Diagnosis and Management of Retained Common Bile Duct Stones After Cholecystectomy

An Essay

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General Surgery

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بسم الله الرحمن الرحيم

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Retained common bile duct stones are found in 4-15% of patients who have undergone surgical exploration of the common bile duct. Most of these stones will be discovered on a T-tube cholangiogram in the early postoperative period. The common bile duct is explored in nearly one quarter of cholecystectomies and stones are removed in approximately 60% of these explorations *(Girard and Legros, 1981).*

Primary common duct stones are the truly recurrent stones, whereas secondary common duct stones never recur once the gall bladder is removed. They are always residual, retained, or "overlooked stones", regardless of the time interval or number of common duct explorations. A primary stone, if missed on common duct exploration and later demonstrated by post-operative cholangiogram, is a residual or retained stone.

An empirical method frequently used for the differentiation of a recurrent from a retained stone is the time interval between the initial and repeat exploration of the common duct. If this interval is less than two years, the stone is considered residual or retained, and, if more than two years, it is classified as recurrent. This method is subject to frequent error. The true recurrent or primary common duct stone may recur within one year, whereas retained or residual secondary stones may be removed from the common duct 12 or 15 years following a positive or negative primary exploration *(Madden, J.L. 1985).* The differentiation between recurrent and retained stones should be made intra-operatively, since the operation to be performed will depend upon the type of stone that is present.

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Decreasing the frequency of unnecessary choledochotomy and retained common duct stones is achieved by better understanding of the pathogenesis, natural history, diagnostic evaluation, and clinical management of choledocholithiasis.

The best treatment of retained stones is to prevent their occurrence by careful pre-operative and/or intra-operative diagnosis of the presence C.B.D. stones in every patient undergoing cholecystectomy. Fortunately this is becoming more feasible and accurate by the introduction of different new techniques both radiological and diagnostic maneuvers.

The management of retained stones depend on several factors namely the time of its diagnosis (whether or not a T-tube is present), the condition of the patient being jaundiced or not, the size of the stone and lastly its composition.

The different options in management may be non surgical or surgical. Non surgical management includes:

- Mechanical extraction mainly through the tract of T-tube.
- Endoscopic sphincterotomy with removal of stone by balloon tipped catheter or Dormia basket.
- Chemical dissolution of stones.

Surgical management by re-exploration of the common bile duct has higher mortality and morbidity and is less successful than first exploration.

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The biliary system and liver develop together from a diverticulum that arises in the embryo from the ventral floor of the foregut and extends into the septum transversum. The caudal portion becomes the gall bladder, cystic duct and the common bile duct whereas, the cranial portion develops into the liver and the hepatic bile ducts. It should be noted that the original gut epithelium of the hepatocyte and ductal epithelium are of mesodermal not epithelial origin *(Howell and Pickleman, 1976).*

Bile ducts of the liver hilum

It is important to note that some portion of both the right and left hepatic ducts, and hence their confluence, are always extra-hepatic and therefore, accessible at the porta *(Kune and Sali, 1980).* In some cases portions of the major tributaries of the right and left ducts are also outside the liver.

Right hepatic duct

The functional right lobe (that part of the liver to the right of the lobar fissure marked by the gall bladder fosa and the inferior vena cava), comprises two segments, anterior and posterior.

In 75 % of individuals, the right anterior and posterior segmental ducts join to form a true right hepatic duct (R.H.D.). In the remaining 25 % there is no true R.H.D., the segmental ducts emptying into the left hepatic duct (L.H.D.) separately *(Kune and Sali, 1980).* The right hepatic duct is readily approached by dividing the peritonium and fat overlying it in the porta hepatis. The right hepatic artery usually runs inferior to it, while the right branch of the portal vein lies posterior to these two structure *(Northover and Terblanche 1982).* The Accessory bile duct and what was erroneously thought to have been the true right hepatic duct in 25 % of individuals, are the two major segmental ducts from the right lobe draining separately into the left hepatic duct *(Hobsley, 1958)*.

