# PITFALLS TO BE AVOIDED IN CHOLECYSTECTOMY

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THE progress made in the surgery of the gallbladder has been one of the great triumphs of operative therapy, and the story of this advance is a fascinating one. A discussion on problems in cholecystectomy would therefore seem presumptuous. And the writer would not consider submitting this paper were it not for the fact that the anatomical and technical pitfalls are still not fully appreciated. Too many common ducts are still being cut during cholecystectomy.[1,25,26,27,28,29,30,31,32,33,34,35,36,3 ,38,39]

Technically, gallbladder surgery is the most difficult and dangerous of any abdominal surgery, and an inadequate appreciation of the variations and abnormalities of this region is responsible for increased mortality and morbidity. The development of improved surgical technic, improvement in preoperative preparation, anesthesia and postoperative management have been important factors in reducing the mortality. In the past fifty years the mortality from operations on the biliary tract have been reduced from 16 per cent (Courvoisier, 1889[23]) to 3 per cent or less (Berkson[24]). However, in the hands of those not especially trained mortality still rises to 10 per cent or even higher.[3] Mortality advances rapidly with age. The mortality is greater in males than in females.[3] Morbidity from bile duct injuries usually go unreported, and hence any estimate of this incidence would be inaccurate. The sequelae of accidental division or excision of a segment of the duct or its inclusion in a ligature during cholecystectomy are such that irrespective of surgical repair of the injury the end results are usually poor. Bakes[4] observed bile issuing from the wound 230 times in 246 cases of simple cholecystectomy—an indication of either a severed accessory bile duct or injury to the bile duct apparatus. Injury to the bile ducts continues to be one of the most significant operative complications. Hence many surgeons have justly stressed among the pertinent factors in reducing mortality and morbidity in cholecystectomy, an intimate knowledge of the common and special anatomy of the bile duct apparatus.[5,13]

These are the days of frequent cholecystectomy, the operation most commonly performed on the biliary tract. Outside of the appendix the gallbladder more often calls for operative treatment than any other intra-abdominal viscus. But if we may judge from the great number of patients unrelieved or requiring a second operation, or the number of strictures of the common duct which occur, there would seem to be room for improvement. Though quite a large number of injuries to the bile ducts have been reported by various authorities, notably Eisendrath,[17] Elliot,[18] Lahey and Walters,[11] these probably represent only a small fraction of the total number, for surgeons do not feel disposed to advertise their errors. That the incidence of duct injury is higher than the inadequate statistics would indicate, is borne out by the numerous reports of methods of reconstruction of bile ducts injured during cholecystectomy. A book by Hargan[6] on the methods of reconstruction of the biliary tract further serves to emphasize the frequency of severe injuries and their great significance. More recently Pearse[7,16] has described the use of vitallium tubes for repair of injured bile ducts and states that common duct strictures are traumatic in origin and are the direct result of cholecystectomy in from 80 to 90 per

cent of the cases. With the increased number of cholecystectomies, complicated surgery of the bile ducts has multiplied.

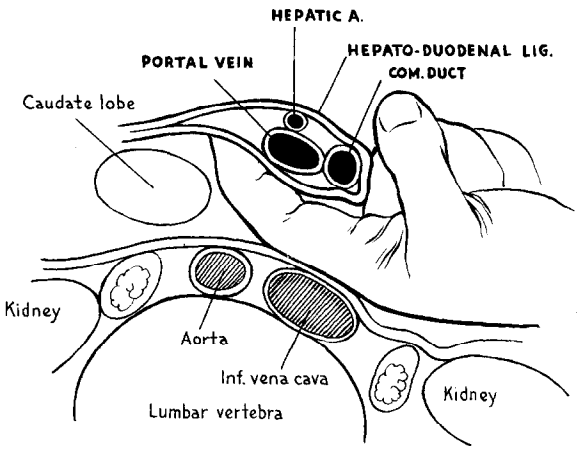



FIG. 1. Shows the left index finger in the foramen of Winslow. Note the common duct, hepatic artery and portal vein in the hapatoduodenal ligament. Raising the ligament interrupts the blood supply to the liver. The hepatic artery may be compressed here for the control of hemorrhage from a torn or slipped cystic artery during cholecystectomy. Related structures in this vicinity are illustrated.

What are the reasons for these anatomical and technical difficulties in cholecystectomy? The anatomy in the region of the gallbladder makes good exposure difficult. The bony framework of the lower wall and the bulk and immobility of the liver, plus its peculiar shape all help to obscure the operative field. The close proximity of the stomach and colon add to the surgeons difficulties. Maintenance of adequate exposure is trying because the structures are in a dark deep hole, the sides of which are kept in constant motion by the diaphragm. Another source of considerable difficulty is the deep situation of all structures under the liver. The structures are short and the right lobe of the liver hides the hepatic and cystic ducts. Add to this a fat patient taut and heaving from insufficient anesthetization and safe cholecystectomy may well nigh be impossible.

