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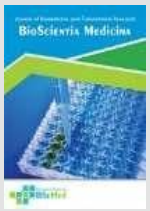

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Diagnosis and Management of Mirizzi Syndrome Related to Gallstones: A Narrative Literature Review

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A B S T R A C T

Mirizzi syndrome (MS) is a rare condition caused by compression of the common hepatic duct due to gallstones located in the cystic duct or neck of the gallbladder. Biliary pain, jaundice, and fever are the most common clinical manifestations of MS. Patients usually report a history of biliary pain with jaundice. There are no pathognomonic features in the history and physical examination. Patients may also come with acute cholecystitis, acute cholangitis, or pancreatitis. In cases where MS is suspected, the diagnosis can be made by ultrasonography (US), computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP), and endoscopic retrograde cholangiopancreatography (ERCP). Surgery is the main treatment for cases of MS and is a challenge because preoperative diagnosis is difficult, thus impacting management during surgery. This literature review aimed to describe the features of MS related to gallstones and management options.

1. Introduction

Gallstones are crystalline deposits that form in the gallbladder or bile ducts caused by high levels of cholesterol or bilirubin in the gallbladder. Disease due to gallstones is defined by the occurrence of symptoms or complications caused by gallstones in the gallbladder and/or bile ducts.[1] Globally, gallstones are common in 10-20% of the adult population, and >20% of people with gallstones will experience symptoms, including biliary pain or infection. The incidence of gallstones is found all over the world. The incidence of gallstones is 15% in America, 5.9-21.9% in Europe, 4-15% in Asia, and 3-11% in China. In Indonesia, the incidence of gallstones per year has not been officially published.[2,3]

Types of gallbladder stones can be classified into cholesterol stones (containing cholesterol >50%), pigment stones (containing cholesterol <20%), and mixed stones (containing cholesterol 20-50%). Types of cholesterol stones are found in 85% of cases of gallstones. The type of stone can also be seen from the color, such as cholesterol stones will be brownish yellow, and brown pigment stones are amorphous and brittle.[2,3] Age, obesity, weight loss, multiparity, hyperlipidemia, diabetes mellitus, and a low-calorie diet will reduce the normal storage and motility function of the gallbladder, causing the formation of cholesterol stones. Diseases such as liver cirrhosis, ileal disease, hemolytic anemia, and biliary tract

infections are risk factors for pigment stone formation.[3] Previous studies stated that 72% of patients with symptoms of gallstones experienced ongoing biliary pain or complications due to inflammation of the gallbladder, gallstone ileus, intestinal obstruction due to impaction of gallstones, obstruction of the bile ducts, emphysema of the gallbladder, severe cholecystitis resulting in disruption of the wall gallbladder or perforation and rupture of the gallbladder. Gallstones are considered a major risk factor for gallbladder, pancreatic, and colorectal cancer.[5]

Mirizzi Syndrome (MS) is a rare condition caused by compression of the common hepatic duct due to gallstones located in the cystic duct or neck of the gallbladder. Argentinian surgeon Pablo Mirizzi defined MS as compression of the bile duct by gallstones with associated pressure ulceration resulting in localized inflammation. Compression can cause external obstruction, erosion, fibrosis, or fistula. The main symptoms seen in patients with this condition are upper abdominal pain and jaundice.[7,9]

The reported prevalence of MS is approximately 5.7% worldwide. The overall prevalence of MS is higher in women than in men. The proportion of women suffering from MS ranges from 55.6-77%. In developed countries such as Europe, MS is found in 0.5% of all cholecystectomies, but in Asia, Central, and South America, the incidence of MS is generally higher and reaches as much as 4.7-5.7%.[9]

Biliary pain, jaundice, and fever are the most common clinical manifestations of MS. Patients usually report a history of biliary pain with jaundice. There are no pathognomonic features in the history and physical examination. Patients may also come with acute cholecystitis, acute cholangitis, or pancreatitis. Patients presented with jaundice without pain in 40%, 36% with jaundice with pain, 16% with cholangitis, and 8% reported pain as their only symptom. Hyperbilirubinemia and elevations of alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) are common. Leukocytosis is commonly seen in acute cholecystitis, cholangitis, or pancreatitis.[9]

In suspected cases of MS, the diagnosis can be made by ultrasonography (US), computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP), and endoscopic retrograde cholangiopancreatography (ERCP). Surgery is the main treatment for cases of MS and is a challenge because preoperative diagnosis is difficult, thus impacting management during surgery. Anatomical distortion due to strong adhesions resulting from prolonged inflammation and the formation of a cholecystoenteric fistula increases the risk of biliary tract injury or massive bleeding.[6,8] This literature review aims to describe the features of MS related to gallstones and management options.

