

## Mini Review

# Dome Down Laparoscopic Cholecystectomy: Our Experience and the State of Art

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## Abstract

**Introduction:** Laparoscopic Cholecystectomy is nowadays the gold standard technique for benign gallbladder disease both in elective and emergency surgery. But it is even true that in very acute cholecystitis when the tissues are inflamed and the anatomy can be difficult to recognize, the classic laparoscopic approach can lead to biliary and vascular injuries. Dome down laparoscopic approach can be used to avoid conversion to open surgery and decrease surgical complications.

**Methods:** A retrospective record of all Cholecystectomy carried out in our unit by experienced surgeons from January 2013 to August 2017 was examined. Cases were divided by surgical technique: Classical laparoscopic technique, Open cholecystectomy, Laparoscopic converted to open cholecystectomy, Dome down laparoscopic Cholecystectomy (DDL). A systematic literature search was performed using PubMed and Embase databases. The search was limited to studies on humans and to those reported in the English language between January 2009 and December 2016.

**Results and discussion:** 194 cholecystectomy were performed, among these 163 with laparoscopic technique and 3% of all laparoscopic approached cholecystectomy were performed as DDL. The mean hospital stay was 5 days (2-11). 1 out of 5 patients needed postoperative ERCP and endobiliary stent was positioned removed in 30 days with no other complications. Other 4 patients were evaluated after 1 week from dismissal with no evidence of postoperative complications.

**Conclusion:** Dome down cholecystectomy is a feasible and safe procedure; it avoids biliary and vascular injuries in difficult cholecystectomy. It can still be improved by the combination with ultrasonic devices or with new surgical techniques such as Single-incision Laparoscopic cholecystectomy.

## Keywords

- Dome down cholecystectomy
- Laparoscopic cholecystectomy
- Benign gallbladder disease

## ABBREVIATIONS

LC: Laparoscopic Cholecystectomy; OC: Open Cholecystectomy; DDL: Dome Down Laparoscopic Cholecystectomy; CBD: Common Bile Duct

## INTRODUCTION

In the late 1980s Mouret at first and then Dubois carried out their first laparoscopic cholecystectomy borrowing the equipment from gynecologists; their approach was fundus first. Reddick did the same in the United States in 1989 but his technique was based on the fundic traction to expose Calot's triangle with the dissection starting from the infundibulum [1,2]. The use of laparoscopic technique spread all over the world during the 1990s and is nowadays considered the gold standard of care in the treatment of noncancerous gallbladder disease [3].

Surgical complications may occur during laparoscopic cholecystectomy (LC) such as biliary injuries sometimes

accompanied by vascular injuries. Vascular-biliary injury is defined as an injury to both a bile duct and a hepatic artery and/or portal vein; the bile duct injury may be caused by operative trauma, be ischaemic in origin or both, and may or may not be accompanied by various degrees of hepatic ischaemia [4]. These complications have been noticed more often in LC than open cholecystectomy (OC) especially in severely inflamed gallbladders [5].

According to LC classical technique, once trocars are placed and pneumoperitoneum is performed, one grasper is applied to the fundus and used to hold it over the dome of the liver while the lateral right grasper is used to retract the infundibulum caudo-laterally.

This maneuver allows a correct exposition of the Triangle of Calot straightening the cystic duct retracting it at 90° from the common bile duct (CBD) and helps to protect the CBD from inadvertent injury. The potential for misidentification of ductal

and vascular structures makes the initial dissection in the Triangle of Calot a critical step, increasing the potential for injury. The anatomical structures of the cholecystic hilus may be difficult to visualize due to numerous factors, including difficult anatomy secondary to severe inflammation or scar tissue, a short cystic duct, tenting of the ductal structures, anomalous right hepatic artery or duct. A study performed in 1997 showed that 71% (126 of 177 cases) of LC bile duct injuries were due to misidentification of anatomy [6]. Once the cystic structures have been clipped and divided, the infundibulum is retracted, and a hook is used to develop a plane in the areolar tissue between gallbladder and liver. The traction-countertraction in this step is essential. The dissection marches up to the entire gallbladder fossa and it is important to be alert for any aberrant vessels and ducts that may arise from the liver bed and enter directly into the gallbladder. These should be clipped and not simply cauterized.