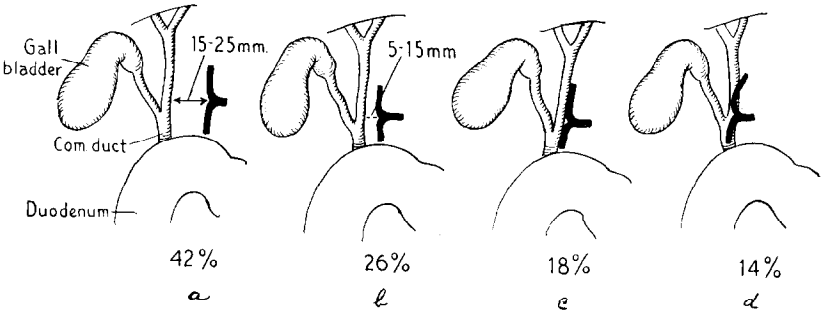



FIG. 2. Shows a relationship of the hepatic artery to the common duct. Figure *d* illustrates a particularly dangerous situation present in 14 per cent of cases according to Rio Bronco when the hepatic artery overlies the common duct. This relationship should be kept in mind during choledocotomy, and the hepatic artery sought for and displaced before incising the duct.[43]

When the above handicaps have been surmounted, the factor of variations and anomalies enter and these are of the utmost importance, since every possible variation

can become an actuality. The occurrence of these variations receive either no mention at all or only a brief one in most all of the main hepatic and the cystic duct. (Fig. 2.) We have been taught and still are taught that the cystic artery is a single

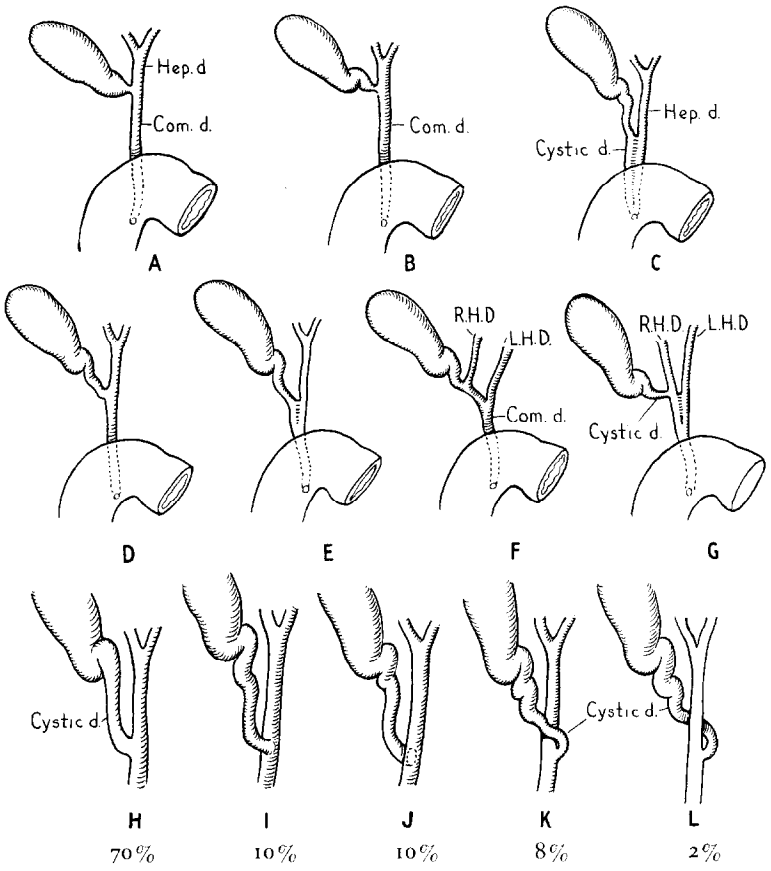
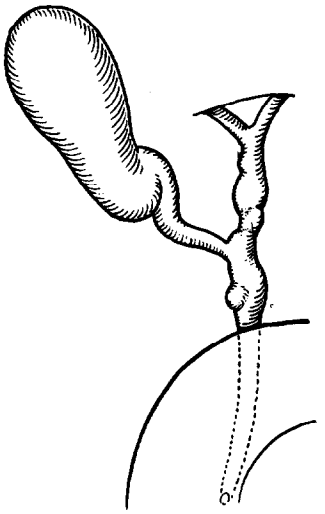



Fig. 3. A, A to E illustrate different relationships of the cystic to the common hepatic duct. The relationship illustrated in C occurs in 24 per cent of cases according to Descamp. This is surgically important. F illustrates an anomaly of the right hepatic duct. G illustrates the cystic duct terminating in the right hepatic duct. H to L illustrate various modes of entry of the cystic into the common hepatic duct and the approximate incidence according to Descamp.[21] K and L illustrate the anterior and posterior spiral modes of entry of the cystic into the common hepatic. The presence of a stone in the cystic duct in K and L could produce clinically the same symptoms as that of common duct obstruction. The removal of a stone from the cystic duct in either K or L could easily result in injury to the common duct unless this anatomical relationship is kept in mind. The spiral mode of entry occurs in 8 per cent of cases according to Descamp and 37 per cent of cases according to Rugi.

of our standard textbooks of anatomy and operative surgery. The anatomical teaching is, that there are two bile ducts one from each lobe which join close to the liver to form the hepatic duct, and this is joined shortly by the cystic duct at an acute angle, and that the common duct is a single structure which is formed by the union vessel arising from the right hepatic, shortly after the latter passes behind the main hepatic duct. The common duct is described as being sufficiently devoid of large blood vessels on the anterior surface of its supraduodenal portion to permit of easy access to an incision in this portion, as the best approach in the removal of

stones from the common duct. If the above teachings were correct, we would not encounter any special technical difficulties.



B

FIG. 3. B, a drawing of the author's dissection showing herniations or parietal sacculi in the wall of the common duct. These outpouchings usually contain no muscle fibers and consist of mucous membrane and adventitia. They are easily torn or ruptured.