Mirizzi syndrome

Mirizzi syndrome is a rare chronic complication of gallstone disease caused by compression of the common hepatic duct by a stone located in the cystic duct or neck of the gallbladder. MS was first described in 1905 by Kehr and later in 1908 by Ruge, describing MS as a disease caused by external obstruction of the bile duct associated with partial bile duct obstruction due to impacted stones in the gallbladder causing jaundice.[10-13] In 1948, Argentinian surgeon Pablo Mirizzi defined it as compression of the bile duct by a gallstone associated with pressure ulceration resulting in localized inflammation and spasm of the bile duct. Compression can cause external obstruction, erosion, fibrosis, or fistula of varying degrees of complexity.[10,11]

The reported prevalence of MS is around 5.7%. MS is higher overall in women than men. The proportion of women suffering from MS ranges from 55.6-77%. The prevalence of MS in Europe was found in 2.1% of all cholecystectomies. The prevalence in Asia, Central, and South America is generally higher and reaches as much as 4.7-5.7%. In the patient population undergoing ERCP, the incidence of MS is estimated to be 1.07%.[10,13]

Preoperative diagnosis of MS is often difficult and can be detected before surgery varies widely around 8-

62.5% because there are no typical signs or symptoms. According to Cui's study (2012), the prevalence of MS was 0.66% of 29,875 patients who underwent cholecystectomy for cholelithiasis. The incidence of MS types I, II, III, and IV were 59.1%, 24.7%, 13.1%, and 3.1%, respectively. In this study, ultrasound examination and MRCP could be suspected of MS in 77.8% and 82.3% of cases.[14,15] Mirizzi syndrome is most common in patients aged 53-70 years. The majority are women (70%), although it is still possible to occur in other age groups due to the presence of gallstones. This MS occurs in the acute process, but most patients complain of symptoms when entering the chronic phase.[16]

Classification is based on the presence or absence of fistula erosions between the gallbladder and bile ducts and the extent of the common hepatic duct lesion. The initial classification by Mc Sherry in 1982 described two types of MS. Type I involves external compression of the bile duct by one or more stones in the cystic duct or Hartmann's pouch. Type II, consisting of a cholecystobiliary fistula caused by a gallstone that has eroded into the bile duct.[12.17]

Table 1. Classification of Mirizzi syndrome.[18,19]

Type	Definition
I	External compression of the bile duct due to an impacted gallstone in the gallbladder infundibulum or cystic duct
II	Cholecystobiliary fistula involving less than one-third of the circumference of the bile duct due to erosion of the anterior or lateral wall of the bile duct by an impacted stone
III	Fistula involving up to two-thirds of the bile duct circumference
IV	Cholecystobiliary fistula with complete obstruction of the bile duct.
V	Cholecystoenteric fistula
Va	Cholecystoenteric fistula without gallstone ileus
Vb	Cholecystoenteric fistula complicated by gallstone ileus

In 1989, Attila Csendes was reclassified into four types, taking into account the extent of the cholecystobiliary fistula. Csendes also reported the frequency of each type of MS, type I 11%, type II 41%, type III 44%, and type IV 4%. In 2007, a type V MS classification was added, which includes the presence of a cholecystoenteric fistula along with other types of MS.[19] Csendes classification as the most commonly used and validated classification. Csendes classified Mirizzi syndrome based on the presence and extent of a cholecystobiliary fistula which helps guide surgical therapy.[18.20]

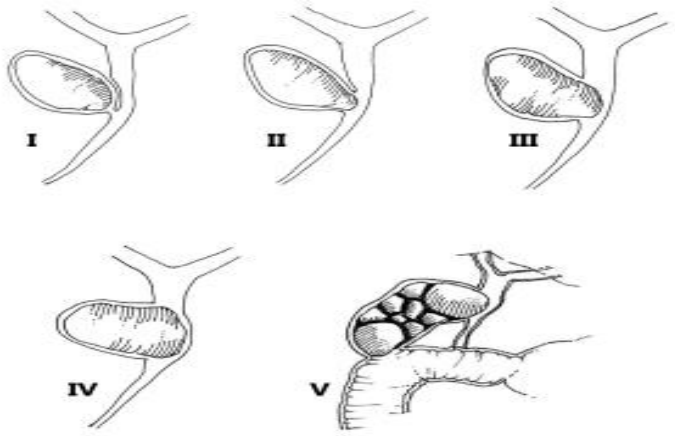

Figure 1. Classification of Mirizzi syndrome type I-V according to Csendes.[21]

Pathogenesis of Mirizzi syndrome

The pathogenesis of MS is external pressure on the bile duct followed by the development of cholecystobiliary and cholecystoenteric fistulas, as distinct stages of the same disease process. MS can result from an acute or chronic inflammatory condition of a single large gallstone or a large number of small gallstones impacted in Hartmann's pouch or in the infundibulum of the gallbladder and cystic duct.[22,23]

