Injury, Int. J. Care Injured 46 (2015) 1734–1737

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Evaluation of diaphragm in penetrating left thoracoabdominal stab injuries: The role of multislice computed tomography

Metin Yucel [a,*], Gurhan Bas [a], Fatma Kulalı [b], Ethem Unal [a], Adnan Ozpek [a], Fatih Basak [a], Abdullah Sisik [a], Aylin Acar [a], Orhan Alimoglu [a]

[a] Department of General Surgery, Umraniye Training and Research Hospital, Istanbul, Turkey
[b] Department of Radiology, Umraniye Training and Research Hospital, Istanbul, Turkey

ARTICLE INFO

Article history:
Accepted 6 June 2015

Keywords:
Penetrating left thoracoabdominal stab injury
Diagnostic laparoscopy
Multislice computed tomography
Diaphragmatic injury

ABSTRACT

Introduction: Penetrating left thoracoabdominal stab injuries are accompanied by diaphragmatic injury in 25–30% of cases, about 30% of which later develop into diaphragmatic hernia. This study aimed to determine the role of multislice computed tomography in the evaluation of left diaphragm in patients with penetrating left thoracoabdominal stab wounds.

Materials and methods: This study reviewed penetrating left thoracoabdominal stab injuries managed in our clinic between April 2009 and September 2014. The thoracoabdominal region was defined as the region between the sternum, fourth intercostal space, and arcus costa anteriorly and the vertebra, lower tip of scapula, and the curve of the last rib posteriorly. Unstable cases and cases with signs of peritonitis were operated with laparotomy; the remaining patients were closely monitored. Forty-eight hours later, a diagnostic laparoscopy was applied to evaluate the left hemidiaphragma in asymptomatic patients who did not need laparotomy. The preoperatively obtained multislice thoracoabdominal computed tomography images were retrospectively examined for the presence of left diaphragm injury. Then, operative and tomographic findings were compared.

Results: This study included a total of 43 patients, 39 (91%) males and 4 (9%) females of mean age 30 years (range 15–61 years). Thirty patients had normal tomography results, whereas 13 had left diaphragmatic injuries. An injury to the left diaphragm was detected during the operation in 9 (1 in laparotomy and 8 in diagnostic laparoscopy) of 13 patients with positive tomography for left diaphragmatic injury and 2 (in diagnostic laparoscopy) of 30 patients with negative tomography. Multislice tomography had a sensitivity of 82% (95% CI: 48–98%), a specificity of 88% (71–96%), a positive predictive value of 69% (39–91%), and a negative predictive value of 93% (78–99%) for detection of diaphragmatic injury in penetrating left thoracoabdominal stab injury.

Conclusions: Although diagnostic laparoscopy is the gold standard for diaphragmatic examination in patients with penetrating left thoracoabdominal stab wounds, multislice computed tomography is also valuable for detecting diaphragmatic injury.

Introduction

Penetrating left thoracoabdominal stab injuries (PLTSI) are important injuries since they may involve abdominal and thoracic regions, and the diaphragm in one-third of these injuries [1–10]. Unfortunately, diagnosis of diaphragmatic injury is challenging due to subtle symptoms [1–6,10–12]. A delay in diagnosis and management of these lesions causes herniation of abdominal organs into the thoracic cavity, with resultant high morbidity and mortality [3,4,13–15]. While it is relatively simple to evaluate diaphragms in patients in need of laparotomy, it is difficult in the remaining asymptomatic patient population. Diagnostic laparotomy is regarded as the gold standard for detection and treatment of diaphragmatic injuries, although computed tomography may also become diagnostic in some patients [1,2,5,11,12,16–22]. The aim of this study was to determine the role of computed tomography in detection of diaphragmatic injury in patients with PLTSI.

Materials and methods

This study was performed in Umraniye Training and Research Hospital, General Surgery Department, after being approved by the

* Corresponding author. Tel.: +90 216 632 1818; fax: +90 216 632 7124.
E-mail address: drmetin69@mynet.com (M. Yucel).

http://dx.doi.org/10.1016/j.injury.2015.06.022
0020–1383/

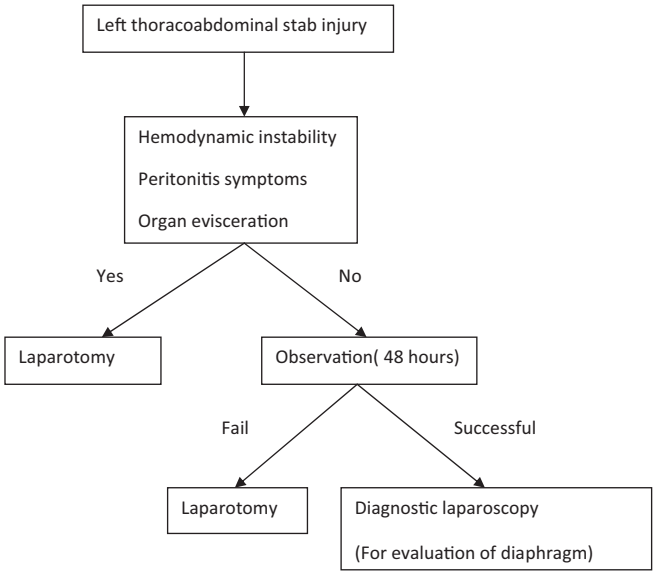

Fig. 1. Algorithm in left thoracoabdominal stab injury.

local ethics committee. All patients gave written informed consent. The patients with PLTSI who were treated between April 2009 and September 2014 were evaluated for the presence of diaphragmatic injury. The thoracoabdominal region was defined as the region between the sternum, fourth intercostal space, and arcus costa anteriorly and the vertebra, lower tip of scapula, and the curve of the last rib posteriorly.