There would be fewer injuries to the hepatic and common duct with fewer strictures of the common duct. The right hepatic artery has been damaged and ligated with resulting progressive hypoglycemia and death,[8] and accidental division of the common bile duct has occurred during cholecystectomy by experienced surgeons.[9] In a review of forty-seven cases of strictures of the common duct, Judd noted that all but five followed some type of operation on the gallbladder or ducts. No less an authority than Doctor Lahey states that practically all strictures of the common and hepatic ducts are man-made strictures.[10] In support of this contention it may not be amiss to relate an incident which occurred in the practice of one of the most skillful and experienced surgeons in the country. He had completed a cholecystectomy and closed the operative wound. He was about to leave the operating floor when he bethought himself to examine the specimen. To his consternation he found a portion of the main duct attached to it. A second operation was done with a very happy result. If such a thing can happen to one of our great surgeons, how much more likely is it to occur in the work of the average surgeon. This serves to illustrate the necessity of careful examination by the surgeon of the specimen immediately after cholecystectomy. Delayed operations for the repair or reconstruction of bile ducts are extremely difficult and must often be performed on deeply jaundiced and otherwise

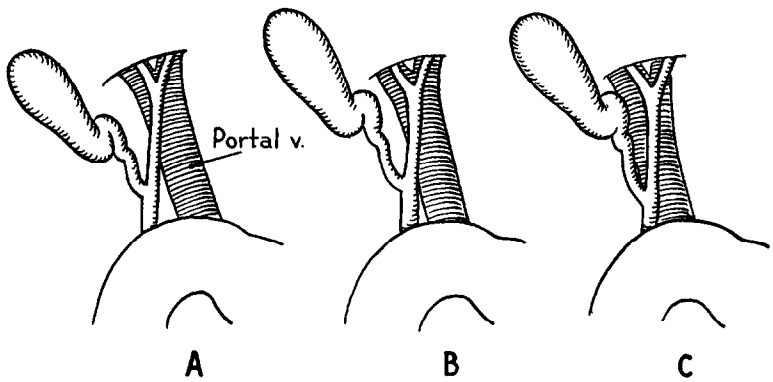



FIG. 4. Illustrates the relationship of the portal vein to the common duct. The relationship is especially close in 24 per cent of cases as illustrated in c; and injury to the portal vein can occur if the common duct is not opened carefully or during repair of a strictured common duct. Kehr and Lahey report injury to the portal vein during operative procedures in this region.

incapacitated patients. The mortality is, therefore, high. Those who recover, frequently after multiple operations, are doomed to ill health, recurrent fever, chills and jaundice.

To avoid errors in operative technic a thorough familiarity with every possible variation in the biliary tract is mandatory, for prevention of injury is of paramount importance. And prevention may be facilitated only through the possession of an intimate knowledge of the variations of ductal and vascular structures. While human beings are singularly alike in their general anatomical construction, yet when one comes to investigate any particular region with more detail, it is surprising how frequently we meet with variations of one sort or another. More especially does this apply to the vascular system and in no region more than in the liver. This I think is generally appreciated by anatomists. My professor of anatomy, the late Doctor Stockhard, of Cornell used to say that if we all had a transparent abdominal wall, we would know each other by the appearance of our viscera, so great are the variations of the normal. Flint[13] after 200 dissections of the gallbladder and ducts found only sixty-nine cases of so-called normal. He states that the variations are so frequent that it is impossible to regard any one type as normal. Anatomical studies by Ruge,[19] Kurz[20] Descamp,[21] Behrend,[22] and Eisendrath[17] have shown for example that there are two cystic arteries in 12 per cent of individuals, a fact generally not appreciated by most surgeons. Descamp[21] believes that 18 per cent is more accurate. At any rate it occurs often enough to put the surgeon on his guard when he has ligated only one cystic artery. (Fig. 6.) To anticipate any normal arrangement of the bile structures is to invite disaster. The writer has therefore summarized the more important variations and anomalies of the bile ducts and the related blood vessels with which every surgeon should be familiar. These anatomical variations may further be distorted by pathological changes. This multiplicity of variations and anomalies, further multiplied by the pathological distortions

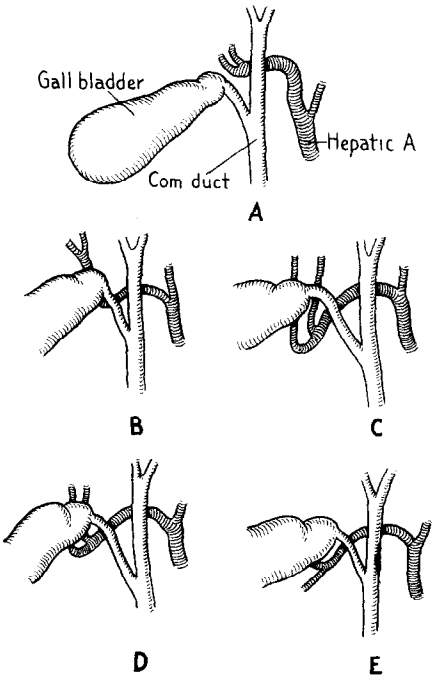



Fig. 5. Relationship of the right hepatic artery to the cystic duct and neck of the gallbladder according to Rio Bronco. A and B represent the usual relationship; C and D a rather frequent occurrence; E a rare relationship. These figures illustrate Calot's triangle with the right hepatic artery as the northern boundary rather than the cystic artery. Ligation of the right hepatic artery in this location for the cystic artery results in hypoglycemic shock and death.[23,43,45]

indicates the serious problems which frequently confront the surgeon during cholecystectomy.

