



Case Report

Penetrating firearm injury of the supra- and infrarenal inferior vena cava successfully treated with primary repair

Trauma vascular penetrante de vena cava en su porción suprarrenal e infrarrenal por proyectil de arma de fuego tratado mediante sutura con evolución clínica favorable

Jaime Ramírez del Río¹, Rodrigo Lozano-Corona²

¹Departament of General Surgery. Centro Médico Lic. Adolfo López Mateos. Instituto de Salud del Estado de México (ISEM). Toluca de Lerdo, Mexico. ²Angiology, Vascular and Endovascular Surgery Service. Hospital Regional Lic. Adolfo López Mateos. Instituto de Seguridad Social y Servicios Sociales de los Trabajadores del Estado (ISSSTE). Mexico City, Mexico

Abstract

Introduction: trauma to the vena cava is one of the most complex and lethal surgical emergencies in the context of patients with blunt and penetrating abdominal trauma, secondary to the complexity of the retroperitoneal approach and primary repair.

Case report and discussion: we present the case of a 31-year-old male patient who suffered penetrating trauma to the thorax and abdomen secondary to a firearm projectile with diaphragmatic, hepatic and vena cava injuries in different segments, which were managed by means of vascular raffia. The case evolved satisfactorily, without postoperative complications despite being a case of maximum complexity.

Keywords:

Inferior vena cava.
Venous injuries.
Penetrating injuries.
Abdominal vascular trauma.

Resumen

Introducción: los traumatismos de la vena cava constituyen una de las urgencias quirúrgicas más complejas y letales que pueden existir en el contexto de pacientes con traumatismos abdominales contusos y penetrantes, secundarios a la complejidad que existe en el abordaje del retroperitoneo y de la reparación primaria.

Caso clínico y discusión: se presenta el caso de un paciente masculino de 31 años que sufre trauma penetrante de tórax y abdomen por un proyectil de arma de fuego con lesiones diafragmática, hepática y de vena cava en distintos segmentos, que se manejaron mediante sutura vascular. El caso evolucionó de manera satisfactoria, sin presencia de complicaciones en el posoperatorio, a pesar de tratarse de un caso de máxima complejidad.

Palabras clave:

Vena cava inferior.
Lesiones venosas.
Lesiones penetrantes.
Traumatismo vascular abdominal.

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Correspondence:

Jaime Ramírez del Río. Departament of General Surgery. Centro Médico Lic. Adolfo López Mateos. Avda. San Juan, s/n. Colonia de la Magdalena. Delegación San Lorenzo Tepaltitlán I. 50010 Toluca de Lerdo, México
e-mail: ackme_mr@hotmail.com

INTRODUCTION

Injuries to the inferior vena cava (IVC) are rare and are associated with high mortality rates. They represent a major challenge for surgeons because of the vessel's anatomical location, large caliber, and the difficulty of access and exposure; therefore, injury to any of its segments requires significant surgical skill and expertise (1). The suprarenal (18%) and infrarenal (39%) segments are most frequently affected, resulting in mortality rates of approximately 50% at hospital admission and up to 70% in the postoperative period (2). There are different treatment strategies for these injuries; however, the choice depends on the patient's hemodynamic stability and the location of the lesion. Injuries located in the infrarenal segment have higher success rates vs those in the retrohepatic segment, where mortality rates of up to 100% due to massive exsanguination have been reported (3). Although ligation is a relatively simple and rapid technique, it has been shown to be associated with greater postoperative morbidity, including increased rates of deep vein thrombosis, pulmonary embolism, and compartment syndrome (4). In contrast, primary repair has demonstrated better outcomes in patients with suprarenal injuries, even in those with hemodynamic compromise (4) (Table I).

