
ORIGINAL ARTICLE

Hepatic Pseudoaneurysms from Motor Vehicle Accidents Treated with Endovascular Embolisations

N Abdullah, Z Mohamed, Y Yaacob

Radiology Department, Universiti Kebangsaan Malaysia Medical Center, Kuala Lumpur, Malaysia

ABSTRACT

Objectives: To highlight the incidence of hepatic pseudoaneurysms secondary to motor vehicle accidents and the rate of successful treatment with endovascular embolisation.

Methods: This was a retrospective study performed in a medical centre in Malaysia from January 2009 to January 2012. Cases were identified using the Integrated Reporting and Imaging System of the department and the angiographic unit server. Further details were collected from the patients' medical records. All patients were followed up by the primary team for at least a year.

Results: There were five cases of hepatic pseudoaneurysms of which two developed arteriportal or arteriovenous shunts. All patients were young adult males with high-grade liver injury. Of these, only one was symptomatic and diagnosed by the presence of fresh blood in the surgical drain; the other four cases were diagnosed by incidental findings on follow-up computed tomography. All the cases were treated successfully with endovascular embolisation: two with glue embolisation and three with coil embolisation. Patients were followed up clinically for 1 year with no significant sequelae.

Conclusion: Hepatic pseudoaneurysms from motor vehicle accidents are a rare complication and, commonly, are incidental findings on follow-up computed tomography. Awareness of this complication is important; treatment with a procedure such as endovascular embolisation can prevent further complications.

Key Words: Aneurysm; Embolization, therapeutic; Hepatic artery

中文摘要

血管內栓塞術治療因交通意外事故而發生的肝假性動脈瘤

N Abdullah, Z Mohamed, Y Yaacob

目的：探討因交通意外事故而發生的肝假性動脈瘤的發生率，以及血管內栓塞治療的成功率。

方法：本回顧研究於2009年1月至2012年1月期間於馬來西亞一所醫療中心進行。利用部門的綜合報告和成像系統，以及血管造影裝置找出相關病例。並從病人的病歷中收集進一步的細節。所有患者於術後由初始治療團隊隨訪至少一年。

結果：五例肝假性動脈瘤中，兩例形成了肝動脈-門靜脈或肝動-靜脈短路。所有患者均為重度肝創傷的年輕成年男性。五例當中只有一例出現症狀，因手術引流中出現鮮血而診斷。其餘四例通過隨訪

Correspondence: Dr Yazmin Yaacob, Radiology Department, Universiti Kebangsaan Malaysia Medical Center, Kuala Lumpur 56000, Malaysia.

Tel: +60 122010582; Fax: +60 391456682; Email: minyaacob@yahoo.com

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電腦斷層掃描偶然發現而診斷。血管內栓塞術成功治療所有病例；其中兩例使用膠體栓塞，另三例用線圈栓塞。一年臨床隨訪中無明顯後遺症。

結論：因交通意外事故而發生的肝假性動脈瘤是一種罕見的併發症，通常於隨訪電腦斷層掃描中偶然發現。意識到這種併發症很重要，使用如血管內栓塞術的治療方法可防止進一步的併發症。

INTRODUCTION

False aneurysm or pseudoaneurysm is formed by disruption of or defect in the arterial wall leading to the extravasation of blood into surrounding tissue where it is contained by formation of a fibrous capsule.¹⁻³ A pseudoaneurysm has a higher risk of rupture than a true aneurysm as it undergoes progressive enlargement. The aetiology is usually inflammation, iatrogenic causes, or trauma.²⁻⁴ Cases of hepatic pseudoaneurysms reported in the literature were caused by blunt or penetrating abdominal trauma, or surgical injury such as post-liver transplantation. Inflammatory causes include pancreatitis, inflammatory vascular disease such as polyarteritis nodosa, or tumours. Literature search shows that most studies on hepatic pseudoaneurysm concentrate on its association with postoperative or postprocedural complications, and rarely with blunt abdominal trauma such as high-grade liver injury from motor vehicle accidents.

We present a retrospective analysis of five patients who developed hepatic pseudoaneurysm specifically after motor vehicle accidents. Of these, two cases had systemic and portal fistulous communication. All cases were treated via endovascular interventions.

METHODS

We reviewed our database using the Integrated Reporting and Imaging System, the main database server of the department, and the angiography unit computer server of our centre from January 2009 to January 2012 for cases of hepatic pseudoaneurysms that underwent computed tomography (CT) of the abdomen, hepatic angiography, and endovascular intervention. The medical records of the patients were also obtained and reviewed.

The imaging findings, laboratory findings, endovascular interventions, and outcomes of all cases were analysed.

