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Case Series

Troublesome gallbladder fossa bleeding during laparoscopic cholecystectomy: case series with review of literature

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ABSTRACT

Gall bladder fossa bleeding is an uncommon but significant complication of laparoscopic cholecystectomy (LC). Effective laparoscopic control of such bleeding is essential to avoid conversion to open surgery. This retrospective case series was conducted in the Department of General Surgery and Advanced Laparoscopic Surgery, Dr. L. H. Hiranandani Hospital, Powai, Mumbai, Maharashtra, India. The study included patients who developed gall bladder fossa bleeding not controlled by conventional measures, during LC between 2013 and 2023. Hospital electronic medical records (EMR) and operative notes were reviewed to identify eligible cases. A total of three patients were included in the study. Data were extracted using a structured case record proforma and included patient's age, sex, diagnosis, intraoperative occurrence of gall bladder fossa bleeding, and the surgical technique used for hemostasis. All patients were managed with laparoscopic gall bladder fossa suturing for control of bleeding. The effectiveness of the technique was assessed based on achievement of hemostasis, need for conversion to open surgery, and intraoperative outcome as documented in operative records. A total of three patients who developed gall bladder fossa bleeding during LC between 2013 and 2023 were included in this case series. The mean age of the patients was 47.3 years (range: 39-57 years). Two patients (66.7%) were male and one patient (33.3%) was female. All cases were diagnosed intraoperatively and were managed successfully with laparoscopic gall bladder fossa suturing. Hemostasis was achieved in all patients (100%) without the need for conversion to open surgery. No intraoperative complications related to the suturing technique were reported in any of the cases. Laparoscopic gall bladder fossa suturing proved to be an effective and safe technique for achieving hemostasis in all patients, with no need for conversion to open surgery and no associated complications. This method may serve as a useful option for controlling persistent gallbladder (GB) bed bleeding when conventional hemostatic measures are ineffective.

Keywords: Cholecystectomy, Fossa, Gall bladder bed, Hemostasis, Laparoscopic, Suturing

INTRODUCTION

Laparoscopic cholecystectomy (LC) is widely regarded as the procedure of choice for patients with symptomatic cholelithiasis. However, LC is associated with potentially serious complications, including haemorrhage and bile duct injury which remain major concerns for surgical safety. Although much attention has been given to bile duct injuries and variations in cystic artery anatomy, bleeding from the GB bed also represents a significant intraoperative challenge. Such bleeding may occur due to injury to venous sinuses, the middle hepatic vein (MHV) and small arterial branches running between the GB and liver, particularly in cases with severe inflammation or difficult anatomical planes.[1] Haemorrhage from these small arterial branches is usually easily controlled, as they are located superficially within the GB fossa. However, injury to the MHV, which lies in close proximity to the GB bed, can lead to profuse bleeding that is difficult to control, potentially compromising

visualization and increasing the risk of conversion to open surgery. The purpose of this paper is to highlight the importance of this problem, to underscore the therapeutic options and feasibility of achieving laparoscopic control of bleeding; and to share our experience regarding the same.

CASE SERIES

This retrospective study was conducted in the Department of General Surgery and Advanced Laparoscopic Surgery, Dr. L. H. Hiranandani Hospital, Powai, Mumbai, Maharashtra, India. The study included patients who developed GB fossa bleeding during LC over a 10-year period from 2013 to 2023.

Hospital EMR including the operative notes were reviewed. A total of three patients were included. Data were collected using a structured case record proforma, including patient demographics, intraoperative diagnosis, occurrence of GB fossa bleeding, and surgical management.

All patients who underwent the said surgery in the specified period, in whom haemorrhage occurred from the gall bladder fossa; which could not be controlled by use of bipolar electrocautery.

The patient demographics along with operative information on the subjects of this study is summarised (Table 1).

Table 1: Patient demographics.

