.5)	39 (12.5)	19 (21.59)	
Median (min-max)	36 (18 to 94)	35 (18 to 94)	45 (18 to 89)	0.002
Mean±SD	40.04±18.33	38.61±18.11	45.1±18.33	
Mechanism of injury				0.144
Car accident	60 (15)	44 (14.1)	16 (18.18)	
Motorcycle accident	264 (66)	214 (68.6)	50 (56.82)	
Bicycle accident	1 (0.25)	1 (0.32)	0 (0.00)	
Pedestrian accident	11 (2.75)	8 (2.56)	3 (3.41)	
Fall	56 (14)	37 (11.86)	19 (21.59)	
Assault	5 (1.25)	5 (1.6)	0 (0.00)	
Sport	3 (0.75)	3 (0.96)	0 (0.00)	
Glasglow coma score				0.212
Mild (13 to 14)	217 (54.25)	162 (51.92)	55 (62.5)	
Moderate (9 to 12)	54 (13.5)	44 (14.1)	10 (11.36)	
Severe (3 to 8)	129 (32.25)	106 (33.98)	23 (26.14)	
Median (min-max)	14 (3 to 14)	13 (3 to 14)	14 (3 to 14)	0.079
Associated injury				
Facial fracture	85 (21.25)	68 (21.79)	17 (19.32)	0.616
Thoracic spine fracture	8 (2.00)	3 (0.96)	5 (5.68)	0.015
Chest injury	75 (18.75)	53 (16.99)	22 (25)	0.089
Abdominal injury	27 (6.75)	19 (6.09)	8 (9.09)	0.322
Pelvic fracture	10 (2.5)	8 (2.56)	2 (2.27)	>0.999
Limb fracture	72 (18)	54 (17.31)	18 (20.45)	0.497
Intracranial lesions				
Calvarial skull fracture	60 (15)	45 (14.42)	15 (17.05)	0.543
Base of skull fracture	18 (4.5)	13 (4.17)	5 (5.68)	0.545
Epidural hematoma	35 (8.75)	28 (8.97)	7 (7.95)	0.765
Subdural hematoma	95 (23.75)	79 (25.32)	16 (18.18)	0.165
Traumatic subarachnoid hemorrhage	89 (22.25)	71 (22.76)	18 (20.45)	0.647
Intraventricular hemorrhage	26 (6.5)	21 (6.73)	5 (5.68)	0.724
Diffuse axonal injury	49 (12.25)	40 (12.82)	9 (10.23)	0.512
Cerebral concussion	181 (45.25)	136 (43.59)	45 (51.14)	0.209
Intracerebral hematoma	57 (14.25)	50 (16.03)	7 (7.95)	0.056

SD=standard deviation

study, being older than 60 years and thoracic spine fracture are significant risk factors of cervical spine injury in an obtunded-blunt-trauma patients with GCS of less than 15. These results are consistent with the other studies[5]. It helps evaluating these patients.

Age older than 60 years is a significant risk factor of cervical spine injury in obtunded blunt trauma patients with a GCS of less than 15. The explanation

Table 2. Univariate analysis of the association between risk factors and cervical spine injury

Variable	Cervical spine injury; n (%)		Crude odd ratio	95% CI	p-value
	Negative (n=312)	Positive (n=88)			
Sex					0.308
Female	88 (81.48)	20 (18.52)	1		
Male	224 (76.71)	68 (23.29)	1.34	0.77 to 2.33	
Age (years)					0.035
≤60	273 (79.82)	69 (20.18)	1		
>60	39 (67.24)	19 (32.76)	1.93	1.05 to 3.54	
Mechanism of injury					0.071
Fall	37 (66.07)	19 (33.93)	2.06	0.53 to 7.98	0.295
Car accident	44 (73.33)	16 (26.67)	1.32	0.37 to 4.69	0.664
Motorcycle accident	214 (81.06)	50 (18.94)	2.91	0.76 to 11.18	0.12
Other	17 (85.00)	3 (15.00)	1		
Glasglow coma score					0.208
Mild (13 to 14)	162 (74.65)	55 (25.35)	1		
Moderate (9 to 12)	44 (81.48)	10 (18.52)	0.67	0.32 to 1.42	0.295
Severe (3 to 8)	106 (82.17)	23 (17.83)	0.64	0.37 to 1.1	0.107
Associated injury					
Facial fracture					0.616
• No	244 (77.46)	71 (22.54)	1		
• Yes	68 (80.00)	17 (20.00)	0.86	0.47 to 1.56	
Thoracic spine fracture					0.014
• No	309 (78.83)	83 (21.17)	1		
• Yes	3 (37.50)	5 (62.50)	6.2	1.45 to 26.5	
Chest injury					0.091
• No	259 (79.69)	66 (20.31)	1		
• Yes	53 (70.67)	22 (29.33)	1.63	0.93 to 2.87	
Abdominal injury					0.325
• No	293 (78.55)	80 (21.45)	1		
• Yes	19 (70.37)	8 (29.63)	1.54	0.65 to 3.65	
Pelvic fracture					0.877
• No	304 (77.95)	86 (22.05)	1		
• Yes	8 (80.00)	2 (20.00)	0.88	0.18 to 4.24	
Limb fracture					0.498
• No	258 (78.66)	70 (21.34)	1		
• Yes	54 (75.00)	18 (25.00)	1.23	0.68 to 2.23	
Intracranial lesions					
Calvarial skull fracture					0.543
• No	267 (78.53)	73 (21.47)	1		
• Yes	45 (75.00)	15 (25.00)	1.22	0.64 to 2.31	
Base of skull fracture					0.546
• No	299 (78.27)	83 (21.73)	1		
• Yes	13 (72.22)	5 (27.78)	1.39	0.48 to 4.00	
Epidural hematoma					0.765
• No	284 (77.81)	81 (22.19)	1		
• Yes	28 (80.00)	7 (20.00)	0.88	0.37 to 2.08	
Subdural hematoma					0.167
• No	233 (76.39)	72 (23.61)	1		
• Yes	79 (83.16)	16 (16.84)	0.66	0.36 to 1.19	
Traumatic subarachnoid hemorrhage					0.647
• No	241 (77.49)	70 (22.51)	1		
• Yes	71 (79.78)	18 (20.22)	0.87	0.49 to 1.56	
Intraventricular hemorrhage					0.725
• No	291 (77.81)	83 (22.19)	1		
• Yes	21 (80.77)	5 (19.23)	0.83	0.31 to 2.28	
Diffuse axonal injury					0.513
• No	272 (77.49)	79 (22.51)	1		
• Yes	40 (81.63)	9 (18.37)	0.77	0.36 to 1.67	
Cerebral concussion					0.210
• No	176 (80.37)	43 (19.63)	1		
• Yes	136 (75.14)	45 (24.86)	1.35	0.84 to 2.18	
Intracerebral hematoma					0.061
• No	262 (76.38)	81 (23.62)	1		
• Yes	50 (87.72)	7 (12.28)	0.45	0.2 to 1.04	