The long cystic duct, parallel to the bile duct, and the low insertion of the cystic duct into the bile duct, are thought to be predisposing factors for the occurrence of MS. Anatomical variations of the cystic duct predispose to the occurrence of MS in 18-23% of cases. The figure below shows a normal cystic duct, a long cystic duct, cystic duct insertion in the distal third of the common hepatic duct, and cystic duct insertion in the middle third of the common hepatic duct.[19,22]

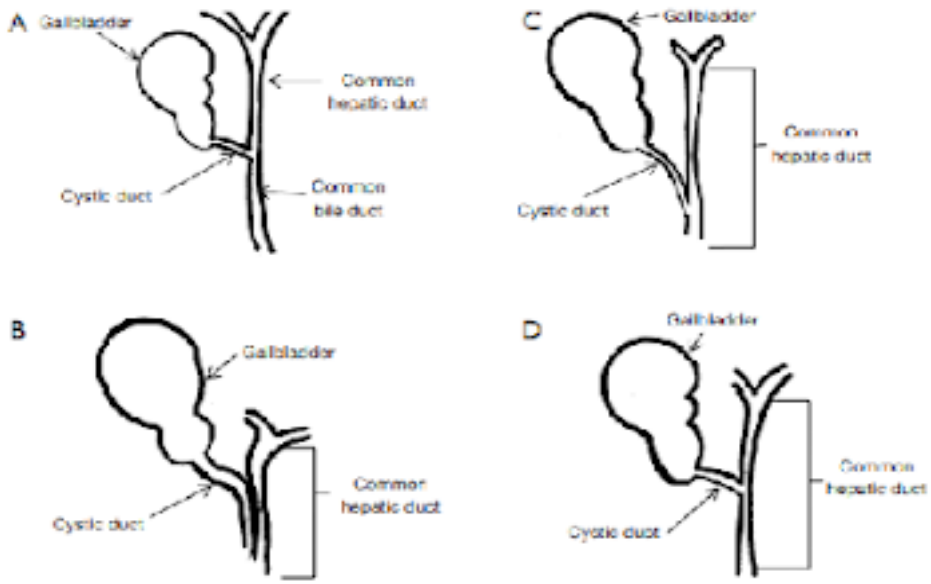

Figure 2. Anatomical variations of the cystic duct.[19]

Repeated impaction of gallstones will lead to repeated episodes of acute cholecystitis and initially distend the gallbladder with thick, inflamed walls. The gallbladder will atrophy, and the walls of the fibrosis will become thicker during contraction. When the gallbladder becomes atrophic, the gallbladder will degenerate into thick or thin walls, and in some cases, these walls will attach to gallstones. Acute or chronic inflammation of the gallbladder close to the bile ducts can result in fusion or fusion of the gallbladder wall and bile duct walls, causing swelling of the inflammatory tissue, which will then become fibrosis and can also cause pressure out of the bile ducts, and shows the characteristics of jaundice obstruction. This final process can be an acute or chronic condition.[21]

Cholecystobiliary fistula is explained by two mechanisms. The first mechanism explains that the attached gallstones and the secondary inflammatory process will close the cystic duct. The attached gallstones will try to enter the bile duct and cause pressure to erode the gallbladder wall and bile duct wall forming a fistula between the two lumens.[21]

The second mechanism explains that gallstones that stick to the infundibulum will dilate the cystic duct causing shortening, as well as fibrosis of the cystic duct, and eventually form a large duct between

the gallbladder and bile ducts, and can even unite the gallbladder with the adjacent bile ducts. If the inflammatory process persists or if chronic inflammation occurs, the gallstones will ulcerate and necrosis, erode into the bile duct, and produce a cholecystobiliary fistula. In some cases, gallstones will also cause other ulcers and, together with cholecystobiliary fistula, will form cholecystoenteric fistula.[21]

Clinical manifestations of Mirizzi syndrome

Symptoms that appear in MS are abdominal pain in the right upper quadrant, fever, and jaundice. The most common symptom of MS is jaundice (60-100%), accompanied by abdominal pain in the right upper quadrant (50-100%). Pain can last 30 minutes to less than 12 hours. A previous history of jaundice may occasionally be found. Patients with MS often present with acute cholecystitis or acute cholangitis.[12,13,22]

Other symptoms are nausea and vomiting (31-62%), cholangitis (56%), fever (21-42%), and anorexia (11-29.2%). Shirah (2017) reported that there was a positive Murphy's sign in 50% of patients during physical examination. The average duration of symptoms ranges from 3 to 24 months. Prasad (2006) reported symptoms in patients suffering from uncomplicated gallstone disease in 50% of MS patients. Patients often do not experience severe pain but feel uncomfortable. The overall percentage of asymptomatic MS ranges from 3.7-17%.[9.23]

