

Anterior and Posterior Moynihan's Hump: A Case Series Highlighting Anatomical Variants of the Right Hepatic Artery in Laparoscopic Cholecystectomy

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ABSTRACT

The gallbladder, a small, pear-shaped organ located in the right upper abdominal quadrant, typically measures between 7 and 10 cm in length and about 4 cm in width. Despite its modest size, it is frequently implicated in cases of abdominal discomfort, most often due to gallstone disease, which may require surgical removal. Its primary vascular supply is derived from the cystic artery, usually a branch of the right hepatic artery (RHA), stemming from the common hepatic artery. However, anatomical deviations in this vascular pattern are not uncommon. Among these, a distinctive and clinically significant variation is the presence of "caterpillar hump" or "Moynihan's hump". Although infrequently reported, this variation presents considerable surgical challenges. Here, two cases are described in which an anterior and posterior Moynihan's hump was detected intraoperatively during laparoscopic cholecystectomy. The report emphasizes the necessity of thorough preoperative knowledge of hepatobiliary vascular anatomy and the use of techniques such as the critical view of safety (CVS) to mitigate risks associated with such anomalies.

Keywords: Case report, Cholelithiasis, Moynihan's hump.

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INTRODUCTION

Anatomical variations in the right hepatic artery (RHA) are well-documented, with deviations in origin, branching pattern, and course posing significant risks during hepatobiliary surgeries.¹ One such variation, termed the caterpillar hump or Moynihan's hump, involves a tortuous looping of the RHA near Calot's triangle. Failure to identify this anomaly intraoperatively may lead to serious vascular injuries, especially during laparoscopic cholecystectomy, liver transplantation, pancreatic head tumor resection, and chemoembolization for hepatic or pancreatic malignancies.²

This tortuous artery may pass either anterior (40%) or posterior (60%) to the common hepatic duct, with the posterior course being more common.³ Its proximity to the cystic duct and mimicry of the cystic artery can confuse even experienced surgeons, increasing the likelihood of inadvertent ligation or transection.⁴ Because vessel caliber is not a reliable differentiator, it is essential to visualize the RHA both above and below the origin of the cystic artery before division.⁵

The importance of understanding such variations cannot be overstated. A solid anatomical knowledge base can help mitigate operative risk and prevent bile duct injuries (BDIs), many of which stem from misidentification of vascular or ductal structures.⁶

From an embryological standpoint, the caterpillar hump may be attributed to the persistence of fetal arterial configurations, particularly segmental arteries from the dorsal aorta. These vessels occasionally remain as accessory arteries in the adult hepatic vasculature.⁷ Another theory proposes that in patients with chronic liver changes such as cirrhosis, architectural distortion of intrahepatic branches may lead to elongation and tortuosity of the RHA. Radiological literature further documents angiographic evidence of hepatic arterial "corkscrewing" associated with these architectural derangements in cirrhosis.⁸

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CASE DISCUSSION

Case 1 (Posterior Moynihan's Hump)

Clinical History

A 25-year-old female patient reported epigastric pain for 1.5 years, which had worsened over the past month. The pain was dull-aching, meal-induced, and associated with nausea. She had been evaluated previously and diagnosed with cholelithiasis via ultrasonography.

General Condition and Investigations

On admission, the patient was conscious, oriented, afebrile, and hemodynamically stable (BP: 110/80 mm Hg, PR: 76 bpm, SpO₂: 98%). Her abdominal examination showed a soft, nontender abdomen with negative Murphy's and Boas' signs. No other systemic abnormalities were noted. Her hematological and biochemical parameters were within normal limits (Hb: 12.6 gm/dL, TLC: 8220/cumm,

