International Journal of Surgery Open ■■ (2016) ■■–■■

Contents lists available at ScienceDirect

International Journal of Surgery Open

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

Case Report

Indirect ballistic injury to the liver: Case report and review of literature

Imraan Sardiwalla *, Magenthran Govender, Oleh Matsevych, Zacharia Koto.

Department of General Surgery, Sefako Makgatho Health Sciences University, South Africa

ARTICLE INFO

Article history:
Received 23 September 2016
Received in revised form 27 September 2016
Accepted 27 September 2016
Available online

Keywords:
Gunshot injury
Indirect ballistic injury
Liver laceration

ABSTRACT

Introduction: Penetrating injury due to gunshot wounds is a common problem seen in trauma centres around South Africa. Gunshot wounds can injure organs directly or may cause indirect injury. The temporary cavity is responsible for injury to organs distant to the wound tract. Organs with higher density such as bone or liver are more prone to injury due to the temporary cavity.

Presentation of case: A 25 year old male patient sustained a gunshot wound to the right lower chest from a handgun. He was haemodynamically and metabolically stable with no evidence of peritonitis. CT scan of the abdomen revealed a Grade 2 injury of the liver. There was subcutaneous emphysema along the tract of the bullet. No injury to the lung or pleura was reported. The patient was explored laparoscopically to rule out diaphragmatic injury. At exploration the peritoneum was not breeched but the liver had a grade two laceration caused by an indirect ballistic injury

Discussion: Penetrating trauma to the right lower chest can potentially injure multiple organs. CT scan can reliably diagnose the bullet tract as well as solid organ injuries. In this case the diaphragm was contused and the liver was lacerated by energy created by the temporary cavity. The difference in severity of the injury of these organs is related to the pliability of the tissue.

Conclusion: Gunshot wounds can injure organs directly as well as those located close to the bullet tract. These injuries may be found in adjacent cavities not traversed by the bullet. A high index of suspicion, as well as imaging, is important to diagnose and grade these injuries. The possibility of indirect ballistic injury should always be kept in mind when managing patients with gunshot wound even in the lower velocity handgun injuries.

1. Introduction

Penetrating injury remains a common mechanism of injury in South Africa. Penetrating trauma constituted 30% of the trauma load with gunshots contributing 5% in Pietermaritzburg [1]. There are two distinct mechanisms of injury caused by gunshot wounds. These are related to "crush" and "stretch" of the tissues (Diagram 1). The crush mechanism is related to passage of the bullet through the tissues, the tissues are pushed away centrifugally and this results in the permanent cavity. The stretch mechanism applies to the adjacent tissues and can be equated to the temporary cavity formed as the bullet passes through the tissues. The temporary cavity reaches a pressure of four atmospheres, lasting about 4–5 milliseconds. The temporary cavity can injure blood vessels and fracture bones not directly passed through by the bullet, the higher the energy transfer of the bullet the larger the temporary cavity produced [2,3]. Elastic tissues with more pliability such as lung and bowel wall, tolerate this stretch much better. Inelastic solid organs such as the liver do not [4].

There have only been a handful of cases published in the literature to date. These cases have been both high and low velocity injuries. The majority of injures documented have been to the small bowel. In World War 1 Fraser and Bates reported on an extraperitoneal injury that caused a bladder rupture [5]. Since this original report there have been reports to injury of various parts of the small bowel, spleen and colon, however no one has objectively reported significant injury to liver from indirect ballistic injury. We present the unique case of an indirect ballistic injury to liver caused purely by the temporary cavity of a passing bullet [6–8].

Abbreviations: CT, computed tomography; ATLS, advanced trauma life support; CO2, carbon dioxide.

* Corresponding author. Department of General Surgery, Sefako Makgatho Health Sciences University, Molotlegi Street, Ga-Rankuwa, Pretoria, Gauteng, South Africa. Tel.: +27845863493.
E-mail address: imraansardiwalla@gmail.com (I. Sardiwalla).

http://dx.doi.org/10.1016/j.ijso.2016.09.006

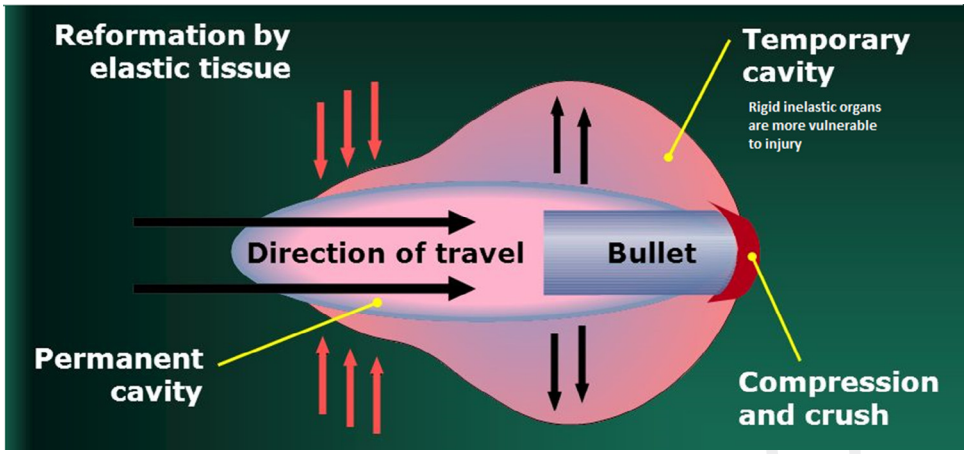

Diagram 1. A schematic representation of the mechanism of injury caused by bullet.

2. Patient information

A 25 year old male patient presented to Doctor George Mukhari Academic Hospital Trauma Unit with a gunshot wound to the right lower chest in an attempted house robbery. The patient sustained a gunshot with a handgun. He was managed according to ATLS principles. The patient was haemodynamically stable. Secondary survey revealed a wound over the 7th intercostal space anteriorly in the midclavicular line and a second wound in the 8th intercostal space midaxillary line. Chest x-ray revealed no haemopneumothorax. The abdomen was clinically soft with no peritonitis. Initial blood gas revealed a metabolically normal patient. Connecting the trajectory of the bullet the liver as well as the diaphragm was likely to be injured (Figs. 1 and 2). A contrasted computed tomography scan of the abdomen was performed. A grade 2 (2 cm laceration) of the liver with surgical emphysema in the soft tissues was noted (Fig. 3). There was no free air or intra-abdominal fluid. Due to trajectory of the bullet diaphragmatic injury was strongly suspected. The patient was taken to theatre for a laparoscopic exploration. Under general anaesthesia with the patient positioned supine pneumoperitoneum of 12 mmHg of CO2 was established by open Hasson technique infraumbilically. There was evidence of contusion (Grade 1) injury to the diaphragm but no peritoneal penetration (Fig. 4). The liver was lacerated (Grade 2) but not bleeding. This did not require therapeutic intervention. The rest of the exam was normal. Chest x-ray on day 1 post operation revealed no delayed pneumothorax. The patient made an uneventful recovery and was discharged on postoperative day 2 tolerating a full diet and full mobilization. The patient was advised to avoid contact sport for six weeks.

Fig. 1. Picture of bullet trajectory a lateral view.

Fig. 2. Picture of bullet trajectory anterior view.

Please cite this article in press as: Imraan Sardiwalla, Magenthran Govender, Oleh Matsevych, Zacharia Koto., Indirect ballistic injury to the liver: Case report and review of literature, International Journal of Surgery Open (2016), doi: 10.1016/j.ijso.2016.09.006