Laboratory evaluation

The most common tests are leukocytes, ALT, AST, ALP, bilirubin, and gamma-glutamyl transpeptidase (GGT). Previous research showed that leukocytosis was found in 73.4% of MS patients.[24] The average leukocyte level was generally around the upper limit of normal levels or slightly above. ALT and AST levels are generally reported to be elevated. ALT increases to 39-98% and 37-89% in AST. The average ALT and AST levels in MS patients are several times higher than normal and can reach 286 and 263 U/L, respectively. ALP levels were elevated in 93.8% of patients, and the reported mean level was 324–402 U/L. Total bilirubin levels increased in MS patients by 92.2%. Average bilirubin levels are reported to be between 2-9.9 mg/dL. GGT levels usually increase with an average range of 204–1018 U/L.[23]

Cancer antigen 19-9 (CA 19-9) is a glycoprotein expressed by several cancers, including biliary (95%), gastric (5%), colon (15%), liver (7%), and lung (13%). CA 19-9 levels can be elevated in many benign conditions, as patients with biliary tract disease usually have levels less than 1000 U/mL. High levels (>20,000 U/mL) of the tumor marker CA 19-9 are consistently found in patients with MS type II or other higher types of MS. There are several reported cases suggesting that CA 19-9 cannot be used as a screening test due to its low sensitivity in early stages of the disease, and hyperbilirubinemia also appears to be a confounding factor as it is associated with high CA 19-9 levels.[19]

Diagnosis of Mirizzi syndrome

Preoperative diagnosis of MS, followed by good surgical planning, is important. The incidence of bile duct injury in patients operated on for MS without a preoperative diagnosis can be as high as 17%. Preoperative diagnosis of MS is difficult and only possible in 8% to 62.5% of cases. Without a proper preoperative diagnosis, it can cause high morbidity and mortality. The diagnosis of MS is based on clinical characteristics supplemented by laboratory and radiological findings. Early and accurate diagnosis has a major impact on management, morbidity, mortality, and preventing future complications 54%.[19.21]

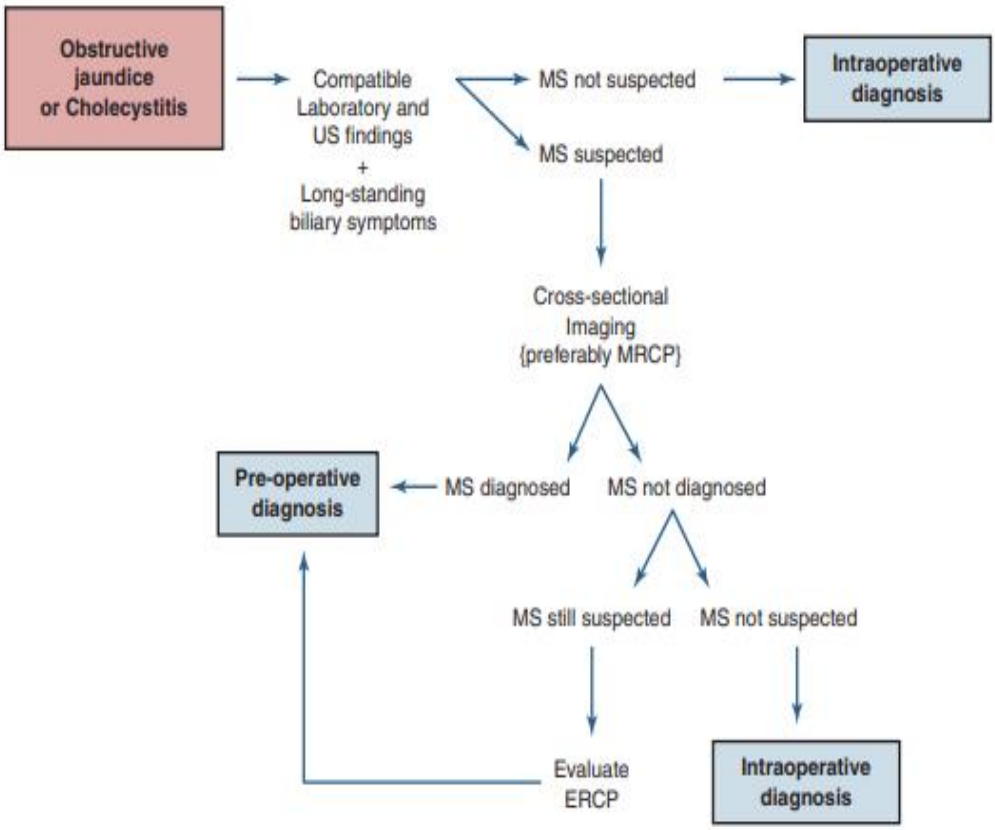

Figure 3. Algorithm for managing suspected MS.[12]

