Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2021 May 01; 9(B):272-275.
https://doi.org/10.3889/oamjms.2021.6008
eISSN: 1857-9655
Category: *B - Clinical Sciences*
Section: *Gastroenterohepatology*

Bismuth Classification of Bile Duct Injury and Its Association with Increasing 30 Days Mortality after Revision Surgery

Budhi Ida Bagus[1]*, Metria Ida Bagus[2], Setyawati Ida Ayu[3]

[1]Department of Surgery, Sebelas Maret University, Surakarta, Indonesia; [2]Department of Surgery, Medical Faculty, Sebelas Maret University, Surakarta, Indonesia; [3]Department of Surgery, Medical Faculty, Pendidikan Ganesha University, Buleleng, Indonesia

Edited by: Ksenija Bogoeva-Kostovska
Citation: Bagus BI, Bagus MI, Ayu SI. Bismuth Classification of Bile Duct Injury and It's Association with Increasing 30 Days Mortality After Revision Surgery. Open Access Maced J Med Sci. 2021 May 01; 9(B):272-275. https://doi.org/10.3889/oamjms.2021.6008
Keywords: Bismuth classification; Bile duct injury; Cholecystectomy; Mortality
***Correspondence:** Budhi Ida Bagus, Department of Surgery, Sebelas Maret University, Surakarta, Indonesia. Phone: +62-8122013921. E-mail: budhi_suryaadnyana@yahoo.com
Received: 12-Mar-2021
Revised: 15-Apr-2021
Accepted: 23-Apr-2021

Funding: This research did not receive any financial support
Competing Interests: The authors have declared that no competing interests exist

Abstract

BACKGROUND: The incidence rate of bile duct injury (BDI) has not been changed for many years for both open and laparoscopic technique. Open cholecystectomy has risen from 0.5% to 1.4% when gallbladder removal is performed laparoscopically. Injuries of the bile duct system after laparoscopic cholecystectomy are more complex than that after an open approach, causing significant morbidity and even death. From initial classification published by Bismuth, there have been many classifications of common BDI. We would report the 30 days mortality rate following reconstruction after BDI according to type of Bismuth classification.

AIM: We aimed to present cases of bile duct injury (BDI).

RESULTS: Seven cases of common BDI were reported from 2016 until 2018 following cholecystectomy (both open and laparoscopic), all cases were diagnosed as early complication and without intraoperative cholangiography performed. The most common BDI was Bismuth Type II and IV (2 patients in each type). Reconstruction has been done by hepaticojejunostomy for Type III and IV. Choledochoduodenostomy bypass was done for Types I and II. Two patients with bismuth type IV have long standing cholangitis and cannot survive during 30 days of follow-up. Four others patients could survive with no intra-abdominal complication nor other morbidity.

CONCLUSION: Bismuth classification was the simplest way to describe the BDI, Bismuth Type IV was associated with the higher risk of 30 days mortality rate.

Introduction

Laparoscopic cholecystectomy (LC) is now a gold standard treatment modality for gallstone diseases. However, the incidence rate of bile duct injury (BDI) has not been changed for many years. From initial classification published by Bismuth, there have been many classifications of common BDI [1]. The reported morbidity rate in initial studies on the removal of laparoscopic gallbladder, complications such as bleeding, wound infection, respiratory insufficiency, trocar injury to the intra-abdominal viscera, major vascular injury, and bile leak ranging from 1.0% to 8.0% [1], [2], [3].

In 1982, the first classification of BDI was authored by Bismuth. Until this current decade, a number of classifications have been proposed by different authors. The Bismuth classification is a more simple based on the location of the biliary tract injury. This is very helpful in treating the patients and to predicting the prognosis after repairing of the BDIs. This included five types of BDIs according to the distance from the hilar structure especially bile duct bifurcation, the level of injury, the involvement of bile duct bifurcation, and individual right sectorial duct [4]. Bismuth type I involves the common bile duct and low common hepatic duct (CHD) >2 cm from the hepatic duct confluence. Bismuth Type II involves the proximal CHD <2 cm from the confluence. Bismuth Type III is hilar injury with no residual CHD confluence intact. Bismuth Type IV is destruction of the confluence when the right and left hepatic ducts become separated. Bismuth Type V involves the aberrant right sectorial hepatic duct alone or with concomitant injury of CHD. However, the Bismuth classification does not include the wide spectrum of possible biliary injuries [5], [6], [7].