CASE REPORT

A 31-year-old man was referred to the emergency department (ED) 4 hours after sustaining a gunshot wound, with an entry wound in the deltoid region of the right upper extremity and no exit wound identified (Fig. 1). On admission, he was conscious, oriented, and cooperative. Examination revealed no cranial or cervical injuries. Chest examination showed decreased air entry predominantly in the right hemithorax, associated with respiratory distress. Cardiac auscultation revealed normal heart sounds. The abdomen was distended due to adipose panniculus, with no visible external lesions; bowel sounds were absent, involuntary muscle guarding was present, and rebound tenderness was positive. The right upper extremity showed a punctiform 5-mm wound with regular edges on the lateral portion of the deltoid muscle, without active bleeding, and limited mobility. The remaining extremities were unremarkable. Vital signs on admission were as follows: blood pressure 120/60 mmHg, heart rate 83 bpm, respiratory rate 23 breaths/min, temperature 36.3 °C, and oxygen saturation 78%. Given the absence of hemodynamic instability, non-contrast computed tomography of the chest and abdomen was performed (Fig. 2), revealing the presence of a hyperdense object in the cavaortic space suggestive of a projectile.

Table I. Traumatic injuries of the inferior vena cava: a case series summary

Author, year	Location of the injury (n)					Treatment (n)				Overall mortality
	Infrarenal	Juxtarenal	Suprarenal	Retro hepatic	Supra hepatic	Ligature	Venorrhaphy	Resection / Anastomosis / Patch	Unknown	Total (%)
Asensio, 2020				12		22	34		33	75%
Hansen, 2000	13		8	9		4	28	2		55%
Tyburski, 2001	65	14	31	32	2					57%
Navsaria, 2005	41		6	1		30	18			31%
Sullivan, 2010	54	21		15	10	25	57			51%
Van Royen, 2014	15		9	3		4	16	1		37%
Hampton, 2016	19	9	3	4		23	6			49%

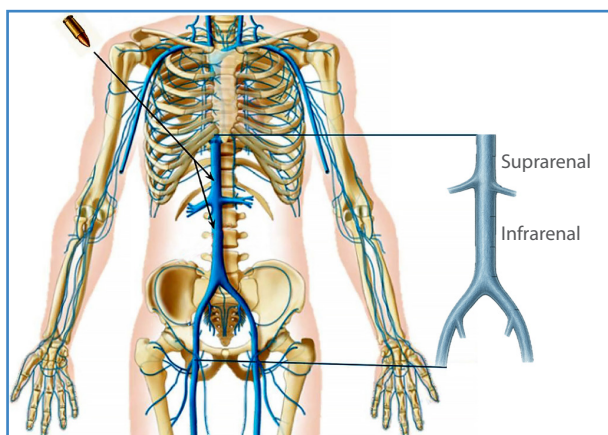


Figure 1. Representation of the projectile's trajectory and its final location.



Figure 2. Simple tomography of the abdomen, thorax and pelvis in coronal section, showing the trajectory of the projectile.

Emergency surgical management was therefore indicated. An exploratory laparotomy was performed, revealing the following findings: a grade II right diaphragmatic injury according to the American Association for the Surgery of Trauma (AAST) classification (laceration < 2 cm), a grade II hepatic injury involving Couinaud segment VI (laceration 1–3 cm), a grade IV intestinal injury (transection), and a grade III vena cava injury (suprarenal and infrarenal involvement affecting < 25% of the vessel

circumference). To address the vascular injury, a Cattell–Braasch maneuver was performed to expose Sheldon zone I. Proximal and distal dissection of the great vessels was performed to ensure adequate exposure. A 1-cm perforation was identified on the anterior wall of the suprarenal segment of the vena cava, as well as a 1-cm perforation on the anterior wall of the infrarenal segment, where the projectile was lodged and partially tamponading the hemorrhage. Therefore, proximal and distal vascular control was achieved using Satinsky clamps (Fig. 3). Both lesions were repaired with continuous 4-0 Prolene sutures. After removal of the vascular clamps, adequate repair was confirmed with no evidence of bleeding. The patient was admitted to the intensive care unit, where he had a favorable clinical course without immediate or late post-operative complications. He was discharged after clinical improvement following 5 days of hospitalization.