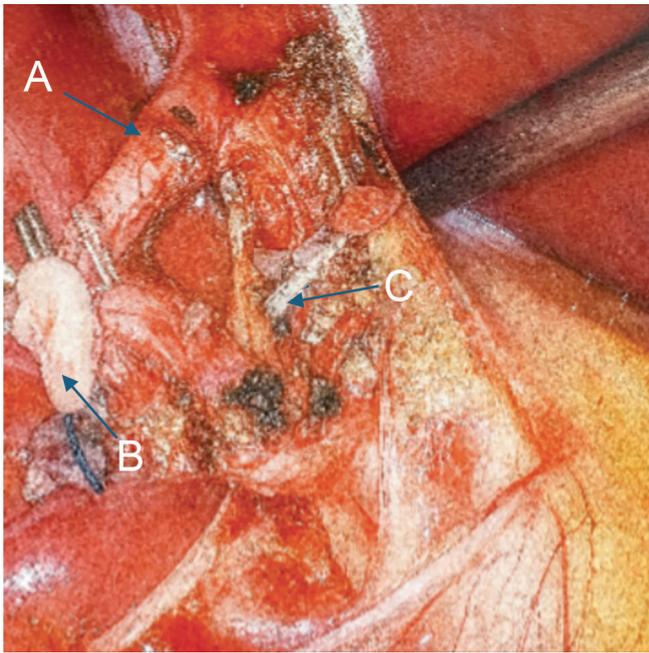


Fig. 1: Intraoperative image of posterior Moynihan's hump. A – Posterior Moynihan's hump (Paracystic); B – Ligated cystic artery; C – Ligated cystic duct

Platelets: 1.75 lakh/cmm). Liver function tests showed mildly raised alkaline phosphatase (170 IU/L) but normal bilirubin and transaminases. ECG revealed a sinus rhythm. Ultrasound (10/05/2025) indicated hepatomegaly with grade I fatty liver, a contracted gallbladder with multiple calculi (average size 6.6 mm), and a mildly dilated common bile duct (CBD) measuring 5.8 mm.

Intraoperative Findings

During laparoscopic cholecystectomy (Operated on 10/05/2025), intraoperative visualization revealed a thick-walled, contracted gallbladder with dense adhesions. A clearly defined Moynihan's hump was identified – a tortuous loop of the RHA running in proximity and parallel to the cystic duct. The artery appeared densely adherent to the cystic duct and was seen entering the liver parenchyma approximately 2 cm anterior to *Rouviere's sulcus* at the cystic plate. Importantly, the cystic artery was not easily distinguishable due to the tortuous RHA loop (posterior Moynihan's hump); meticulous dissection was necessary. Dissection proceeded with careful mobilization of Calot's triangle, exposing the cystic duct and artery junction, followed by ligation of the cystic duct distal to the crossing artery. Critical view of safety (CVS) was confirmed before any structure was divided (Figs 1 and 2; Supplementary Video 2).

Case 2 (Anterior Moynihan's Hump)

Clinical History

A 42-year-old female had been apparently well until 8 months prior, when she began experiencing pain in the right upper abdomen accompanied by episodes of vomiting. After conservative management at a local clinic, she was diagnosed with cholelithiasis and referred for surgical intervention.

General Condition and Investigations

On examination, the patient was conscious, oriented, and afebrile, with vital signs within normal limits (BP: 100/70 mm Hg, PR: 76 bpm,

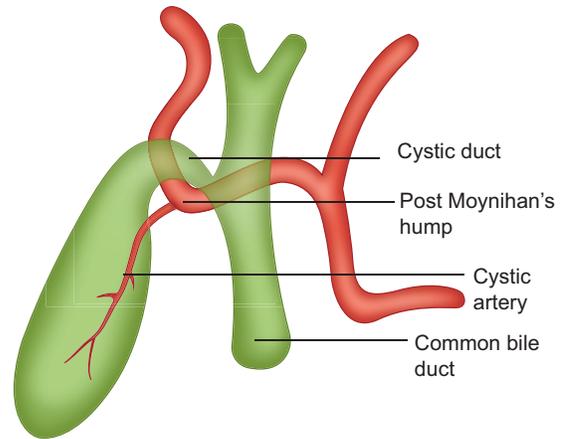


Fig. 2: Diagrammatic representation of posterior Moynihan's hump

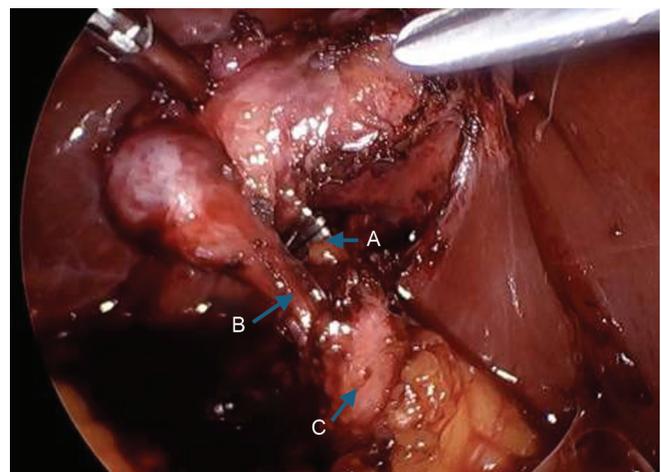


Fig. 3: Intraoperative image of anterior Moynihan's hump. A – Cystic artery; B – Cystic duct; C – Anterior Moynihan's hump (Supracystic)