Left hepatic duct

Unlike the right lobe, the left lobe of the liver is always drained by a single channel, the true left hepatic duct *(kune and Sali, 1980)*. The left hepatic artery usually runs below or behind the left hepatic duct, while the left branch of the portal vein may, unlike the right branch, partly spiral around the upper border of its hepatic duct to form an anterior relation to the latter as the two structures pass into the liver substance *(Hobsley, 1958)*.

Common hepatic duct

This bile duct segment is of enormous surgical importance, being involved in two-thirds of post-operative strictures *(Warren et al., 1971)*. It is formed by final confluence of all ducts issuing from the liver and ends when the lumen of the cystic duct opens into it to form the common bile duct. In most individuals it is 2.5 - 3.5 cm in length *(Flint, 1923)*, but this is variable. It lies in the right edge of lesser omentum, with the common hepatic artery to its left and the portal vein situated posteriorly. Its important variable neighbours are the right hepatic artery, cystic artery and cystic duct. In about 90 % of cases, the right hepatic artery passes behind the duct, while in the rest it passes infront and hence is more prone to accidental injury *(Michels, 1955)*. In about 22 %, the cystic artery arises from the right hepatic artery to the left of common hepatic duct, thence crossing it anteriorly in 20 % and posteriorly in the remainder *(Daseler et al., 1947)*. The cystic duct normally joins the common hepatic duct at an angle, but in about 30 % it is intimately bound to the right, anterior or posterior wall for a variable distance before the lumina join *(Northover and Terblanche, 1982).*

The gall bladder

It is usually globular, lying in its fosa on the under surface of the liver. The only common variant in form, occurring in up to 18 %, is the phrygian cap deformity in which the distal fundus is folded upon itself *(Boyden, 1935).*

The gall bladder consists of fundus, body, infundibulum, neck and ends by the cystic duct. The fundus project beyond the liver. The body lies in a fossa on the inferior surface of the liver. The infundibulum is the part of the organ between the body and neck; it sags down as a pouch **(pouch of Hartmann)** towards the duodenum. The neck leaves the upper part of the infundibulum and soon narrows to form the cystic duct *(Decker et al., 1986).*

The arterial supply is via the cystic artery, which usually arises from the right hepatic artery in Calot's triangle. Venous drainage is via vessels running directly into the liver and several veins which join the pericholedochal plexus *(Northover and Terblanche, 1982).*

The cystic duct

It is very variable in length and mode of union with the common hepatic duct. The junction is easily seen with minimal dissection in about 65 %, while in the remainder the duct runs a longer course, parallel with or spiralling around the common hepatic duct *(Johnston and Anson, 1952).* The distal part of the cystic duct in these circumstances is often incorporated into the wall of the common hepatic duct so that attempts to remove it entirely may lead to duct damage and stricture *(Kune and Sali, 1980).*

Calot's triangle

This area is bounded by the cystic duct, common hepatic duct and the inferior surface of the liver *(Wood, 1979)*. The importance of this triangle lies in the risk of applying the clamp, which is designed to clamp the cystic duct, on one of the important structures that pass in relation to this region. These structures are the hepatic artery (related to Calot's triangle in 83 % of individuals), the aberrant right hepatic artery, when present, in 93 % (i.e. in 16 % of all individuals), and an accessory bile duct, when present, in 85 % (10 of all individuals). The R.H.A. is in danger when it describes a loop to the right (the caterpiller hump) *(Benson and Page, 1976)*.

The common bile duct

Formed by the confluence of the common hepatic and cystic ducts, the common bile duct is normally located in the free edge of the lesser omentum, and subsequently passes behind the pancreas to enter the second part of the duodenum. In up to 20 % of individuals, however, the common bile duct is not visible, as the confluence lies behind the duodenum or pancreas *(Johnstone and Anson, 1952)*.