Ultrasound

Ultrasound is used as a routine examination of biliary disease. This US may show gallstones and cholecystitis and reveal evidence of MS, such as an atrophied gallbladder, dilated common hepatic duct with bile ducts distal to or below normal obstruction, or gallbladder edema caused by acute cholecystitis. US diagnostic accuracy in MS with sensitivity between 8.3-57%, specificity 90.9-100%. Cui's study (2012) involved 198 patients with US sensitivity in cases of MS by 77.8%.[24]

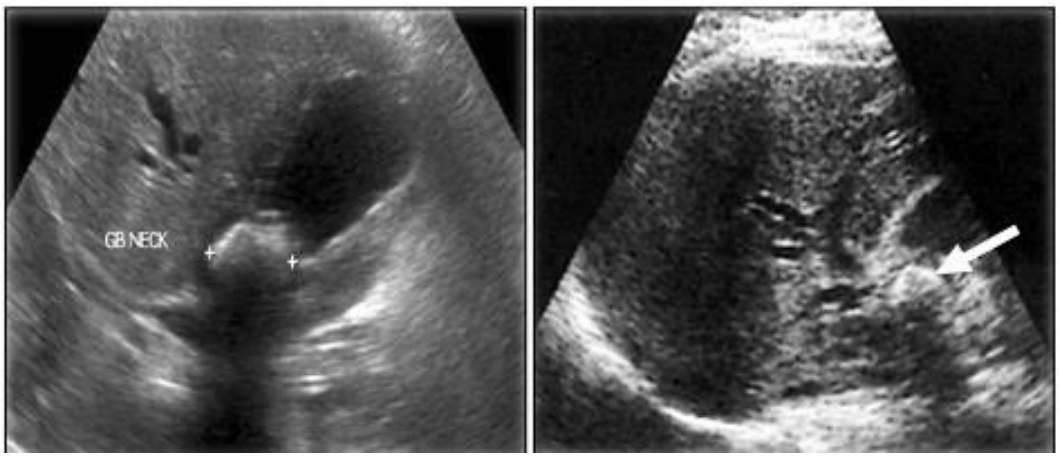

Figure 4. Ultrasound on Mirizzi syndrome.[21]

Computed tomography

Computed tomography (CT) of the abdomen can identify the gallbladder and measure the thickness of its wall and bile duct dilatation. Periductal inflammation can be mistaken for gallbladder cancer. Radiological signs found on CT examination are non-specific. Although no specific radiologic features of MS can be recognized on CT imaging, this technique can be very effective in detecting the cause and location of biliary obstruction.[24]

Computed tomography is also useful in differentiating hepatic portal or infiltrating hepatic tumors. In patients with cholecystobiliary fistulas, CT is useful in differentiating MS from neoplasia. Fabien et al. (2015) reported 5 cases in which CT could be used to adequately diagnose MS and concluded that an adequate diagnosis could be reached based on clinical symptoms and CT features. The sensitivity of CT in MS is between 42–50%.[25,26]

Magnetic resonance cholangiopancreatography

Magnetic resonance cholangiopancreatography (MRCP) is a widely used diagnostic tool and noninvasive imaging technique. MRCP is a useful tool to see if there is extrinsic compression of the bile duct and to determine whether or not a fistula is present. MRCP is also useful to rule out choledocholithiasis and other causes of bile duct obstruction. Some of the characteristics of MS can be demonstrated by MRCP examination, such as extrinsic narrowing of the common hepatic duct, gallstones in the cystic duct, dilated common hepatic duct, and normal choledochal duct. MRCP can also show the extent of the inflammatory process around the gallbladder and has the advantage of avoiding the complications associated with endoscopy cholangiography.[27]

MRCP examination is necessary when US examination detects bile duct dilatation with evidence of obstructive jaundice or impacted bile duct stones. The bile duct and pancreas can also be assessed with MRCP, which can provide a superior view of inflammation around the gallbladder. This inflammation is characteristic of MS and can be used to differentiate biliary conditions, including cancer. MRCP is not efficient in determining cholecystocholedochal fistula. Diagnostic accuracy for MRCP in MS with a sensitivity of 77.8-100% and a specificity of 93.5%.[24]