After initial evaluation and resuscitation, haemodynamically unstable patients and patients with signs of peritonitis were urgently operated with laparotomy, while the rest underwent a selective conservative approach in the context of the algorithm (Fig. 1). In the conservative therapy, the patients were admitted to the hospital and monitored for a 48-h period. Asymptomatic patients not requiring any surgical intervention after this period underwent a routine diagnostic laparoscopy to evaluate the left diaphragm. Patients who refused diagnostic laparoscopy were excluded from the study protocol.

Multislice tomographic images obtained from the digital database were retrospectively evaluated by a radiologist who was blind to the results of the surgery at the postoperative period. An injury line crossing the diaphragm, diaphragmatic irregularity, or loss of diaphragmatic integrity were considered signs of diaphragmatic injury. Image reconstruction was made and coronal and sagittal sections were examined together in the case of unclear axial images or in equivocal cases (Fig. 2). Patients with inaccessible computed tomography images were excluded from the study.

The demographic properties, multislice tomography images, and operative findings of the patients were compared.

Statistical analysis

All patient data were recorded in a digital database. The statistical analyses were performed using the IBM SPSS Statistics 22 software package. Descriptive statistics were expressed as mean, frequency, and percentage. Qualitative variables were compared with the use of Fisher's Exact Chi-Square test. The statistical results were presented with a 95% confidence interval (CI). A p value less than 0.05 was considered statistically significant.

Results

The study population consisted of 43 patients fulfilling the inclusion criteria, 39 males (91%) and 4 females (9%), and their mean age was 30 years (range 15–61 years).

A total of 5 (12%) patients underwent laparotomy due to haemodynamic instability and signs of peritonitis in the first assessment and 48-h observation period. In 2 of them, computed tomography showed diaphragmatic injury whereas three had normal computed tomography findings. One of the two patients with tomographic signs of diaphragmatic injury also had diaphragmatic injury in laparotomy. The remaining patients had no diaphragmatic injury.

The remaining 38 (88%) patients underwent diagnostic laparoscopy. Eleven had diaphragmatic injury as evaluated by multislice computed tomography (Fig. 3). Twenty-seven patients had normal computed tomography. Eight of the 11 patients with diaphragmatic injury according to computed tomography, and 2 of 27 patients with normal tomography, had isolated diaphragmatic injury in laparoscopy.

When the findings of the operations (diagnostic laparoscopy and laparotomy) and multislice computed tomography were compared, diaphragmatic injury was confirmed by surgery in 9 (69%) of 13 patients with diaphragmatic injury by tomography and 2 (7%) of 30 patients with normal tomographic findings (Table 1). Multislice computed tomography was significantly effective in showing diaphragmatic injury in penetrating left thoracoabdominal stab injury ($p < 0.01$), with a sensitivity of 82% (95% CI: 48–98%), a specificity of 88% (71–96%), a positive predictive value of 69% (39–91%), and a negative predictive value of 93% (78–99%).

Discussion

Laparotomy was once a routine procedure to rule out intraabdominal organ injury in penetrating abdominal stab wounds; in its place, a conservative approach was adopted because some studies showed that routine laparotomy was

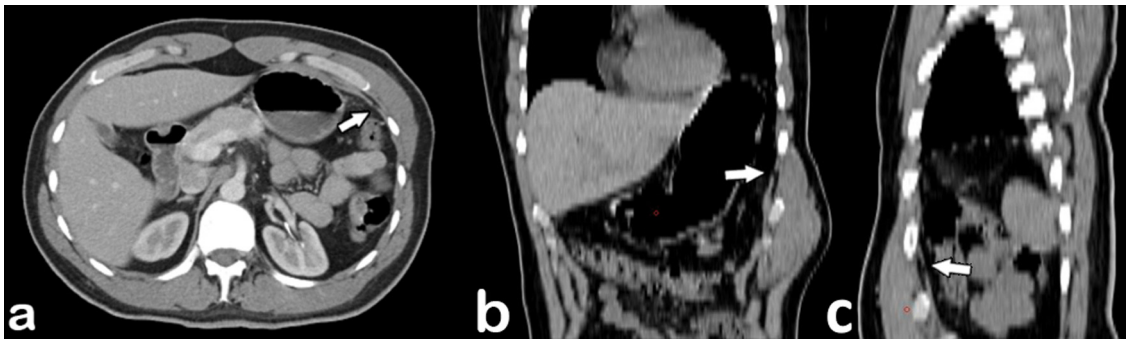

Fig. 2. Coronal (b) and sagittal (c) plane views of a suspicious diaphragmatic injury on axial (a) plane.