Age (in years)/ sex	Condition of GB	Procedure performed	Bleeding effectively controlled (Y/N)	Conversion to open (Y/N)
39/M	Chronic, non-inflamed	GB fossa suturing	Y	N
57/F	Acute, inflamed	GB fossa suturing	Y	N
46/M	Chronic, non-inflamed	GB fossa suturing	Y	N

A total of 1065 LCs were performed by a single surgeon, in a single centre, between 2013 to 2023. Out of these, 3 patients who developed GB fossa bleeding were included in this case series. Thus, the incidence of troublesome GB fossa bleeding during LC in the present series was 0.28%. The mean age of the patients was 47.3 years (range: 39-57 years). Two patients (66.7%) were male and one patient (33.3%) was female. All cases developed intraoperative GB fossa bleeding during dissection of the GB from the liver bed. The bleeding was managed successfully using laparoscopic GB fossa suturing in all three patients. Prior to suturing, standard intraoperative measures including application of firm pressure and electrocautery were utilized.

However, definitive hemostasis was achieved only after application of sutures to the bleeding GB bed.

Laparoscopic hemostasis was successfully achieved in all cases (100%) using GB fossa suturing. No patient required conversion to open surgery. No intraoperative complications related to the suturing technique were observed. Postoperative recovery was uneventful in all patients, and no secondary bleeding or bile leak was documented.

A total of 3 patients were included in present study; all operated on by a single surgeon. All patients were assessed for fitness for surgery on an outpatient basis. The specific preoperative investigations included an Ultrasonography (USG) scan of the abdomen, liver profile, and a complete blood count, in addition to other routine biochemical investigations.

Operative technique

A standard 4 trocar LC was performed for all the patients. While separating the GB from the liver, haemorrhage occurred. A control of the same was attempted first with monopolar electrocautery failing which bipolar cautery was used (Figure 1 A).

When inspite of use of bipolar cautery, the bleed did not come under control, it was decided to take under-running stitches. Prior to initiation of suturing, a gauze piece was introduced in situ and used for tamponade, while the team got ready to suture (Figure 1 B and C). This was done using 2-0 Polydiaxanone (PDS) on round body needle (Figure 1 D, 2 A-D, 3 A).

In all 3 patients, the haemorrhage was effectively stopped by this measure. Local irrigation was then given to ensure perfect hemostasis (Figure 3 B). Then the gauze was removed (Figure 3 C). Some surgicel was also packed in the GB fossa over the suture line (Figure 3 D).

A 32 French tube drain as inserted through the lateral 5 mm trocar and kept in situ in the Morrison's pouch. In all 3 patients, the drain was removed on post operative day (POD) 2 and they were discharged from the hospital. During their POD 10 out patients department follow up visit, all the operative wounds had healed well in all the patients and they were asymptomatic.

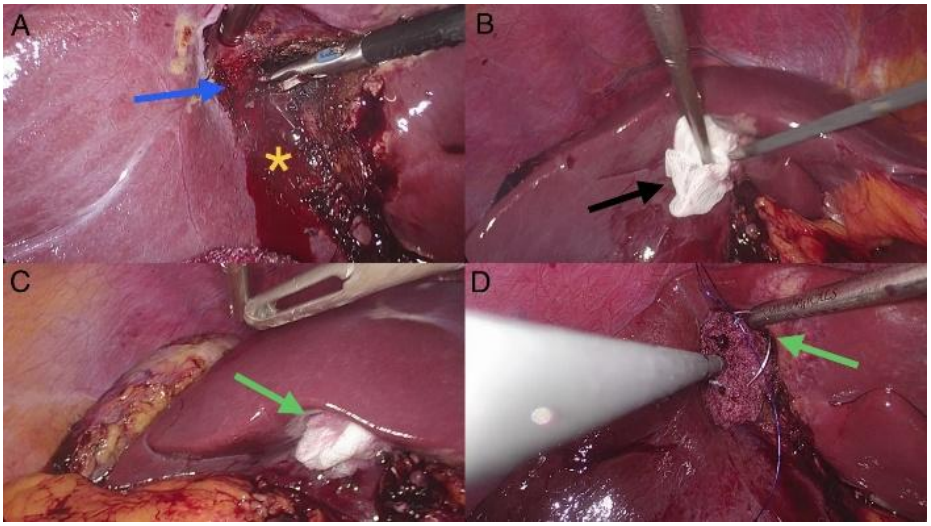


Figure 1: A) Control of active bleed from GB fossa (yellow asterisk) being attempted using bipolar electrocautery (blue arrow), B) gauze piece introduced in situ to pack (black arrow) after cautery failed, C) gauze pack *in situ* (green arrow), D) initiation of underrunning sutures (green arrow) with pack in situ so as to have vision and relatively clear field.