Seven cases of common BDI were reported from 2016 until 2018 following cholecystectomy (both open and laparoscopic), all cases were diagnosed as early complication and without intraoperative cholangiography performed. The most common BDI was Bismuth Type II and IV (2 patients in each type). Reconstruction has been done by hepaticojejunostomy for Type III and IV. Choledochoduodenostomy bypass was done for Types I and II. Two patients with bismuth Type IV have long standing cholangitis and cannot survive during 30 days of follow-up. Four others patients could survive with no intra-abdominal complication nor other morbidity. Patients description and characteristics are shown in Table 1.

Table 1: Patient characteristics

Sex	Open/ laparoscopy	Bismuth type	Reconstruction	Post-operative morbidity	30 Days mortality
Female	Laparoscopy	IV	Roux n Y hepaticojejunostomy	Intra-abdominal abscess	+
Male	Open	II	Choledochoduodenostomy	-	-
Female	Open	I	Choledochoduodenostomy	-	-
Female	Open	III	Choledochoduodenostomy	Intra-abdominal abscess	-
Female	Open	IV	Choledochoduodenostomy	Intra-abdominal abscess	+
Male	Laparoscopy	II	Hepaticojejunostomy	-	-
Female	Open	I	Choledochoduodenostomy	-	-

Case numbers 1 and 5 were female at 47 and 56 years old patients, had previous cholecystectomy from rural hospital with no history of jaundice and cholangitis before operation. Persistent pain and jaundice were the symptoms of this patients since 10th post-operative days (1st patient) and 14 post-operative day (5th patient), these patients has been referred to referral hospital 21 days after the surgery with clinical sign and symptom of localized peritonitis. Both of them had leukocytosis and elevated liver function test. After revision surgery of Bismuth Type IV injury, these patients had sepsis condition with post-operative intra-abdominal abuses and were not survive from this prolonged sepsis on days 14th and 20th in the intensive care unit.

Discussion

There are a number of classifications for BDI. The description and classification of iatrogenic BDIs after cholecystectomy should always include all clinically relevant data on each injury pattern, which will have an impact on surgical treatment and outcome [4], [6], [7].

Since 1931, radiographic intraoperative cholangiography (IOC) was first reported in clinical practice, this procedure has been widely used as almost the only method by which to delineate the bile duct anatomy during cholecystectomy. Several studies have revealed that routine use of IOC during LC may reduce the incidence of BDI, or at least its severity. In practice, however, the frequency of use of IOC during LC varies widely among surgeons and hospitals, probably because of several disadvantages of IOC: a longer operation time, the need for additional medical resources, exposure of the patient and medical staff to radiation, and an increased risk of BDI caused by insertion of a transcystic tube [6]. Intraoperative ultrasonography is also an established modality for confirming the bile duct anatomy and presence of gallstones during LC; however, it requires considerable skill to scan the biliary tract and interpret cross-sectional ultrasonographic images [7], [8].

Key factors for more accurate bile duct identification are administration of indocyanine green (ICG) as far in advance as possible before surgery, sufficient extension of connective tissues around the bile ducts, and placement of the tip of the laparoscope close and vertically to triangle of Calot's. IOC can be performed successfully and safely in the majority of patients undergoing cholecystectomy for gallstone related disease and a calculous cholecystitis case. Although the positive predictive value is suboptimal and results in a number of unnecessary post-operative common bile duct investigations, IOC accurately rules out common bile duct stones in patients with acute gallstone-related conditions [7], [9], [10].