CI=confidence interval

Table 3. Multivariate analysis of the association between potential factors and cervical spine injury

Variable	Univariate analysis		Multivariate analysis	
	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (years)		0.035		0.029
≤60	1		1	
>60	1.93 (1.05 to 3.54)		1.99 (1.07 to 3.68)	
Thoracic spine fracture		0.014		0.013
No	1		1	
Yes	6.2 (1.45 to 26.5)		6.40 (1.48 to 27.63)	

OR=odds ratio; CI=confidence interval

Table 4. Subgroup analysis of the association between age and fall

	Cervical spine injury; n (%)		Crude odd ratio (95% CI)	p-value
	Negative (n=312)	Positive (n=88)		
Age ≤60 years	(n=273)	(n=69)		
Fall				0.084
• No	249 (91.21)	58 (84.06)	1	
• Yes	24 (8.79)	11 (15.94)	1.97 (0.91 to 4.24)	
Age >60 years	(n=39)	(n=19)		
Fall				0.515
• No	26 (66.67)	11 (57.89)	1	
• Yes	13 (33.33)	8 (42.11)	1.45 (0.47 to 4.49)	

CI=confidence interval

for this result may be that some old age patients had osteoporosis. In the older population, falls were the most common cause of traumatic brain injury (82.9%)[6]. So, being older than 60 years with fall should be a potential risk factor for cervical spine injury in an obtunded patient.

The authors found that thoracic spine fracture is a significant risk factor of cervical spine injury in obtunded patients. This result has been reported by others[5]. One explanation for this increased risk may be that incidence of lower cervical spine injury was found more than upper cervical spine injury in the present study, and the thoracic spine may function as a buffer and dissipating the energy that would otherwise be transferred to the cervical spine, for distribution of cervical spine fractures. The most frequent cervical spine fracture was C6 level (34.09%). On the contrary, Thesleff et al found that C2 (including odontoid) was the most fractured vertebra consisting of 22.8% (n=23) of all (n=101) fractured individual vertebrae[7].

Other risk factors in trauma patients have been reported to associate with cervical spine injuries such as severe head injury, motorcycle accident, and fall[7-10]. Hasler et al reported facial fracture was an increased risk for cervical spine injury in adult major trauma patients[11]. Foster first suggested the principle that "all head and neck trauma patients should be considered to have a cervical spine injury until proven otherwise"[12]. However, it is not a significant risk factor for cervical spine injury in the present study.

The incidence of cervical spine injury in head-injured patients has been reported to range from 4% to 8%[7]. To what extent can head trauma severity be associated with cervical spine injury is controversial and depend upon the study methods and population studied. The authors study of the obtunded blunt trauma patient with a GCS of less than 15 showed that the incidence of cervical spine injury in obtunded blunt trauma patients in the present study was 22% (88/400). An explanation for the increased incidence may be that the most common mechanism of injury in the present study was motorcycle accidents, 66% (264 of 400), which was more severe injury than other mechanisms.

Due to the difficulty to identify neurological deficit in unexaminable patient or obtunded patient, the indication for surgery was spinal instability. The present study showed a 19.32% (17 of 88) prevalence of unstable cervical spine injuries. Tian et al[9] demonstrated a 26.76% (19 of 71) unstable cervical spine in patients who sustained combined craniocervical injury.

For Thailand, if clinician knew about risk factors for cervical spine injury in an obtunded blunt trauma patient, they should closely monitor for cervical spine injury in the patient older than 60 years and having thoracic spine fracture.

The limitation of the present study includes the study was a retrospective study. There are some missing data such as alcohol consumption and helmet wearing, that cannot be interpreted in the study. Cervical ligament and soft tissue injuries may have been missed in patients not assessed with magnetic resonance imaging (MRI). So, the incidence of cervical spine injuries occurred less than the true incidence.

Conclusion

From the present study, being older than 60 years and thoracic spine fracture are the significant risk factors of cervical spine injury in obtunded blunt trauma patients.

What is already known on this topic?

The clinician should send for cervical CT scan in obtunded blunt trauma patient who is older than 60 years old or has thoracic spine fracture.

What this study adds?

In rural hospitals that are unable to send every obtunded blunt trauma patient for cervical CT scan, the clinician should select to send for cervical CT scan only the obtunded blunt trauma patient who is older than 60 years old or those having thoracic spine injury.

Conflicts of interest

The authors declare no conflict of interest.

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