RESULTS

There were five cases of hepatic pseudoaneurysm secondary to motor vehicle accidents. All the cases had high-grade (predominantly grade III and grade IV) liver

injuries.¹ Grade III injuries include subcapsular injury, with involvement of more than 50% of the surface area or ruptured subcapsular or intraparenchymal bleeding with haematoma measuring more than 10 cm in diameter or laceration leading to a capsular tear measuring more than 3 cm in depth. Grade IV injuries include ruptured intraparenchymal haematoma with active bleeding, laceration and parenchymal disruption involving 25% to 75% of the hepatic lobes or involving one to three Couinaud segments.² Initial imaging and evaluation were performed by ultrasound and CT. All the patients were under 30 years of age with no significant medical or surgical history. Three of the five cases underwent exploratory or urgent laparotomy to secure haemostasis.

Of the five cases, only one was symptomatic. This was a 25-year-old man who had a motor vehicle accident and sustained grade III liver injury with subcapsular haematoma. He underwent exploratory laparotomy because of clinical symptoms of intra-abdominal infection. The intraoperative findings were blood clots, pus, and necrotic materials in segment VII, infected subcapsular haematoma complicated with small bowel perforation. Liver debridement and bowel repair were performed. Twenty days post-trauma, the abdominal drain from segment VII showed persistent fresh blood, with the haemoglobin level dropping from 100 to 85 g/l. An urgent CT arteriography showed two pseudoaneurysms measuring 0.5 x 0.6 x 0.5 cm and 1.8 x 1.6 x 2.2 cm arising from the right hepatic artery (Figure 1). Endovascular treatment was performed and both pseudoaneurysms were embolised with histoacryl glue.

Two cases of hepatic pseudoaneurysms showed fistulous communications. One was a 21-year-old man who sustained polytrauma and grade IV liver injury. Thirty-four days post-trauma, he underwent a CT scan for reassessment which revealed a right hepatic artery pseudoaneurysm. However, on angiography, a large pseudoaneurysm of 2.1 x 2.0 x 2.0 cm with fistulous communication with the portal vein was detected (Figure 2). Coils were used to embolise the pseudoaneurysm and



Figure 1. Contrast-enhanced computed tomography in axial section showing a lobulated enhancing mass (arrow) surrounded by haematoma in segment 6/7 in keeping with a diagnosis of pseudoaneurysm.



Figure 2. Hepatic arteriography showing a large pseudoaneurysm with communication with the right portal vein (arrow).



Figure 3. Post-embolisation arteriogram showing successful coil embolisation of the pseudoaneurysm and arteriportal shunt. Note one coil has migrated to the portal system due to the large size of the fistula (arrow).



Figure 4. Hepatic arteriogram showing a large pseudoaneurysm (arrow) with communication with the middle hepatic vein (arrowhead). C is a Rosch hepatic angiographic catheter and S is a biliary stent.

block the fistula (Figure 3). A small coil migrated to the small posterior branch of segment VII portal vein due to the large size of the fistula, but this was not associated with any significant complication on follow-up.

The other case was a 22-year-old man with alleged motor vehicle accident with polytrauma and grade IV liver injury. He underwent an urgent laparotomy. A CT reassessment performed 19 days post-trauma showed

a right hepatic pseudoaneurysm measuring 3.4 x 2.2 x 2.6 cm. Angiographically, the pseudoaneurysm had a fistulous communication with the middle hepatic vein (Figure 4). Embolisation with coils was done and subsequently showed no flow into the pseudoaneurysm with minimal flow through the fistulous communication into the middle hepatic vein (Figure 5). There were no significant complications on 1-year follow-up.

All the five cases were successfully treated with endovascular embolisation with no significant liver-related complications at 1-year follow-up. The fistulous communications between the arterioportal and arteriovenous systems were treated successfully with



Figure 5. Post-embolisation arteriogram showing successful coil embolisation of the pseudoaneurysm and venous shunt.

coil embolisation (Table).

DISCUSSION

Post-traumatic hepatic artery pseudoaneurysm is a rare complication of blunt abdominal injury with a reported prevalence of 1%.³⁻⁵ Post-traumatic hepatic artery pseudoaneurysms associated with arterioportal or arteriosystemic fistulas are also rare; however, there are no data on the exact incidence of these conditions. In our case series, two out of five cases of hepatic artery pseudoaneurysm had arterioportal and arteriosystemic fistulas.

Pseudoaneurysm may be asymptomatic and detected only as an incidental finding during radiological examination such as on follow-up imaging of the liver injury or by the presence of intra-abdominal collection. In our case series, four out of five patients were asymptomatic and one patient had a ruptured aneurysm as demonstrated by the presence of fresh blood from the abdominal drain and drop in haemoglobin level.