In the era of laparoscopic surgery, many surgical procedures were suggested to minimal invasive surgery such as symptomatic cholelithiasis, colorectal resection, acute, or chronic appendicitis. It has been established as a standard of care not only for diagnostic tool but also in definitive treatment of gastrointestinal surgery cases. Minimal invasive surgery also has a limitation, the less tactile sensation during minimal invasive surgery is the common issue and the learning curve has play an important role to gain the safety surgery and for the better clinical outcome of the patients [11].

The most common post-operative complication during LC is intra-operative bleeding and BDI including the early or late BDI. By the good clinical learning program and clinical course, those complications could be decreased significantly. This incidence was higher when compared with open conventional technique; data from the last two decades still remain stable. Nowadays, with better identification and well trained surgeon during the resident level, the incidence of BDI was decreased [8], [10].

One of the best techniques to identify and to reduce the incidence of BDI is using the awareness of "critical point of view" during LC [12]. With better identification of cystic duct, common bile duct, common hepatic duct, we can perform a safe and better procedure. In some case, if we cannot identify those structures, the better suggestion might be a conversion to laparotomy technique. There was no enough data from current study about the recommended operative time while performing laparoscopy cholecystectomy before we decide to converse to laparotomy, it might be still operator dependent and surgeon decision when we faced to those kind of cases [9].

Bismuth Types I and II usually present with local fluid collection and could resolve spontaneously without needed surgical intervention. Endoscopy treatment could be play an important role by starting using of endoscopic retrograde cholangiopancreatography (ERCP) and stent placement on Type III, and also on selected case of Type IV injury. On Types IV and V injury with more massive disruption of the bile duct after surgery, there was more possibility of massive intra-abdominal fluid (bile) collection, not only localized but also diffuse intra peritoneal biloma. The more severe the BDI and biloma formation, the more chance of long lasting cholangitis it would be and increasing the morbidity and mortality rate.

Even in Types III, IV, and V of BDI, if it has been diagnosed as early as possible or be recognized earlier, we can treat with many options including endoscopic or surgical revision later. In this cases, delayed of the diagnosed was found on both case, the persistent sign and symptoms of pain was treated only with routine post-operative pain management and no imaging was done to evaluate the post-operative complication after cholecystectomy (both open and laparoscopic).

The key point of the treatment of BDI is to prevent this complication by good identification of critical structure during cholecystectomy (cystic duct, cystic artery, and common bile duct) [11], [13]. By good identification using critical view of safety, we could reduce the possibilities of BDI. Nowadays, we can use ICG guiding during cholecystectomy to evaluate those structures [11], [12], [14]. Since ICG has been announced, the incidence of BDI decreasing following the recommendation of minimal invasive surgery for symptomatic cholelithiasis [15]. Especially in minimal invasive technique, conversion to open technique was not a harmful option if we could not identify those critical structures although has been guided by ICG. The safety of the patients is the most critical option in every treatment option.

The unfavorable outcome of BDI cases usually associated with the delay presentation of those cases. It was not only depend on the Bismuth type of BDI, but also the delayed referral period to the hepatobiliary surgeon might play an important role on short-and long-term clinical outcome of the patients. By good clinical judgment, we hope we can make this minimal invasive surgery become better and more safe and gives good clinical outcome not only in cholelithiasis cases [12], [15]. The limitation of this case study is this was a single center and single operator experience only, as an endoscopy is one of treatment option on this case, increasing the learning curve to threat the BDI by ERCP is a promising option, multidiscipline team should be achieved especially in the referral hospital.

Conclusion

Bismuth classification was the simplest way to describe the BDI, Bismuth type IV was associated with the higher risk of 30 days mortality rate.