Endoscopic retrograde cholangiopancreatography

Endoscopic retrograde cholangiopancreatography (ERCP) is an invasive procedure that is not only useful for confirming the presence of MS with or without cholecystobiliary or cholecystoenteric fistulas but also for therapeutic purposes that allow stone removal, stent placement, and other procedures. The diagnostic accuracy of MS with this method is around 55-90%, with failure rates ranging from 5-10%. ERCP overview in MS includes narrowing or extrinsic compression involving the lateral portion of the distal common hepatic duct with dilatation of the proximal duct.[26,28]

Despite its invasive nature, ERCP is considered a gold standard diagnostic tool in MS cases. ERCP produces superior visualization of the extrahepatic bile duct and can clearly demonstrate extrinsic compression by a gallstone of the bile duct with resulting proximal biliary dilatation. ERCP can accurately determine the presence of fistulas, fistula locations, and biliary obstruction. ERCP is associated with adverse complications, and its application to patients with MS should be considered with extreme caution.[25,31]

Intraoperative

It is reported that more than 50% of patients with MS are diagnosed during surgery. Surgical characteristics include the presence of a shrunken gallbladder with distorted anatomy or a dilated gallbladder with thick walls and large gallstones, or multiple gallstones, impacting the gallbladder neck or infundibulum, missing Calot's triangle, and a dense fibrotic mass in the Calot's triangle. MS should be suspected after strong adhesions are found between the gallbladder and the common hepatic duct at the hepato-duodenal ligament or near Calot's triangle.[25,31]

Intraoperative cholangiography can then be used to confirm the position and dimensions of the fistula, detect stones in the duct, and assess the integrity of the bile duct wall, as well as retrieve residual postoperative stones. Intraoperative cholangiography carries a significant risk of secondary injury to the bile ducts because of the distorted anatomy commonly encountered in Calot's triangle.[31]

Preoperative assessment

Most cases of MS are difficult to identify preoperatively, despite the availability of modern imaging techniques. Preoperative diagnosis can avoid bile duct injury. The preoperative scoring system assists with an assessment based on clinical, laboratory, and radiological imaging parameters to predict the diagnosis of MS.[33] Each parameter found is given 1 point and rated on a scale of 0-10. A score of 3 or more has a sensitivity of 90.6% and a specificity of 78.1% for predicting the presence of MS. A score of 6 or more has a sensitivity of 80% for predicting type II, III, and IV MS and indicates the presence of a fistula. Jaundice, leukocytosis, choledocholithiasis, intrahepatic biliary dilatation, meniscal signs, and mass as significant parameters.[17,33]

Table 2. Parameters in the MS scoring system.[33]

Assessment	Score
Clinical	
Duration of symptoms	> 24 months
Frequency of attacks	> 1 time
Jaundice	Yes
Biochemistry	
Total bilirubin	>1.2 mg/dL
Leukocyte	>11,000/mm^3
ALP	>150 U/L
Imaging	
Choledocholithiasis	Yes
Intrahepatic biliary radical dilatation (IHBRD)	Yes
Meniscus sign	Yes
Mass	Yes

Differential diagnosis

The differential diagnosis includes other causes of obstructive jaundice, such as gallbladder carcinoma, cholangiocarcinoma, pancreatic carcinoma, metastatic disease, or sclerosing cholangitis. Gallbladder carcinoma is very difficult to differentiate from MS. In approximately 6-27% of patients with a preoperative diagnosis of MS. The postoperative diagnosis is gallbladder carcinoma.[9] Preoperative imaging studies such as US, CT, MRCP, and intraoperatively collected tissues play an important role in recognizing suspicious signs of gallbladder cancer.[9]

Management of Mirizzi syndrome

The goals of the management of patients with MS are to decompress the bile ducts and prevent a recurrence. Management in cases of MS depends on the type, degree, and inflammation of the biliary tract that occurs. Gallstones in the cystic duct are difficult to remove endoscopically and through endoscopic lithotripsy.[7,25]