Variations in the bile ducts and in the cystic artery are the more frequent causes of accidental injury to the ducts during cholecystectomy. (Figs. 3 and 6.) Though the gallbladder and the cystic duct are the ready guides to the common duct, it should not be forgotten that the cystic duct is not at the bottom of the gallbladder, but to its inner side, and that the pelvis of the gallbladder may overlap the cystic duct and cover the preduodenal common duct. (Fig. 8F.) The cystic duct varies in size as shown by recent studies.[11] In

55 per cent of cases the duct is believed to be from 2 to 4 cm. long; in 25 per cent more than 4 cm. in length, and in 20 per cent less than 2 cm. in length. The circumference of the cystic duct varies, but it is smaller than the hepatic or common bile ducts. This small caliber of the cystic duct is of significance since many accidents of gallbladder surgery occur about the cystic duct at its site of contact or union with the hepatic duct. Careful examination should, therefore, be carried out to determine the anatomic relation and it may be assumed that a large duct in this region is more probably not the cystic duct. This junction of the cystic, common and hepatic ducts is the important area. Moreover Calot's triangle is frequently completed by the right hepatic artery instead of the cystic as described by Calot. This variation may

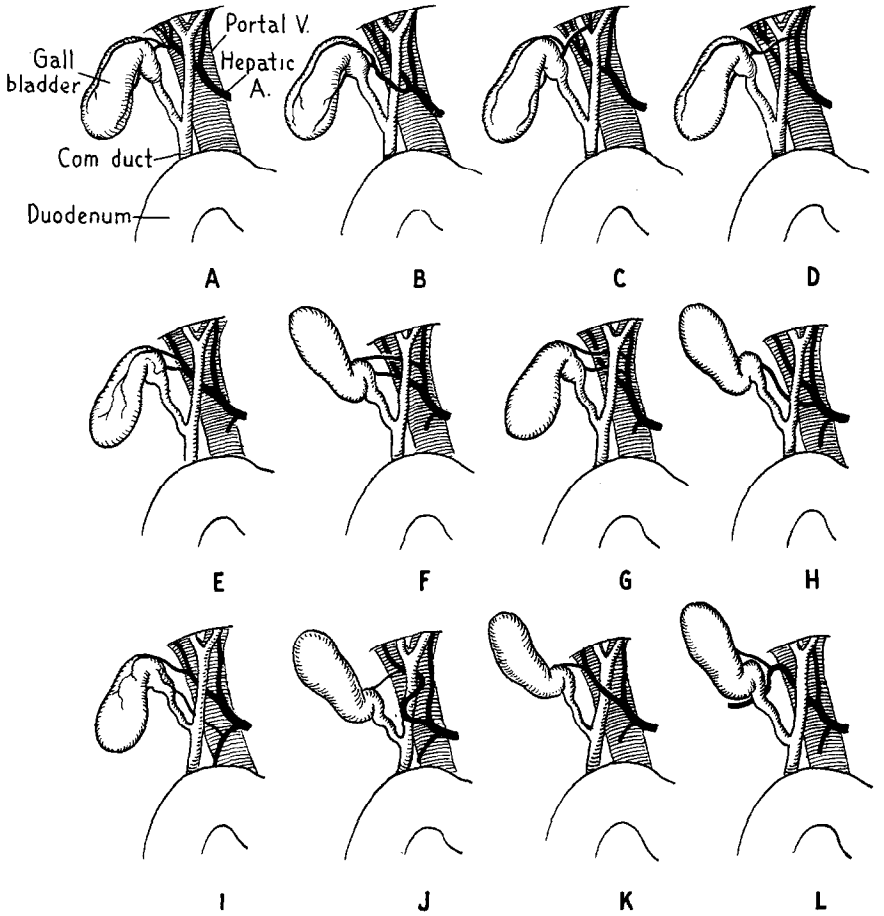



Fig. 6. Shows variations of the single and double cystic arteries. E, F, G, and I show the various types of double cystic arteries. The double cystic artery occurs in 12 to 18 per cent of cases. E shows both cystic arteries off the right hepatic artery. F shows one cystic artery from the right hepatic and one from the left. G shows two cystic arteries from the left hepatic. H shows the cystic artery coming directly from the common hepatic. I illustrates one cystic from the right hepatic and another from the gastroduodenal. The cystic artery may be branched or double. This often gives rise to hemorrhage after the cystic artery has been considered ligated. The cystic artery may be a branch of the pancreatoduodenal artery or even from the superior mesenteric artery.[45] The right hepatic artery may be tortuous and in close relation to the ducts. It may even cover the ducts as shown in Figure 2D and Figure 6J and L making all sorts of fantastic figures. The cystic duct is in close relation to the artery which may be injured during cholecystectomy.

result in ligation of the right hepatic artery for the cystic artery with resulting so-called "liver death." (Fig. 5A to E.) trol it accurately. Instead of this, he clamps wildly and picks up the hepatic duct in the clamp." Attempts to control bleeding