As previously reported, there are many chances to succumb to CBD or vascular injury especially when cholecystectomy is performed in emergency and the tissue is strongly inflamed. But LC is still a useful technique when it is performed with an alternative gallbladder dissection sequence. Removing the gallbladder from the gallbladder bed first (dome-down or fundus first) [7] is a frequently used technique in open surgery cholecystectomy, now often applied even during the laparoscopic technique. The patient is placed in the supine position and general endotracheal anesthesia is administered. The Dome Down Laparoscopic Cholecystectomy (DDL) starts with a transumbilical open – technique access, a 10-12 mm trocar is there placed. Pneumoperitoneum with carbon dioxide is performed and a 30° laparoscope is used to a complete exploration of the abdomen. Other three 5 mm trocars are placed, one in right flank, one in the right hypochondrium and one in the left one. The patient is then repositioned in a 30° reverse Trendelenburg position with a 10° tilt to the left. These trocars will be the access for two graspers on the right side and the monopolar hook on the left side. The fundus is tractioned laterally and inferiorly (toward right foot) while liver is carefully pushed upward to better exposes the Cholecystic bed. Dissecting the gallbladder from the gallbladder bed first, and subsequently following the gallbladder to the cystic duct, allows to proceed with the dissection from a well known anatomy as the gallbladder wall is, to the potentially difficult anatomy of the Triangle of Calot [7]. After the complete dissection of the gallbladder fossa the infundibulum is still connected to the hilus, this allows a safe division of the cystic duct and artery. Cystic duct is identified and isolated, creating a 360-degree view of the gallbladder– cystic duct junction. Usually no attempt is made to dissect or isolate the CBD, right hepatic duct, or left hepatic duct. The cystic artery is identified, isolated, ligated between clips, and transected. Once the dissection is over, a final inspection of the gallbladder fossa and the clipped cystic structures should be carried out. Holding the gallbladder over the right upper quadrant, an endobag is introduced in the abdomen and the gallbladder is placed in the bag, which is then cinched closed. Once leave the bag from the umbilical trocar a final inspection and washout is performed. During surgery, conversion to an OC occurred if anatomy could not be safely visualized even with dome down technique dissection due to inflammation, oedema, or adhesions.

In our unit the laparoscopic approach to cholecystectomy is the first choice when the surgical history and clinical condition of the patient allow it. When possible instead of conversion to laparotomy a dome down laparoscopic technique is performed in order to avoid any duct or vascular injury. Conversion to OC must not be seen as a failure, but when possible, dome down cholecystectomy avoids all the disadvantage of a laparotomy maintaining a good range of safety.

## METHODS

The authors searched in our database in order to find out all Cholecystectomy performed from January 2013 to August 2017 considering as eligible patients with varying degrees of gallbladder disease, excluding cancer. Cases were divided in 4 groups: Classical Laparoscopic Cholecystectomy, Open Cholecystectomy, Open converted Cholecystectomy and Laparoscopic Dome down Cholecystectomy. For each group Urgent and elective cases were divided.

A systematic literature search was performed using PubMed and Embase databases. The search was limited to studies on humans and to those reported in the English language between January 2009 and December 2016. The following MESH search headings were used: “((laparoscopic cholecystectomy) AND fundus first) OR dome down cholecystectomy”. The references reported in the identified studies were also used to complete the search. The authors independently reviewed and screened all the papers retrieved.

## RESULTS

Cholecystectomy was performed in 194 patients from January 2013 to August 2017.

Cases division by surgical techniques is summarized in Table 1.

One hundred sixty three patients were treated with laparoscopic technique, among these, in 5 (3%) cases a dome down laparoscopic cholecystectomy (DDL) was performed. Three patients were women and 2 men. The age ranged from 29 to 79 years with a mean age of 56 years. In terms of mode of admission 60% were operated in emergency because of an attack of acute cholecystitis, 40 % were admitted on selective basis for chronic disease. In terms of intraoperative complications, gallbladder perforation with bile spillage occurred in 1 patient. The mean operative time was of nearly 3 hours (2-5 hours). Early postoperative complication occurred in 1 patient with bile spillage from the drainage in first postoperative day. The patient underwent ERCP and an endobiliary stent was positioned, easily removed without other complications 1 month later. Patients were discharged after a mean time of 5 days (2-11 days). Fundus first cholecystectomy was performed when the cystic artery and duct were hard to separate because of inflammation or when cystic duct was obscured by strong adhesions and when the presence of a Mirizzi syndrome was suspected.

The decision to proceed with dome down cholecystectomy was made by experience surgeons in order to avoid conversion when carrying out the dissection at the pedicle would likely lead to CBD or vascular possible injuries.