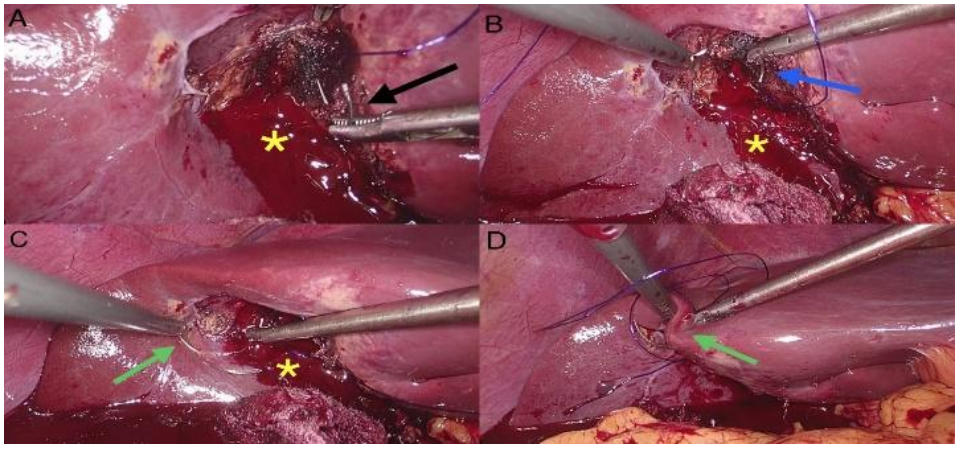


Figure 2: A-C) Under running sutures being taken (black, blue and green arrows) with active haemorrhage (yellow asterisk), D) suturing nearing completion (green arrow).

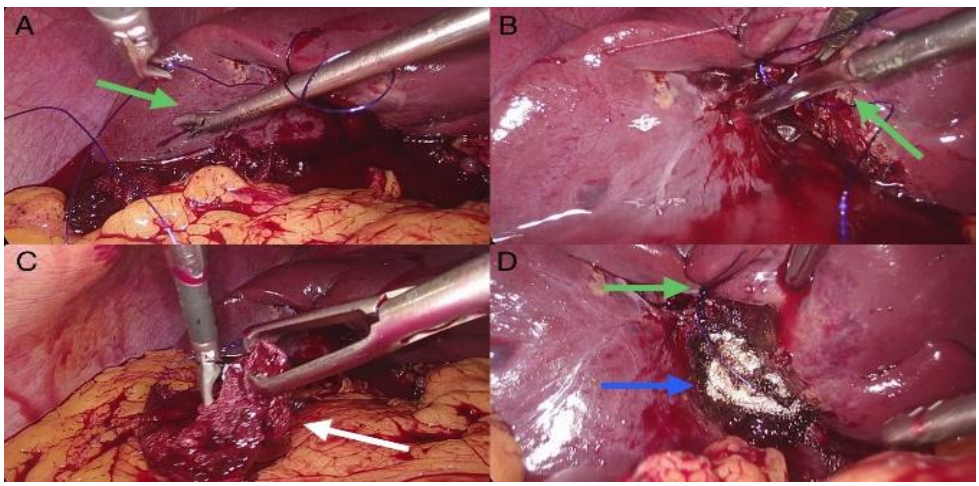


Figure 3: A) Final stitch being tightened (green arrow), B) saline irrigation being done (green arrow), C) gauze pack being removed (white arrow), D) End result-suture line (green arrow) and surgicel (blue arrow) *in situ*.