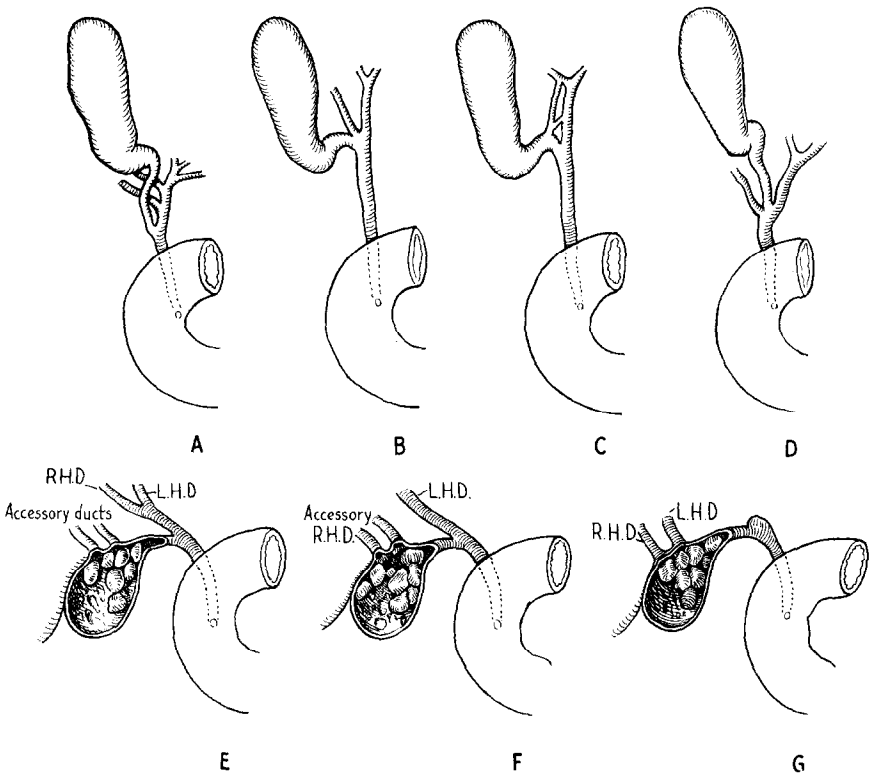
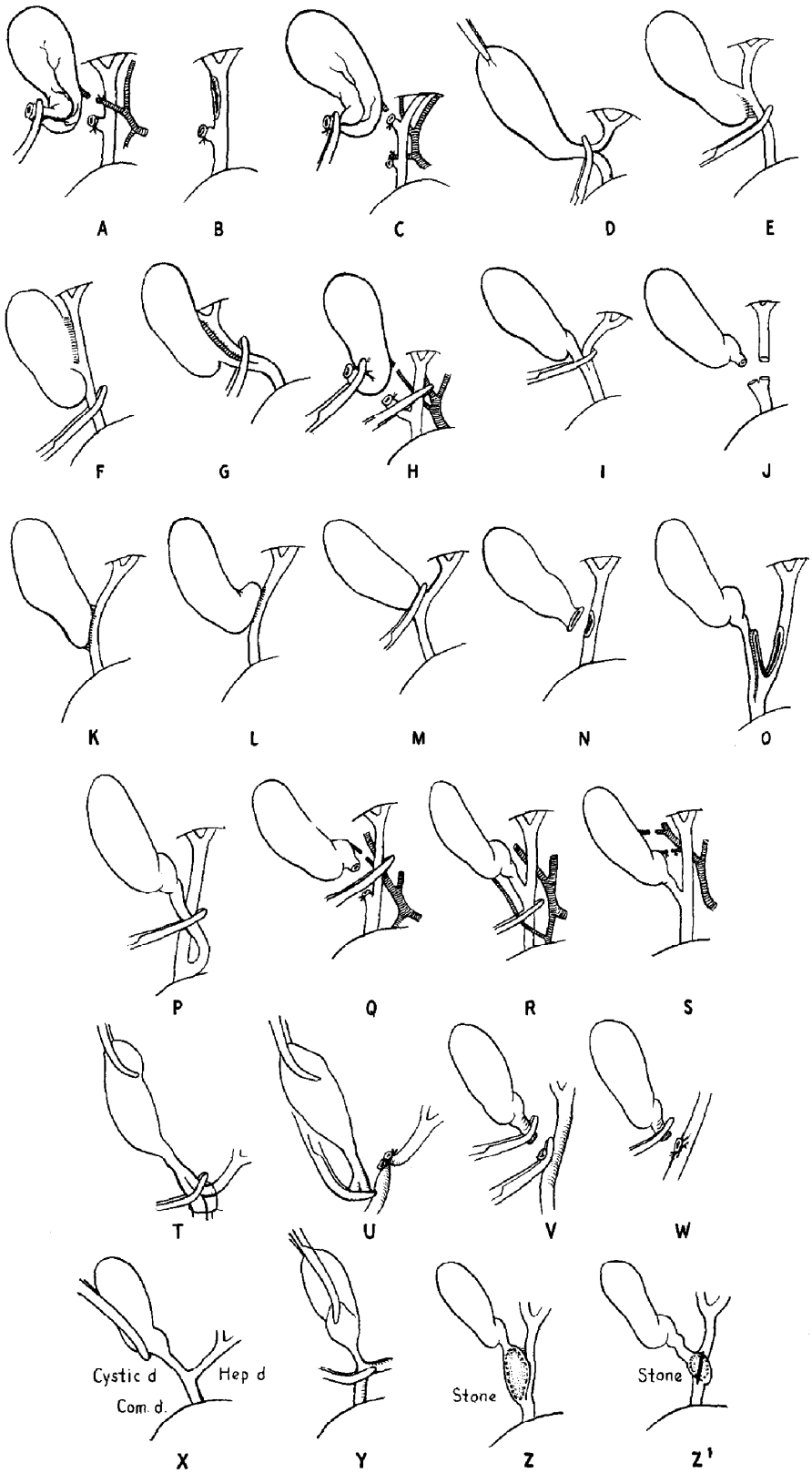



FIG. 7. A to E illustrate the various types of accessory bile ducts which are present in 20 per cent of cases.[43] Leakage of bile from a divided end may be a troublesome or even fatal complication. F shows the right hepatic entering the gallbladder directly and G shows both the right and left hepatic ducts entering the gallbladder. Cholecystectomy *from the cystic duct up* in F and G would result in a fatality, while attempted cholecystectomy *from the fundus down* would recognize this anomaly and cholecystostomy could be done.