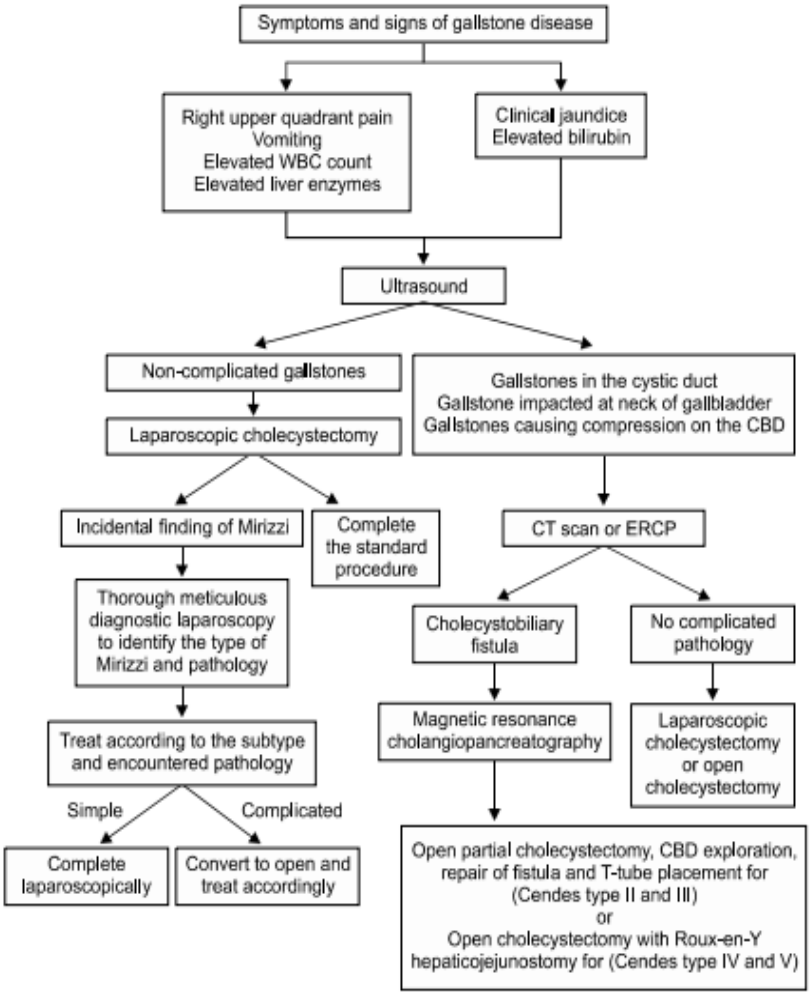

Figure 5. Clinical algorithm for the management of Mirizzi syndrome.[21]

Surgery

Surgery is the gold standard of management for MS Surgery is also possible to rule out other causes of jaundice and assess the inflamed gallbladder due to stones to eliminate causes of obstructive jaundice.[28] Surgical intervention should meet the goals for gallstone extraction and biliary tract restoration. Surgery is required based on the type of MS. Type I MS can be managed by cholecystectomy or subtotal cholecystectomy, whereas types II, III, IV, and V require biliary reconstruction.[7,28]

Open surgery

Open surgery is the gold standard in the management of MS, with good short and long-term results and low mortality and morbidity. MS is often diagnosed during surgery, and planning optimal preoperative surgery is challenging. Beltran (2012) recommends different surgical approaches depending on MS classification.[28]

Management of MS type I recommended total cholecystectomy or subtotal cholecystectomy. In subtotal cholecystectomy, the gallbladder is opened with an incision in the fundus, and gallstones are removed. Gallstones are sometimes firmly attached to the wall of the gallbladder or loosely attached to the wall and are easily removed. The cystic duct was identified from the inside of Hartman's pouch. The gallbladder should be closed with absorbable monofilament sutures. Subtotal cholecystectomy is also recommended for type II MS cases, and leaving a small remnant of the gallbladder wall above the

cholecystobiliary fistula can help close the defect. MS type II can be successful using this technique. The bile duct should be explored to rule out other causes of obstructive jaundice.[9,28]

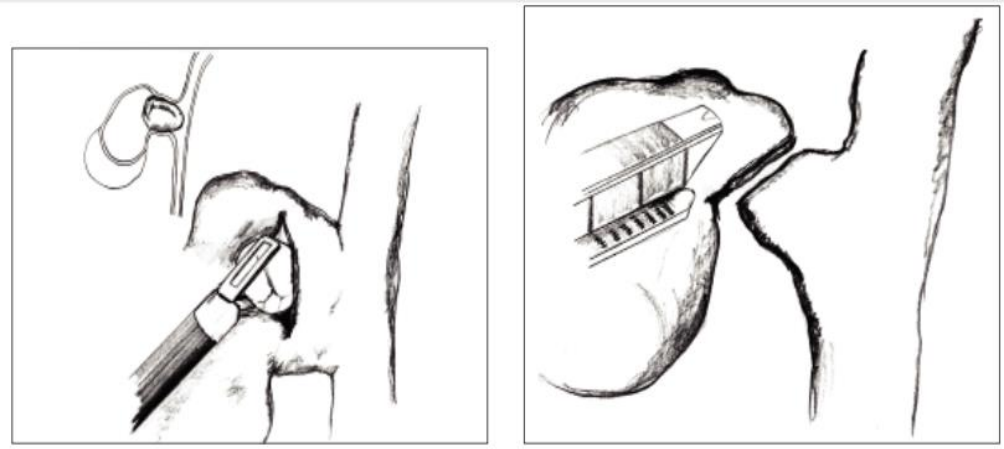

Figure 6. Extraction of gallstones and subtotal cholecystectomy.[6]