SpO₂: 98%). Abdominal examination showed a soft, non-tender abdomen, and both Murphy's and Boa's signs were negative. Her blood tests showed mild anemia (Hb: 10.6 gm/dL) but otherwise normal parameters (TLC: 7800/cumm, Platelets: 1.67 lakh/cmm). Liver enzymes and renal function were within reference ranges. Ultrasound (02/05/2025) revealed a contracted gallbladder with multiple calculi, the largest measuring 14 mm, and a normal CBD caliber.

Intraoperative Findings

In this case, laparoscopic cholecystectomy (operated on 03/05/2025) access revealed an intraoperative finding, which was the presence of a Moynihan's hump with an anterior looping of the RHA closely hugging the gallbladder neck and cystic duct junction. Anterior loop closely adhered to the cystic duct demanded careful dissection followed by establishment of CVS with clear identification of both cystic arteries and the cystic duct before division by clipping of the cystic duct and dissection (Figs 3 and 4; Supplementary Video 1).

PROCEDURE

Both patients underwent elective laparoscopic cholecystectomy under general anesthesia for symptomatic cholelithiasis. They were positioned in the reverse Trendelenburg with a slight left lateral tilt to facilitate optimal visualization of the gallbladder fossa and

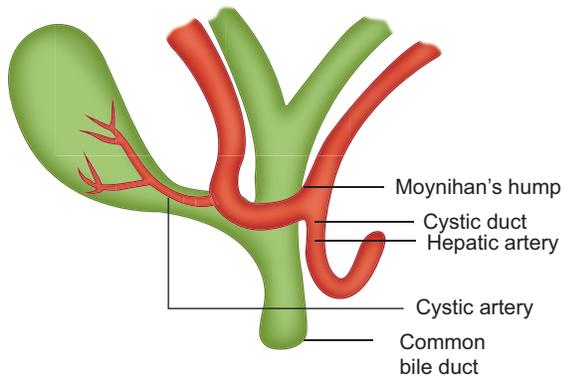


Fig. 4: Diagrammatic representation of anterior Moynihan's hump

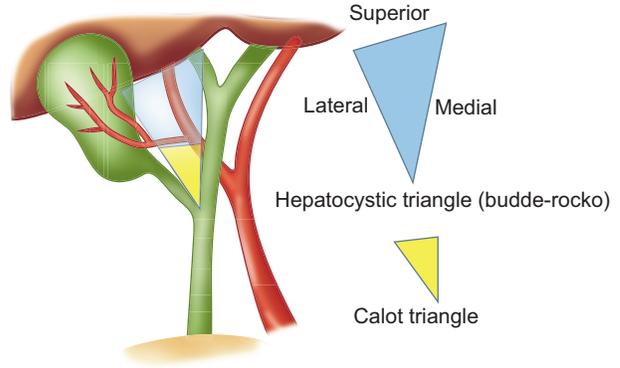


Fig. 5: Critical view of safety diagrammatic representation

Calot's triangle. Pneumoperitoneum was established using a Veress needle, and intra-abdominal pressure was maintained at 12 mm Hg.

A standard four-port technique was employed. A 30° laparoscope was introduced through a 5 mm trocar at the umbilicus, facilitating visualization and subsequent specimen retrieval. Three additional trocars were inserted, where 10 mm was inserted at the epigastric region, 5 mm at mid-clavicular and anterior axillary line.

In both cases, initial inspection revealed thick-walled, contracted gallbladders with pericholecystic adhesions, requiring careful dissection to expose the Calot's triangle. The assistant retracted the fundus upward while the surgeon laterally retracted the infundibulum.

The visceral peritoneum around the gallbladder neck was incised using a monopolar hook, followed by blunt and sharp dissection of the fibrofatty tissue within Calot's triangle.