**Table 1:** case division by surgical technique.

Technique	N° of cases	Urgent	Planned	% of all 194 cases	% urgent among the specific technique	% elective among the specific technique
Classic Laparoscopic	147	30	117	76	20	80
Converted to Open Technique	11	6	5	5,7	55	45
Open Technique	31	10	21	16	32	68
Dome down Laparoscopic	5	3	2	2,6	60	40

## CLINICAL OUTCOMES

All patients that underwent dome down cholecystectomy were evaluated at 1 week; one of them needed a rehospitalization to remove the endobiliary stent positioned during ERCP. No other postoperative complications were observed.

## DISCUSSION AND CONCLUSION

Dome down Cholecistectomy is not performed routinely, but is used in cases when the cholecystic dissection is difficult to approach with the standard technique giving a more safe dissection with a proper exposure of the elements of the cystic hilus. The selective use of Dome down cholecistectomy was also recommended by Kelly in 1.1% of all laparoscopic cholecistectomy [2]. The feasibility of Dome Down technique in patients with acute or chronic inflammation is confirmed by various authors. Raj et al., suggested that it might decrease the rate of CBD injuries [8]. Ichihara et al., reported tape ligation of the cystic duct followed by fundus first dissection in 500 patients and recommended it as a way of decreasing rates of CBD injuries [9]. Of course one of the main indication of the fundus first dissection is to improve safety avoiding conversion to open surgery, as Gupta et al., showed as the choice of a DDLC technique decreases conversion to open surgery rate in a small series of patients with chronic cholecystitis from 18.8% to 2.1% [10]. Mahmud et al., reported the use of fundus-first dissection in a larger series of patient with a decrease of the conversion rate from a potential 5.2% to 1.2% [11]. In a recent study Kassem described that fifty-five difficult cholecystectomies were performed by the DDLC with a success rate of 91.6% [12]. Liver retraction is sometimes needed to better expose the Calot's triangle conferring an advantage in difficult cholecystectomy with a major contribute to low conversion rates [13]. Postoperative nausea and pain seems to be decreased if not avoided combining the ultrasonic dissection with dome down cholecystectomy as Cengiz et al., reported in a randomized trial of 80 elective patients [14]. Nonetheless Neri et al., showed how operative time can be reduced using fundus first technique [15]. As Fullum noticed, dome down cholecistectomy reduced the requirement for intraoperative cholangiography because the anatomy of the gallbladder and the cystic duct were clearly identified [16]. Considering the difficulties that surgeons may find in the identification of the ductal anatomy in patients with Mirizzi's syndrome it has been shown that the dome down laparoscopic approach is feasible in these patients, and therefore conversion to an OC is not always necessary. Kok et al., reported in a review that among 878 procedures from 1991 to 1996, 6 cases of Mirizzi's syndrome were approached using DDLC successfully [16]. As reported before, the combination of DDLC and ultrasonic surgical devices has its benefits, with the ultrasonic cavitation effect, separating tissue planes; the dissection is facilitated,

developing the plane between the gallbladder and liver. In a recent study, none of the 105 patients had collateral injuries [7]. Cui showed how the fundus first approach is safe and feasible when combined with Single-incision laparoscopic technique because of the good delineation of the ductal anatomy [17]. Yamamoto et al., assure that the Single-incision laparoscopic cholecystectomy combined with dome down separation is safe and feasible even for surgeons who have never performed it before, and suggest it as the new standard technique for benign gallbladder disease [18]. Although DDLC is usually performed by expert surgeons, a recent study showed how this technique can be easily learned even by year 2 and 3 residents. The study showed that the mean number needed to gain competency was 14.7 DDLC and that the use of animate simulators was also important. As they concluded Dome-down laparoscopic cholecystectomy must be taught to surgical residents as a secondary approach to use in difficult cases. Not forgetting that the most important factor for this technique is exposure to an adequate number of cases [19].

Surgical complication rate for Laparoscopic cholecystectomy in very acute cholecystitis or biliary and vascular anomalies are higher than in Open Technique. The Fundus first cholecystectomy may become the new standard technique, in order to reduce the risk of complications by providing a clear and sudden approach of anatomy. Certainly this technique can be combined to other surgical technique or non conventional instruments in order to improve the safety and feasibility of the dome down approach reducing not only the conversion to open surgery rate, but even the operative time and postoperative complications.

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