Management of type III MS cases with subtotal cholecystectomy and leaving the remaining gallbladder wall measuring at least 1 cm to repair the bile duct. If the cholecystobiliary fistula is too large and the gallbladder is significantly inflamed, another approach such as a bilioenteric anastomosis such as a choledokoduodenostomy or Roux-en-Y hepaticojejunostomy is recommended. A bilioenteric anastomosis is also recommended for Mirizzi syndrome type IV.[33]

In cases of type Va MS, simple sutures with absorbable sutures are performed on the bilioenteric fistula above the viscera, and total or subtotal cholecystectomy based on the presence of a cholecystobiliary fistula or simple external compression of the bile duct. In the case of MS type Vb, the management is still being debated. It is recommended to treat the acute condition first, namely gallstone ileus, and after the patient recovers from surgery for about 3 months or more, action on the gallbladder according to the presence or absence of external compression of the bile duct or cholecystobiliary fistula.[30]

Laparoscopy

A laparoscopic cholecystectomy is a viable option in most patients with type I MS. Laparoscopic cholecystectomy was found to be effective in 59% of patients with MS. Laparoscopic cholecystectomy is an option for uncomplicated MS and begins with a thorough diagnostic identification of the anatomy and pathology of the gallbladder, cystic duct, and bile duct using imaging techniques.[18]

The main advantages of laparoscopy are minimal incisions, and shorter hospital stays, thereby saving costs. This laparoscopy requires a skilled operator, and results may vary. MS is also considered a contraindication to laparoscopic cholecystectomy because of the increased risk of bile duct injury. Patients must be selected carefully because conversion to open surgery may be necessary. Patients with poor surgical risk should avoid laparoscopy.[9]

Lai (2006) reviewed studies on laparoscopy in MS cases. Conversion to open surgery varies widely, from 0% to 100%. In type II MS, conversion to open cholecystectomy is more common. The overall complication rate with laparoscopic cholecystectomy ranges from 0-60%, the rate of bile duct injury ranges from 0-22%, and in-hospital mortality ranges from 0-25%. Due to the high morbidity and mortality associated with laparoscopy, it should be considered in an experienced surgical center. Antoniou (2010) reported that out of a total of 124 patients, laparoscopic MS treatment was successfully

performed in 73 patients (59%). Conversion to open surgery was required in 32 of 68 patients with type I MS (47%) and 7 of 16 patients with type II.[9,20]

Nonsurgical

Nonsurgical management has been reported using an endoscopic approach. Indications for this procedure are MS patients with poor surgical risk. Another thing is also the choice of this action is limited by many factors, such as lack of expertise, high cost, and risk of complications.[27]

Endoscopy

This procedure can be used to confirm the diagnosis, reduce jaundice, relieve cholangitis and allow local resolution of the inflammatory process in preparation for subsequent elective definitive surgical intervention.[18]

Endoscopy in MS cases includes balloon extraction of gallstones and biliary drainage of the bile duct with or without gallbladder drainage by placing a biliary endoprosthesis. Lithotripsy techniques, including electrohydraulic (EHL), shock waves, or lasers, may be necessary in some cases where conventional stone extraction methods have failed. Endoscopic therapy is temporary and is usually considered for patients with poor surgical risk, such as the elderly, who have multiple co-morbidities.[9]

Complications Mirizzi syndrome

The most common complication of MS is the formation of cholecystobiliary or cholecystoenteric fistulas due to prolonged inflammation. Surgical complications with long procedure times due to the presence of strong adhesions may also occur. Complications that occur include bile duct injury and bleeding. Massive bleeding during Calot's triangle surgery can occur in complex cases. Another complication of prolonged inflammation that can be seen in MS patients.[31]

Chronic obstruction of the bile ducts can cause permanent liver damage, especially when there is a certain degree of chronic infection. This situation leads to the proliferation of the bile duct epithelium, which may be followed by portal fibrosis. Prolonged cholestasis can eventually lead to secondary biliary cirrhosis. Recovery of cholestasis can be successful with appropriate interventions in order to reduce liver damage with loss of biliary pigment infiltration.[25]

Prognosis

The prognosis is excellent in type I MS, as it can be corrected by simple cholecystectomy. Meanwhile, postoperative morbidity can increase in MS types II, III, IV, and V. [27] Shirah (2017), a study of 64 patients diagnosed with MS, had a morbidity rate of 3.1% and 0% mortality. Patients diagnosed with MS by prior US examination have good treatment outcomes, the least morbidity, and the shortest hospital stay. The average length of stay in the hospital was 8 days (range 3-13 days).[33]

2. Conclusion

Diagnosis of MS can be done by examination of US, CT, MRCP, and ERCP. However, the management of MS depends on the type, degree, and biliary inflammation that occurs.

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