No one with experience in biliary surgery will deny that this dangerous triangular region which complicates biliary surgery lies at the deepest, most inaccessible point of the operative field. Unexpected hemorrhage from the slipping of a clamp or a tie off the cystic artery in this area is frequently the beginning of a vicious circle. Lahey,[12] speaking of duct injuries says, "They are the result of excitement, I think, the cystic artery gets loose, bleeds into the deep operative field. The inexperienced operator fails to realize that by pinching the hepatic artery with his finger he can stop the bleeding artery, wipe the field dry, find the bleeding vessel, and control it accurately. Instead of this, he clamps wildly and picks up the hepatic duct in the clamp." Attempts to control bleeding in this area from a torn or cut cystic artery can produce injury not only to the bile ducts but also to the portal vein, duodenum and even the head of the pancreas.

What is the safest technic for cholecystectomy? There is still difference of opinion among surgeons as to whether the gallbladder should be removed by *starting at the fundus and dissecting downward*, or by *starting at the cystic duct and working upward*. Both methods have their protagonists, but which ever method is chosen, two main factors must be emphasized: (1) It is absolutely essential that a complete isolation of the cystic duct be made before any clamps or ligatures are applied.

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(2) The cystic artery and duct must be tied securely (either separately or together).

*In cholecystectomy beginning at the cystic duct*, the cystic artery and duct are ligated first, this makes cholecystectomy a cinch, for the circulation is controlled from the outset. However, identification and isolation of the cystic artery and duct is not always easy, because of the difficulties of exposure mentioned above and because of the great variations in the arrangement of the bile ducts and blood vessels. Besides the cystic artery does not always lie to the north of the cystic duct in vermillion color (as illustrated in textbooks of operative surgery) waiting to be ligated. More often

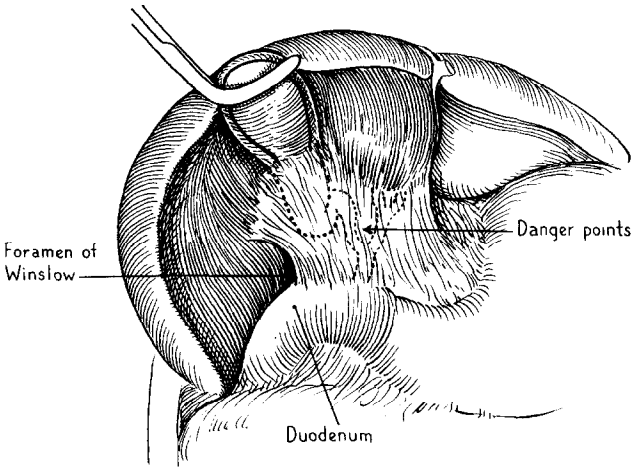


Fig. 9. Shows the method of cholecystectomy *from the fundus down*. Note the author's method of grasping the fundus so that the tips of the right angle clamp extend beyond the gallbladder. If the tips of the clamp terminate on the gallbladder, the wall of the gallbladder is soon perforated with tearing and leakage of bile. Note the foramen of Winslow and the danger points which are submerged and buried in adhesions. Cholecystectomy *from the cystic duct up* is more hazardous when the danger points are submerged and they usually are.

Fig. 8. Illustrates the various mechanisms of operative trauma from A to Z during the performance of cholecystectomy: A, shows ligature of right hepatic artery during the performance of cholecystectomy (after Maingot); B, shows button holing of the common duct (after Maingot); C, shows ligature of right hepatic duct during cholecystectomy (after Maingot); D, clamping of common duct during cholecystectomy (after Kehr); E, the common bile duct has been clamped in mistake for cystic duct. Hartman's pouch overhangs the duct and the gallbladder is adherent and sclerosed (Fig. 2); G, division of common hepatic duct with an adherent cystic duct (after Walton); H, duct and artery clamped by a hemostat following the slipping of the ligature which has been applied to the cystic artery (after Walton); I and J, resection of the junction of cystic and common ducts; K and L, tear or division of the main hepatic duct which might arise in separating the upper side of the pelvis of the gallbladder from the duct (after Thorek); M and N, shows what may happen during cholecystectomy by clamping when the cystic duct is very short. O, shows an injury which may result to the hepatic ducts when the cystic and hepatic ducts run parallel for a long course; P, injury which may arise to the hepatic duct when the cystic duct winds around in front of it; Q, injury resulting to the hepatic duct during effort to catch bleeding cystic artery; R, injury to the common duct during effort to catch anomalous bleeding cystic artery arising from the gastroduodenal; S, hemorrhage which may occur from overlooked second cystic artery; T and U, show semi-diagrammatically how a section of the common and hepatic ducts may be removed by applying the clamp too low after pulling up on the cystic duct (after Lahey) (Figs. 12 and 13); V and W, show diagrammatically how stricture of the duct can result from applying the clamp in cholecystectomy too low. X and Y, show how traction on the gallbladder during cholecystectomy will bring the cystic and common ducts into the same line. The surgeon may, therefore, mistake the common for the cystic and crush it by clamp or ligature (Fig. 15); Z and Z', illustrate how a stone in the cystic duct can occlude the common duct. Removal of such a stone from the cystic duct as illustrated in Z' can injure the underlying or overlying common duct, especially when the stone is located by palpation of the duct and the incision is made directly over the stone.