The common bile duct continues downwards and slightly to the left in the free edge of lesser omentum, with the hepatic artery proper on its left and the portal vein behind. It passes behind the first part of the duodenum where now the gastroduodenal artery lies to its left and retroduodenal artery lies infront. It then passes into a groove in the head of pancreas and runs to the right infront of the inferior vena cava *(Bernard and Hand, 1987)*.

The diameter of the common bile duct is variable, since the advent of operative cholangiography, the individual importance of diameter as an indication for duct exploration has diminished. Sometimes however, when the cholangiogram is difficult to interpret, duct diameter is a useful parameter in the decision to explore. *Leslie (1988)* in a useful practical study found that ducts below 9 mm in diameter never contained stones, while those over 17 mm always had distal obstructive pathology, hence deserving exploration. The common bile duct has several surgical relations. The common duct lymph gland located to the right of the duct as it disappear behind the duodenum, can be a useful pointer to the duct in a difficult dissection *(Cattel and Breasch, 1959)*. Crossing the duct anteriorly just below this point, behind the duodenum, is the retroduodenal artery, a large vessel which supplies the duct and which can be the source of dangerous operative haemorrhage *(Henley, 1955)*. It arises from the gastroduodenal artery which runs parallel to the duct behind the duodenum, about 1 cm to its left or it arises from the inferior pancreatico-duodenal artery *(Bradely, 1973)*; this constant relation aids avoidance of the duct during gastrectomy.

The termination of the common bile duct at the duodenal papilla is normally found on the posteromedial wall of the descending duodenum. In about 5 % the papilla is in the third part of the duodenum, but very rarely proximal to its normal position *(Lindner et al., 1976)*. When performing sphincterotomy or sphincteroplasty it is therefore best to begin the duodenotomy at the mid point of the second part and proceed distally - the commonest error is to begin too proximally *(Kune and Sali, 1980)*.

Choledochoduodenal area

In the early part of this century, several authorities believed that the sphincter of Oddi was only partly responsible for the control of the flow of bile *(Buget, 1925)*. A little later it was considered to be fully independent of the duodenal muscle *(Lueth, 1931)*. In more recent times with the advent of image intensifier, it was concluded that the sphincter was fully independent *(Smith, Walter, and Beal, 1952).* Subsequent electromyographic studies confirmed that *(Ono, Watanabe, Suzuki et al., 1968).*

Radiologically the common bile duct becomes abruptly narrowed as it approaches the duodenum *(Partington, and Sachs, 1951).* This terminal narrowing of the common bile duct, not detectable on its external surface, was due to marked increase of muscle fibres in the wall. This produced an abrupt reduction in the width of the lumen that correlated to a radiologically recognizable notch. The notch was found to lie some 2 mm proximal to the duodenal wall and corresponded to the upper edge of the superior choledochal sphincter. The muscular narrow-lumened portion of the common bile duct, referred to as the thickened segment, varies in length from 11 mm to 27 mm the average being 16 mm. The length of the intraduodenal part of the thickened segment is thus 2 mm less i.e. 9 mm to 25 mm *(Bernard and Hand, 1987).*

The pancreatic duct, lying posteriorly or posteromedially approaches the common bile duct just above the level of the notch. Here the two ducts become surrounded by a common muscular sheath but remain separated by a muscular septum *(Kune, 1964).* In the submucous layer of the duodenum, the two ducts may fuse by gradual thinning and breakdown of the septum to form a common channel or pancreatobiliary canal. Alternatively, the two ducts may open separately on the major papilla. 85 % have a common channel and 13 % have separate openings; in 2 % the duct of Wirsung is not patent and all pancreatic drainage passes via the duct of Santorini *(Hand, 1963).*

Tradition refers to the common channel as the ampulla of Vater, but recent studies fail to demonstrate any dilatation in the region *(Dowdy, Waldrone, and Brown, 1962).* The length of the common channel has been