

The Role of CT Scan in Recognizing Blunt Diaphragmatic Rupture

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ABSTRACT

Background: Blunt traumatic diaphragmatic rupture (BTDR) occurs when significant deceleration mechanism and energy are applied to the torso, and it is associated with significant injuries and high morbidity and mortality. Although it has limitations, CT scan is the diagnostic of choice for BTDR. This study is a retrospective analyse of our experience in diagnosing BTDR using the 64-slice CT scanner. Sensitivity and specificity of this exam were assessed.

Methods: We reviewed reports from 2006 to 2009 of all CT scans of the abdomen that were done in the first 24 hours of hospitalization of blunt trauma patients. We compared CT findings to surgery reports.

Results: Our cohort consisted of 2670 patients; 69% were male. We found 28 cases of BTDR, most of them on the patient's left side (54%). Eleven percent of cases were bilateral. BTDR was often caused by motor vehicle collisions. We found sensitivity of 86%, specificity of 99%.

Conclusion: CT scan is reliable tool in blunt trauma patients. As new technologies arise, its sensibility and specificity also increases.

Keywords: Diaphragmatic rupture, Blunt trauma, CT scan.

How to cite this article: Passos E, Nascimento B, Netto FS, Tien H, Rizoli S. The Role of CT Scan in Recognizing Blunt Diaphragmatic Rupture. *Panam J Trauma Critical Care Emerg Surg* 2012;1(1):24-26.

Source of support: Nil

Conflict of interest: None declared

RESUMEN

Introducción: La ruptura diafragmática traumática embotada (RDTE) ocurre cuando la energía significativa de la desaceleración se aplica al torso, y él se asocia a lesiones significativas, y altas morbilidad y mortalidad. Aunque tiene limitaciones, la tomografía computarizada (TC) es el diagnóstico de la opción para RDTE. Este estudio es un análisis retrospectivo analiza de nuestra experiencia en diagnosticar RDTE usando escanografía multicorte. La sensibilidad y la especificidad de este examen fueron determinadas.

Métodos: Repasamos informes a partir de 2006 a 2009 de todas las e TC del abdomen que fueron hechas en el primer 24h de la hospitalización de los pacientes con trauma embotado. Comparamos resultados de TC a los informes de la cirugía.

Resultados: Nuestra cohorte consistió en 2670 pacientes; los 69% eran masculinos. Encontramos 28 casos de RDTE, la mayor parte de él en el lado izquierdo del paciente (el 54%). los 11% de casos eran bilaterales. RDTE fue causado a menudo por colisiones del vehículo de motor. Encontramos la sensibilidad de el 86%, especificidad de el 99%.

Conclusiones: La TC es herramienta confiable en pacientes del trauma embotado. Como se presentan las nuevas tecnologías, sus aumentos de la sensibilidad y de la especificidad también.

Palabras clave: Ruptura diafragmática, traumática embotada /contusa, tomografía computarizada (TC).

BACKGROUND

Blunt traumatic diaphragmatic rupture (BTDR) may occur when significant energy is applied to the torso. The occurrence of BTDR usually indicates the existence of associated injuries,^{1,2} which bear significant morbidity and mortality.³ Several mechanisms, such as compression of intra thoracic structures; impairment of ventilation; strangulation or rupture of herniated organs with spillage of visceral content, and subsequent infection; and chronic herniation may account for the high mortality associated with BTDR.³⁻⁶ Despite the clinical significance of BTDR and the recent advances in imaging, its diagnosis remains challenging, and this may compromise the timely management of this injury.⁷ Despite some limitations, computed tomography (CT) scan continues to be widely used as the preferred imaging method to identify BTDR for decades.^{8,9} Recently, the newer generation 64-slice CT scan was introduced into clinical practice with an implied expectation of being able to reduce the number of misdiagnosis including of BTDR.^{10,11} We decided to review our experience with this equipment and test its ability to diagnose BTDR in our center.

OBJECTIVE

Review the experience of Sunnybrook Health Sciences Centre (SHSC) in the diagnosis of BTDR based on the 64 slice CT scan of the abdomen.

METHODS

Study Description

After Research Ethical Board approval, we performed a retrospective review from January 2006 to December 2009 of patients sustaining blunt trauma of torso who underwent CT scan of abdomen in the first 24 hours. Surgery was considered the gold standard (Thoracotomy or VATS; exploratory laparotomy or laparoscopy) for the confirmation of BTDR.

Setting

Sunnybrook Health Sciences Centre (SHSC) is a large Academic Trauma Centre in Canada, where approximately 1,100 severely traumatized patients are admitted yearly, with a mean injury severity score (ISS) of 30. We have

continuously available a full time trauma team and fully equipped imaging center, with 64 slices CAT scan.