we encounter a lot of bleeding connecting tissue strands down deep in a dark hole. If the cystic duct which is isolated more readily than the artery is dissected and cut first, the vessel which is shorter than the duct may tear, retract and bleed freely. Attempts to catch this retracted vessel may lead to the injuries described above. Then again one cystic artery having been secured and ligated, a similar hemorrhage and retraction may occur from a second overlooked cystic artery which is inadvertently cut or torn. This can occur in 12 to 18 per cent of individuals and stampede the operator into efforts of blind control of hemorrhage with its hazards of bile duct injury.

The frequency of ductal and vascular variations in this triangular danger zone emphasizes the hazard of beginning the removal of the gallbladder in this area. Figure 5 shows how easy it is to mistake the right hepatic artery for the cystic and ligate or injure same. That this may occur, it may not be amiss again to relate an incident which the writer witnessed recently in the practice of one of the best surgeons in this country. Under spinal anesthesia, the gallbladder and ducts were exposed in a particularly dry, clean field. In plain view, what appeared to be the cystic artery was easily demonstrated, completing the boundary of Calot's triangle. A ligature was passed around this vessel but fortunately it was not divided since it later proved to be the right hepatic artery and not the cystic. Again, if this can happen to our great surgeons, how much more frequently can this occur in the work of the average surgeon; and most of the cholecystectomies today are performed by the average surgeon.

An adequate incision, proper retraction and a good light are essential for proper exposure and the avoidance of complications. There are few operative fields where roughness and haste are more disastrous. Many technics and tricks have been devised and described toward obtaining good exposure for cholecystectomy. But a good anesthesist is still the best agent of all for the acquisition of a satisfactory

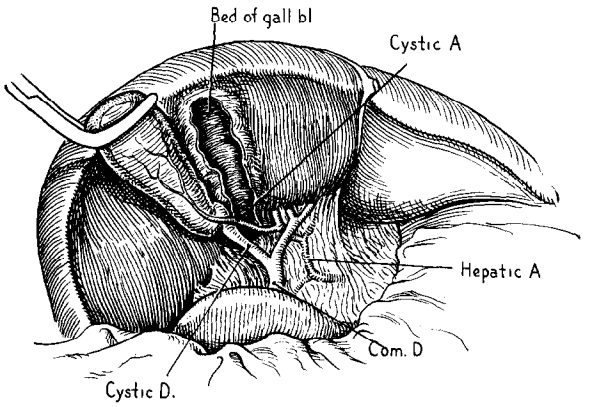


FIG. 10. Illustrates the further progress in removing the gallbladder *from the fundus down*. The gallbladder is stripped from its avascular cleavage plane in the liver bed leaving a margin of peritoneum with which to cover the raw surface of the liver. Traction on the fundus draws the gallbladder away from the liver bed until the cystic vessels and common duct are reached. In this manner considerable portions of the cystic duct are not left behind and variations of the blood vessels and ducts are more easily recognized. The cystic duct is delivered out of its depth, straightened out and ligated under better exposure and direct vision. (Fig. 10.)

FIG. 11. Photo of the author's dissection showing Hartman's pouch overhanging the common duct with an adherent and sclerosed gallbladder.

view of the parts concerned in the field of operation. "To see is to save" and anything which cannot be seen especially be certain of the anatomy. Hence the most expert surgeons have been led into entrapments at the triangle which have

Fig. 12.

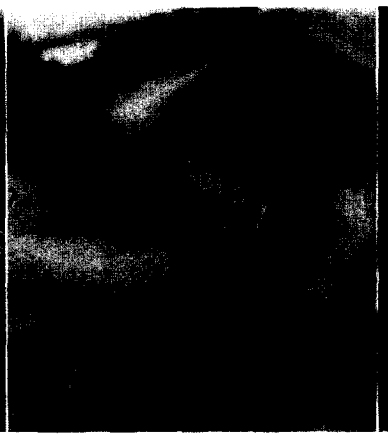

Fig. 13.

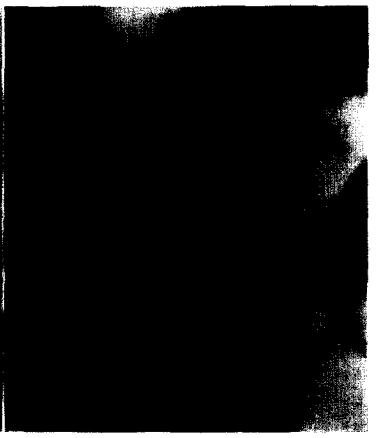

Fig. 14.

Fig. 12. Photo of author's dissection showing how traction on the cystic duct can produce angulation of the common duct.

Fig. 13. Photo of author's dissection showing the mechanism of injury of the common and hepatic ducts by applying the clamp too low after pulling up on the cystic duct.