DISCUSSION

Uncontrollable hemorrhage during LC occurs in 0.1% to 1.9% of all cases, with 88% originating from GB bed.[1] Although the incidence of major hemorrhage during LC is less than 2%, the consequences can be severe, contributing significantly to perioperative morbidity and mortality. Anatomically, large branches (mean diameter=2.1 mm) of the MHV lie in close proximity to the GB bed in nearly 10% of the patients, with an additional 10% having branches within 1mm of the bed.[2] Overall, up to 20% of cases may demonstrate a sizeable venous branch adherent to or immediately adjacent to the GB fossa increasing the risk of intraoperative bleeding.[2] During the dissection of GB from the liver bed, it is crucial for the surgeon to recognize that the MHV often runs close to the GB fossa and may follow a superficial course at times. Furthermore, chronically scarred and contracted GB may increase the risk of significant bleeding, requiring conversion to open. In acute cholecystitis lasting more than 72 hours, severe pericholecystic inflammation causes fusion of the GB wall with surrounding hepatic tissue, obliterating the normal dissection plane. As a result, the GB often needs to be dissected directly from the liver parenchyma, which can lead to diffuse liver bed bleeding that is difficult to control with cautery and carries a risk of postoperative bile leakage as well. Furthermore, Patients with hepatic cirrhosis, or portal hypertension are especially prone to intraoperative haemorrhage due to increased vascularity and fragile liver tissue.[3]

Intraoperative bleeding can be classified as vessel injuries, slippage of clips/ ligatures of the cystic artery, liver bed bleeding and others. To prevent vascular complications, during cystic plate dissection, it is crucial to exercise caution even after dissecting the hepatocystic triangle and confirming the critical view of safety.[4,5] Regardless of it's source, the immediate priority in intraoperative bleeding is the achievement of effective hemostasis.

Initial haemostasis is typically achieved through the application of firm, direct pressure using a sterile gauze sponge. A sterile gauze soaked in a 1:10,000 epinephrine solution can also be used as it promotes vasoconstriction and clot formation.[6] With the evolution of advanced laparoscopic techniques, newer methods for vascular control have been introduced. Traditionally, titanium clips are widely used for hemostasis. However, clips may have limitations such as slipping, dislodgement, migration. Rarely, titanium clips may also cause tissue reactions or interfere with imaging studies, raising considerations regarding cost and healthcare resource utilization.[7] Another commonly used alternative for vascular control is electrothermal cauterization, which includes monopolar and bipolar diathermy. The fundamental principle underlying these modalities involves tissue necrosis and hemostasis through heat generation. Tissue denaturation begins at around 60 degree Celsius with protein coagulation occurring between 70-80 degree Celsius.[8]

In monopolar electrosurgery, current flows from the active electrode at the surgical site to the patient's body to a dispersive return electrode attached to the skin. In contrast, bipolar electrosurgery contains both active and return electrodes within the same instrument, allowing current to pass through the tissue grasped between the jaws. This requires lower voltage, which results in less thermal spread, provides better vessel sealing due to combined thermal energy and mechanical compression.[8] Bipolar devices can seal larger vessels upto 5 mm compared with monopolar electrosurgery, which is generally limited to vessels less than 2 mm.[9] Although electrosurgery is associated with highest incidence of thermal injuries, it remains one of the most widely used energy modalities in laparoscopic surgeries.

When electrocautery fails to control persistent oozing from the GB fossa, laparoscopic suturing of the GB bed or injured venous branches has been described as an effective method for achieving hemostasis. In addition to suturing techniques, advancements in energy devices have provided alternative strategies for improving hemostatic control during laparoscopic procedures. Harmonic® Scalpel (HS) is a superior option to more conventional electrocautery (EC) because it reduces temperatures, smoke, and lateral tissue damage. The HS also lowers the risk of injury due to minimal heat dispersion. Due to less trauma, there is a decrease in both moderate and severe bleeding. The HS has served as a safe alternative to EC for the haemostatic dissection of tissues.

For minor but persistent bleeding, topical haemostatic agents such as oxidized regenerated cellulose (e.g., Surgicel) can be applied. Surgicel is a bioabsorbable hemostatic agent made of oxidized regenerated cellulose (ORC), commonly used during LC to control bleeding from small vessels when conventional hemostasis is difficult. It acts by providing a matrix for clot formation and binding to hemoglobin, which promotes platelet aggregation. This makes it particularly useful in laparoscopy where minor bleeding can obscure the narrow operative field. Surgicel is typically absorbed within 7-14 days, with complete degradation by about 8 weeks.[10]

In addition to oxidized regenerated cellulose- based agents, other topical hemostatic modalities have been increasingly utilized to enhance bleeding control in surgical practice. Fibrin sealant use in the surgical procedures is gaining popularity in the recent years and this drug's efficacy in bleeding is well known. Especially in patients with bleeding disorders such as hemophilia they can be safely used. Fibrin sealent (Tissel) is a biodegradable biological medication formed by combination of highly concentrated human plasma-derived fibrinogen (75-115 mg/ml) and thrombin (500