Variables Collected

Clinical and radiology data were retrieved from the hospital chart and electronic patient records. Our trauma registry database was used to obtain data on injury severity scores. Demographics and physiologic data included: Age, gender, glasgow coma scale (GCS), injury severity score (ISS), length of stay (LOS), mechanism and type of injury, associated injuries.

Outcomes

The main outcome of the study was the identification of BTDR in CT scan using surgery as the gold standard. Since, we used surgery as gold standard for BTDR, we calculated sensitivity and specificity for those that underwent surgical procedure (n = 157).

The secondary outcomes were associated injuries, deaths, and length of stay.

RESULTS

During the 4-year study period, we had 2670 trauma patients who underwent CT scan of abdomen in the first 24 hours. From this population, 25 had positives CT scans for BTDR. Overall, 157 patients underwent surgery and BTDR was found on 28 patients (Table 1). One false-positive was found on the right side. Four false-negatives were found at right side. The right side component on bilateral injuries

was missed in three cases. We found sensitivity of 86%, specificity of 99%.

The most common mechanism of injury was motor vehicle collision (MVC), found in 89% of cases. All cases of BTDR involved a vehicle, being MVC, recreational MVC, or pedestrian struck by a vehicle (Table 2).

The presence of free fluid was the most common finding (79%) in BTDR, regardless the side of injury. Liver injuries were found most commonly in right BTDR, but it was also common in left ruptures. The presence of pelvic and rib fracture was usual, and can be related to the high level of energy involved in those traumas (Table 3). Other findings included lesions to spleen, mesentery, bowel, pancreas and kidney.

The length of stay for survivors was 9 days (range 3-18). The in-hospital mortality rate was 14%. In fatal cases, the left side was involved in 13%, whereas the right side was not involved in none of the cases. Bilateral cases were found in 67% of nonsurvivors, expressing the severity of the case and associated injuries (Table 4).

CONCLUSION

We found that CT scan is a valuable tool in trauma patients, despite not being considered the gold standard for the diagnosis of blunt diaphragmatic rupture. In our study it only incorrectly diagnosed five cases since, we had missed injuries or false-positives at the right side.

CT scan showed a good sensitivity and excellent specificity; although someone may argue the lack of long-term follow-up on those patients.

Table 1: Demographics

Data	Population	BTDR			
	Ab CT ¹ 24 hours (n = 2670)	Total (n = 28)	Left DI (n = 15)	Right DI (n = 10)	Bilateral DI (n = 3)
Percentage	100%	1%	54%	36%	11%
Male (%)	69%	54%	60%	40%	67%
Age	45 ± 20	42 ± 17	40 ± 15	42 ± 17	53 ± 28
Direct	1489	13 (46%)	8 (53%)	3 (30%)	2 (67%)
Time to arrival (m)	90 (50-300)	130 (59-223)	120 (55-232)	145 (83-206)	70 (70-177)

¹Ab CT: Abdominal CT scan

Table 2: Mechanism of injury

Data	Population	BTDR			
	Ab CT 24 hours (n = 2670)	Total (n = 28)	Left DI (n = 15)	Right DI (n = 10)	Bilateral DI (n = 3)
MVC ¹	1316	25 (89%)	15 (100%)	7 (70%)	3 (100%)
Pedestrian	411	1 (4%)	0	1 (10%)	0
Recreational MVC	97	2 (7%)	0	2 (20%)	0
Other	846	0	0	0	0

¹ MVC: Motor vehicle collision

Table 3: Associated findings in BTDR

Finding/injury	Total (n = 28)	Left DI (n = 15)	Right DI (n = 10)	Bilateral DI (n = 3)
Free fluid	22 (79%)	12 (80%)	8 (80%)	2 (67%)
Liver	16 (57%)	8 (53%)	7 (70%)	1 (33%)
Pelvic fracture	15 (54%)	9 (60%)	4 (40%)	2 (67%)
Rib fracture	14 (50%)	8 (53%)	5 (50%)	1 (33%)

Table 4: Other Secondary Outcomes

Data	Population Ab CT 24 hours (n = 2670)	BTDR			
		Total (n = 28)	Left DI (n = 15)	Right DI (n = 10)	Bilateral DI (n = 3)
Deaths	236	4 (14%)	2 (13%)	0 (0%)	2 (67%)
ISS ¹	23 (14-34)	39 (29-43)	33 (27-41)	42 (36-47)	38 (36-47)
LOS ²	9 (3-18)	16 (10-28)	15 (9-17)	27 (21-44)	5 (4-18)

¹ ISS: Injury severity score; ² LOS: Length of stay

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