Dissection proceeded cautiously to achieve the CVS:

- Complete clearance of Calot's triangle. Dissection along the gallbladder close to its wall.
- Identification of only two structures entering the gallbladder (cystic duct and cystic artery).
- Mobilization of the lower third of the gallbladder off the liver bed, allowing visualization of the liver surface through the triangle above *Rouviere's sulcus*.

After achieving the CVS, the cystic ducts and arteries were carefully clipped proximally and distally and divided. Special care was taken in both cases to preserve the RHA, particularly in the presence of a tortuous loop. In both cases, cystic arteries were individually secured and divided after confirming their anatomy.

The gallbladders were dissected from their hepatic beds using electrocautery and extracted through the umbilical port. Both procedures were completed without any intraoperative complications. The patients were kept under observation for 24 hours and discharged the next day with oral antibiotics. On follow-up, sutures were removed at an interval of 7 days, and the biopsy came out to be consistent with chronic cholecystitis.

DISCUSSION

Anatomical variation in the hepatobiliary vasculature is a well-established risk factor for BDIs and vascular complications during laparoscopic cholecystectomy. Among the most clinically significant of these is Moynihan's hump, where the RHA forms a tortuous loop close to the cystic duct, often mimicking or obscuring the true cystic artery.⁹

It is essential to emphasize that a vessel appearing to follow the course of the cystic artery, running parallel to the cystic duct, may in fact be the RHA. The caliber of the vessel alone is not a reliable determinant to distinguish between the cystic and hepatic arteries. Therefore, the RHA must be identified both superior and inferior to the origin of the cystic artery before ligation is performed.¹⁰

In the presence of such anomalies, relying solely on textbook anatomy may lead to misidentification, the most common cause of major BDIs. The classic error involves mistaking the CBD for the cystic duct and dividing it. Similarly, aberrant hepatic ducts or arteries may be confused with standard structures, increasing the risk of both ductal and vascular damage.¹¹

The CVS aims to reduce such errors by ensuring that only two structures—the cystic duct and cystic artery are conclusively identified before division. However, CVS cannot always be applied effectively, especially in cases with severe inflammation, fibrosis, or anatomical anomalies. In these situations, alternative strategies such as intraoperative cholangiography, bailout procedures, or subtotal cholecystectomy may be employed to avoid injury (Fig. 5).^{12,13}

In case 1, the cystic artery originates from a normal area of the RHA at Calot's triangle, but distal to its origin, the RHA travels along with the cystic duct and turns abruptly towards the sulcus. Due to adherence of RHA to the cystic duct, the cystic duct was ligated distal to its turn after performing a slit at the Hartman pouch and extraction of the impacted stone from that. While in case 2, RHA traveled anteriorly and made loop in front of the cystic duct. During the operative procedure, we dissected Moynihan's hump carefully by pushing it downward from the cystic duct, enabling complete visualization of the cystic duct, followed by clipping and dissection of the cystic duct.

Furthermore, studies have shown that atypical blood supply and accessory cystic arteries are present in approximately 7.4% of laparoscopic cholecystectomy cases, adding complexity to dissection. These arteries may arise from unexpected sources like the gastroduodenal artery or left hepatic artery, or may be duplicated or absent within Calot's triangle, as observed in one of our reported cases.¹⁴

In both cases presented, careful dissection and identification of the RHA loop (Moynihan's hump), one anterior and one posterior, prevented major complications. Intraoperative findings in both cases revealed the presence of a Moynihan's hump—a tortuous RHA coursing very close to and parallel with the cystic duct, entering the liver parenchyma near *Rouviere's sulcus*. Achieving CVS, using

Rouviere's sulcus as a landmark, and maintaining a high index of suspicion for vascular variants were key to ensuring procedural safety.

CONCLUSION

Both cases illustrate that Moynihan's hump is not merely a textbook anomaly but a real-world intraoperative challenge. Early identification, systematic dissection, and unwavering adherence to the principles of safe cholecystectomy are the cornerstones of preventing major iatrogenic injuries. These cases further advocate for continued training in anatomical variations and the utility of documenting such findings for surgical education.

SUPPLEMENTARY MATERIALS

The supplementary videos 1 and 2 are available online on the website www.wjols.com.

Video 1: Anterior Moynihan hump

Video 2: Posterior Moynihan hump

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