References

1. Björn T, Cecilia S, Gunnar P, Magnus N. Effect of intended intraoperative cholangiography and early detection of bile duct injury on survival after cholecystectomy: population based cohort study. BMJ. 2012;345:e6457. https://doi.org/10.1136/bmj.e6457
   PMid:23060654
2. Yoshiharu K, Takeaki I, Keigo T, Nobuhiro H, Junichi K, Akio S, *et al*. Techniques of fluorescence cholangiography during laparoscopic cholecystectomy for better delineation of the bile duct anatomy. Medicine (Baltimore). 2015;94(25):e1005. https://doi.org/10.1097/md.0000000000001005
   PMid:26107666
3. Halbert C, Altieri MS, Yang J, Meng Z, Chen H, Talamini M, *et al*. Long-term outcomes of patients with common bile duct injury following laparoscopic cholecystectomy. Surg Endosc. 2016;30(10):4294-9. https://doi.org/10.1007/s00464-016-4745-9
   PMid:26823055
4. Strasberg SM, Helton WS. An analytical review of vasculobiliary injury in laparoscopic and open cholecystectomy. HPB (Oxford) 2011;13(1):1-14. https://doi.org/10.1111/j.1477-2574.2010.00225.x
   PMid:21159098
5. Chun K. Recent classifications of the common bile duct injury. Korean J Hepatobiliary Pancreat Surg 2014;18(3):69-72. https://doi.org/10.14701/kjhbps.2014.18.3.69
   PMid:26155253
6. McPartland KJ, Pomposelli JJ. Iatrogenic biliary injuries: Classification, identification, and management. Surg Clin North Am. 2008;88(6):1329-43. https://doi.org/10.1016/j.suc.2008.07.006
   PMid:18992598
7. Massarweh NN, Flum DR. Role of intraoperative cholangiography in avoiding bile duct injury. J Am Coll Surg. 2007;204(4):656-64. https://doi.org/10.1016/j.jamcollsurg.2007.01.038
   PMid:17382226
8. Sheffield KM, Riall TS, Han Y, Kuo YF, Townsend CM Jr., Goodwin JS. Association between cholecystectomy with vs without intraoperative cholangiography and risk of common duct injury. JAMA. 2013;310(8):812-20. https://doi.org/10.1001/jama.2013.276205
   PMid:23982367
9. Pitt HA, Sherman S, Johnson MS, Hollenbeck AN, Lee J, Daum MR, *et al*. Improved outcomes of bile duct injuries in the 21st century. Ann Surg. 2013;258(3):490-9. https://doi.org/10.1097/sla.0b013e3182a1b25b
   PMid:24022441
10. Jabłońska B, Lampe P, Olakowski M, Górka Z, Lekstan A, Gruszka T. Hepaticojejunostomy vs. end-to-end biliary reconstructions in the treatment of iatrogenic bile duct injuries. J Gastrointest Surg. 2009;13(6):1084-93. https://doi.org/10.1007/s11605-009-0841-7
    PMid:19266245
11. Ambe PC, Plambeck J, Fernandez-Jesberg V, Zarras K. The role of indocyanine green fluoroscopy for intraoperative bile duct visualization during laparoscopic cholecystectomy: An observational cohort study in 70 patients. Patient Saf Surg. 2019;13:2. https://doi.org/10.1186/s13037-019-0182-8
    PMid:30651756
12. Boni L, David G, Mangano A, Dionigi G, Rausei S, Spampatti S, *et al*. Clinical applications of indocyanine green (ICG) enhanced fluorescence in laparoscopic surgery. Surg Endosc. 2015;29(7):2046-55. https://doi.org/10.1007/s00464-014-3895-x
    PMid:25303914
13. Ankersmit M, van Dam DA, van Rijswijk AS, van den Heuvel B, Tuynman JB, Meijerink WJ. Fluorescent imaging with indocyanine green during laparoscopic cholecystectomy

in patients at increased risk of bile duct injury. Surg Innov. 2017;24(3):245-52. https://doi.org/10.1177/1553350617690309 PMid:28178882

14. Calabro KA, Harmon CM, Vali K. Fluorescent cholangiography in laparoscopic cholecystectomy and the use in pediatric patients. J Laparoendosc Adv Surg Tech A. 2020;30(5):586-9. PMid:32301652

15. Graves C, Ely S, Idowu O, Newton C, Kim S. Direct gallbladder indocyanine green injection fluorescence cholangiography during laparoscopic cholecystectomy. J Laparoendosc Adv Surg Tech A 2017;27(10):1069-73. https://doi.org/10.1089/vor.2017.0462 PMid:28574801