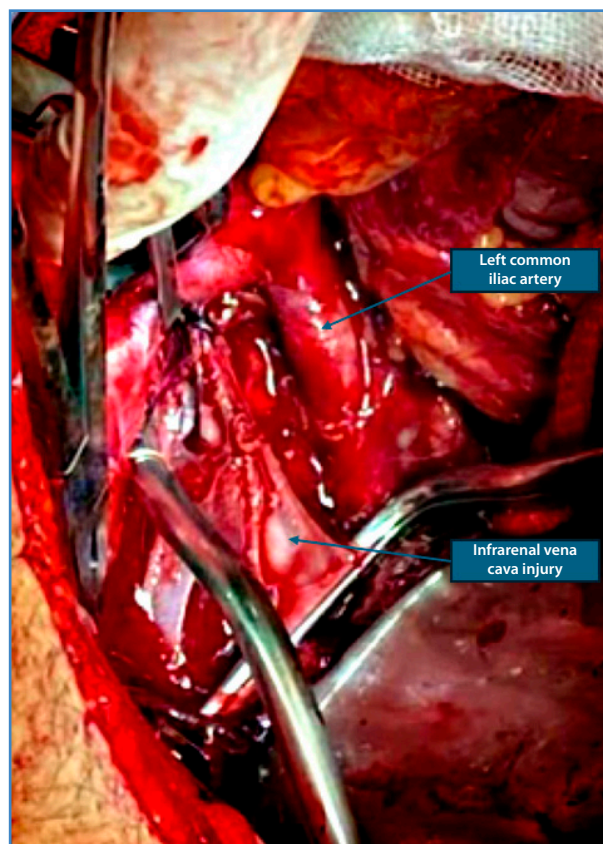


Figure 3. Vascular control with Satinsky clamps in the suprarenal and infrarenal portions of the inferior vena cava.

DISCUSSION

This case is notable for its atypical clinical presentation, as there were no signs of hemodynamic instability, which is most often associated with major vascular injuries. This finding contrasts with reports by Castater et al., who noted that most patients with such injuries present to the ED in hemorrhagic shock (5).

The favorable clinical outcome is also noteworthy, as Castater et al. reported mortality rates ranging from 20% to 70%, and from 20% to 50% in isolated vena cava injuries (5). However, in the present case, involvement of 2 vena cava segments along with concomitant injuries to other organs would typically be expected to increase mortality and morbidity due to synergistic effects in this type of trauma.

Therapeutic options depend on the injured segment, patient condition, and available resources. Given the involvement of both supra- and infrarenal segments of the vena cava and the absence of hypovolemic shock, primary repair with 4-0 monofilament

suture was chosen (Fig. 4). This approach has been shown to be associated with lower complication rates compared with ligation, which is linked to higher rates of postoperative complications, longer hospital stays, prolonged intensive care unit admissions, and extended durations of mechanical ventilation (5-8).

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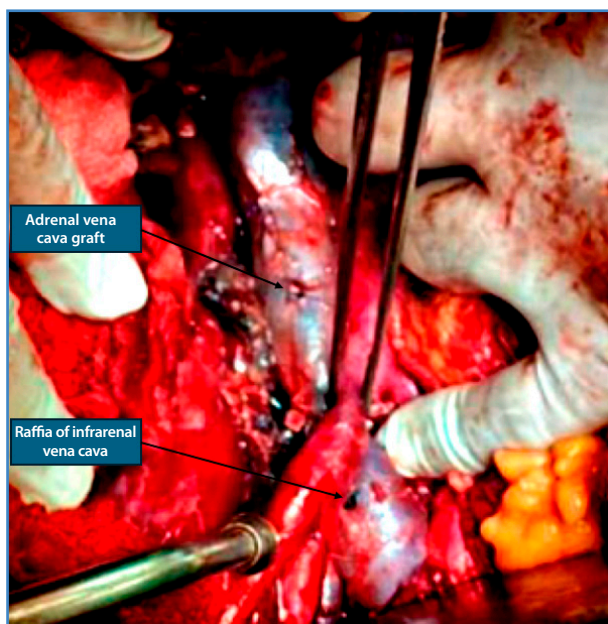


Figure 4. Supracaval and infrarenal inferior vena cava lesion repair with 4-0 Prolene suture.