Pseudoaneurysms must be treated, even in asymptomatic patients, as the potential of rupture is high compared to a true aneurysm. Reported data show that the presenting symptoms in symptomatic patients include persistent fever, pain, and upper gastrointestinal bleed.^{2,5} Abdominal pain was the main symptom in 55% of the patients, and gastrointestinal bleed or haemobilia occurred in up to 46% of the symptomatic patients.⁶⁻⁸

Due to the risk of rupture, it is important to recognise pseudoaneurysm during CT evaluation of blunt liver trauma. Published data show that pseudoaneurysm may be diagnosed from 3 days to 6 months post-trauma.^{3-5,9,10} In our study, pseudoaneurysms were diagnosed between 10 and 34 days post-trauma.

Table. Demographics, presentation, and management of patients with pseudoaneurysm.

Pa-tient No.	Age (years)	Grade of liver injury	Presentation and timing of detection	Size of aneurysm (AP x W x CC)	Presence of fistula	Type of embolisation used for treatment
1	20	Grade III	Asymptomatic; 13 days post-trauma on follow-up CT	1.2 x 1.5 x 1.4 cm	No	Coil
2	13	Grade IV	Asymptomatic; 10 days post-trauma on follow-up CT	0.5 x 0.5 x 0.4 cm and 1.0 x 0.8 x 1.0 cm	No	NBCA glue
3	25	Grade III	Symptomatic; 21 days post-trauma on urgent CT	0.5 x 0.6 x 0.5 cm and 1.8 x 1.6 x 2.2 cm	No	NBCA glue
4	21	Grade IV	Asymptomatic; 34 days post-trauma on follow-up CT	2.1 x 2.0 x 2.0 cm	Yes	Coil
5	22	Grade IV	Asymptomatic; 19 days post-trauma on follow-up CT	3.4 x 2.2 x 2.6 cm	Yes	Coil

Abbreviations: AP = anterior-posterior; CC = craniocaudal; CT = computed tomography; NBCA = N-butyl cyanoacrylate; W = width.

Identification of an arterioportal fistula (hepatic artery–portal vein) is important to avoid the late complication of life-threatening portal hypertension and formation of varices. An arteriosystemic fistula (hepatic artery–hepatic vein) can cause cardiovascular compromise with high output cardiac failure secondary to blood shunting.^{3,9} Arterioportal and arteriosystemic fistulas were observed in our cases (patients 4 and 5); however none of them demonstrated the complications of portal hypertension or high output cardiac failure at 1-year follow-up.

On CT imaging, hepatic artery pseudoaneurysm is identified as a well-defined, focal, hyperdense lesion, with same contrast enhancement as the arterial structure. All patients in this study had CT examination prior to endovascular embolisation. The sensitivity of diagnosing hepatic artery pseudoaneurysm was 67%, 33%, and 100% by CT, ultrasound, and selective angiography, respectively.³ However, the sensitivity is likely to be higher with newer generation of the ultrasound machines and multidetector CT scanners.

The treatment of choice for hepatic pseudoaneurysm is endovascular embolisation. Selective or even superselective cannulation must be attempted to close the pseudoaneurysm. Proximal embolisation would result in large area of infarct and higher risk of hepatic necrosis and re-bleeding because of the risk of retrograde flow from the collateral branches into the pseudoaneurysm.³ Many embolic agents can be used to occlude the pseudoaneurysm including gel foam, glue or N-butyl cyanoacrylate, or metal coils such as platinum or steel. Additional treatment options include placement of vascular stents or stent grafts across the aneurysm and percutaneous thrombin injection.⁹

In this study, three out of five patients were treated with endovascular coiling, while two were treated with direct embolisation of the pseudoaneurysm with N-butyl cyanoacrylate or glue. Glue is the embolic agent of choice in our study, provided an aneurysm is reachable by superselective cannulation and if there is no fistula presence. For hard-to-reach aneurysms in which technically distal cannulation cannot be

performed, the safest embolisation method would be coil embolisation of the feeder vessel.¹¹ In addition, fistulous communication with the portal or systemic veins must be closed to avoid high-flow communication to the veins. As illustrated in our study, we closed the fistulous communication with coils.

CONCLUSION

The possibility of hepatic pseudoaneurysms should be considered when managing patients with high-grade liver injury as patients could be asymptomatic. Hepatic pseudoaneurysms can be effectively treated with endovascular embolisation. We recommend a large cohort study to verify the needs for surveillance in trauma patients and the effectiveness of endovascular intervention.

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