IU/mL). In the presence of calcium chloride, mixture of these components leads to the development of three-dimensional polymerized fibrin matrix. During this process, the final step in biological coagulation is imitated. Therefore, fibrin adhesives can be used as an adjunct in hemostasis during the surgical procedures. Building upon the principles of fibrin-based hemostasis, a wider range of biological adhesives has subsequently been developed to improve efficacy and overcome the limitations of earlier agents.[11]

Biological adhesives for hemostasis have evolved from traditional fibrin and cyanoacrylate glues to modern bio-based adhesive hydrogels. Early fibrin adhesives such as Tissel and Evicel mimic the human coagulation cascade to form a fibrin mesh for wound closure but have limited bonding strength, poor moisture resistance, and potential risks related to blood-derived components. In contrast, bio-based adhesive hydrogels offer strong wet adhesion, good biocompatibility, and effective hemostasis, even in bleeding environments. They control bleeding through both passive mechanisms (forming a physical barrier and absorbing blood to concentrate clotting factors) and active mechanisms (biochemical interactions that promote platelet aggregation and clot formation). These properties make them particularly useful in patients with coagulation disorders or those on anticoagulant therapy, where conventional hemostatic agents may be less effective.[12]

Where conventional hemostatic techniques may be less effective, in such scenarios, energy-based modalities like lasers can also be used. Lasers were first used in laparoscopic surgery in 1979. They generate heat through a concentrated beam of light, which is absorbed by tissue and converted into heat, enabling tissue cutting and coagulation.

In addition to laser technology, other non-contact energy devices have been developed to enhance coagulation efficacy and precision. Argon Beam Coagulation (ABC) is a non-contact electrosurgical technique in which radiofrequency current is conducted to tissue through ionized argon gas. The argon gas jet helps displace blood from the surface, allowing faster, more uniform, and shallow coagulation with less smoke and reduced tissue damage compared to conventional electrosurgery. However, a potential complication is argon gas embolism, which can occur because argon in insoluble in blood.[8]

Table 2: Review of literature on different hemostatic options for GB fossa.

Author/year of publication	Study type	Technique used to control GB fossa bleeding	Key findings	Conclusion
Rahila et al 2025[13]	Randomized controlled trial	Electrocoagulation vs direct pressure	Successful hemostasis in 86%, in the direct pressure group and 95%, in electrocautery group	Electrocauterization-superior bleeding control. Direct pressure-reduced postoperative pain
Masci et al 2018[14]	Retrospective cohort	ORC vs electrocautery	Used when cautery fails; avoids excessive thermal injury	ORC effective adjunct in persistent bleeding
Liao et al 2020[15]	Systematic reviews and meta-analyses	HS vs monopolar electrocautery	HS consistently reduced intraoperative blood loss, smoke generation, and thermal injury.	Harmonic energy is a safe alternative that improves operative visualization and may reduce minor bleeding
Brown et al 2024[16]	Narrative/systematic reviews	ORC, fibrin sealants, collagen, gelatin, thrombin	Topical hemostatic agents are useful adjuncts for diffuse oozing when electrocautery or suturing is insufficient. ORC remains one of the most widely used absorbable agents.	Topical agents should complement-not replace-standard surgical hemostatic techniques.
Chaoliang et al 2020[17]	Retrospective case series	Laparoscopic suturing/ligation for GB bed hemorrhage due to MHV injury	8 cases successfully managed laparoscopically using compression followed by definitive vascular suture control.	Laparoscopic suturing-an effective salvage technique for major GB fossa bleeding, especially venous injury, and may avoid conversion to open surgery.

CONCLUSION

Intraoperative haemorrhage during LC, though uncommon, remains a critical challenge. A thorough understanding of anatomical variations, careful surgical technique, and familiarity with various hemostatic modalities are essential for optimal outcomes. Early decision-making, including conversion to open surgery when necessary, plays a vital role in reducing morbidity and mortality. As seen in this series, the presence of an advanced setup ably complemented with advanced laparoscopic skills is essential and effective in managing these patients and minimises risk of conversion to open surgery.

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