Fig. 14. Photo of author's dissection showing how stricture of the duct can result from applying the clamp too far down on the cystic duct during cholecystectomy. Part of the wall of the common duct is ligated producing a stricture.

when it is in the operative field is in danger of injury. It seems to me that no one in the light of present information ought to perform cholecystectomy without a thorough knowledge of the parts in the region of the foramen of Winslow. (Fig. 1.) The first step should be to examine the gallbladder and bile ducts and it is good practice to observe the condition of the pancreas at the same time. We are apt, when disease of the gallbladder is manifest, to forget to examine the ducts until a later period of operation, and in consequence we may find ourselves at a disadvantage.

The actual method of removing the gallbladder whether *from the fundus downward* or *from the cystic duct upward* has been a subject of discussion for years. Surgeons beginning at the cystic duct argue that their method is easier since the circulation is controlled at the outset, and in this manner the most difficult part of the operation is accomplished first. However, even with perfect exposure, under spinal anesthesia, one cannot always

led to unhappy experiences. In many instances the neck of the gallbladder and cystic duct are submerged in dense adhesions, and it is not uncommon for the fundus and body of the gallbladder to be well submerged, too. The writer has, therefore, always deemed it safer to begin the excision of the gallbladder at the fundus, since this is usually the least involved by pathological conditions, and work toward the more involved region in the danger zone. (Figs. 9 and 10.) The gallbladder when freed affords an excellent handle to raise the liver, to put the cystic duct on stretch, and to pull forward the deeper lying bile ducts. (Fig. 10.) Hartman has stated that the gallbladder is often the thread of Adridne which guides us through a labyrinth of adhesions to the position of the common duct. When the gallbladder is dissected free from the liver, the cystic duct and artery are drawn well up into the wound, and there they can be ligated together. Every stroke of the knife or scissors is thus made under direct vision, and in-

flammatory or other bands separated close to the gallbladder. When cutting across the cystic duct care must be taken

FIG. 15. Photo of the author's dissection showing how traction on the gallbladder during cholecystectomy will bring the cystic and common ducts into the same line. It is then possible to mistake the common for the cystic duct and crush it by clamp or ligature.

to avoid too much traction on the gallbladder or Hartman's pouch, so as not to pull up or angulate the common duct. (Fig. 8 T, U, V, X.) In doing cholecystectomy *from the cystic duct up*, the cystic duct having been cut first we are at once deprived of the above advantages; moreover if the accessory ducts as illustrated in Figure 7E, F, and G, are present the operator is in an uncomfortable situation. Therefore, the freeing of the gallbladder from the fundus down is preferred by the writer because variations can be noted first and the cystic duct can be freed more simply in this direction and it leads to the common duct. If the gallbladder is large, tense, or obstructs the approach to Calot's triangle, it can be partly emptied by aspiration. Long remnants of the cystic duct are thus not left behind with the possible sequelae of biliary dyskinesia.[14] Any vessel present can be clamped on or close to the gallbladder or cystic duct as encountered, and thus there is less danger of injury to the right hepatic artery or ducts. The great variations in the arrangement of the biliary ducts and hepatic and cystic arteries as illustrated occur in 70 per cent of cases.[13] Since it is unsafe to anticipate any regular or normal arrangement of these structures it is highly important in every case positively to identify the cystic duct and artery, regardless of their situation before they are cut or ligated. This is often difficult. If the duct is isolated and divided before the cystic artery, the cystic artery which is shorter may tear and retract with sharp hemorrhage deep in the wound. The relationship of the artery to the duct is almost like a bowstring to a bow, since it is shorter than the duct and lies on a plane closer to the liver. The cystic artery usually passes behind and not along the cystic duct to the gallbladder. The order must then be reversed and the cystic artery ligated first before cutting the cystic duct to prevent trouble. If one can localize and be certain of the position of each of these structures, there is certainly no objection to the method from the cystic duct up. Judd's method[15] of carefully catching the cystic duct and artery, exposing them together and separating them from the notch of the liver while sealed in their connective tissues and ligating them together may be tried. However, so many variations and adhesions are so often found in this inaccessible area that the inexperienced operator may mistake the common for the cystic and even the hepatic duct may be completely severed or a section of it removed. This accident can be avoided if the fundus and neck of the gallbladder are dissected carefully down to the cystic duct and the cystic duct followed to its junction with the common before it is ligated and divided (see Fig. 16). The cystic duct should not be removed flush with the common hepatic duct. (Fig. 8V.) It is safer to leave enough of the cystic duct to minimize the danger of later cicatricial contraction of the common duct. In all

cases of doubt it is much wiser to leave a small portion of the gallbladder than to run the risk of injuring the common or hepatic duct. Besides since there may be two cystic arteries, dissection from the fundus down would encounter and secure these vessels during dissection either on the wall of the gallbladder or behind the cystic duct. The contents are thus noted, stones can be felt and if a stone is impacted in the ampulla or cystic duct it can be pushed back into the gallbladder, giving easier access to and localization of the duct. The peritoneal coat is stripped off from the gallbladder leaving a margin of about three-fourths of an inch on either side and by blunt dissection the gallbladder is stripped from its avascular cleavage plane between the gallbladder and liver bed. (Fig. 10.) Traction on the fundus draws the gallbladder away from the liver bed until the cystic vessels and ducts are reached. (Fig. 10.) In this manner considerable portions of the cystic duct are not left behind and anomalies of the blood vessels and biliary ducts are more easily recognized. The cystic duct is delivered out of its depth, straightened out and ligated under better exposure and direct vision. Good exposure is often difficult if not impossible by any other method in this danger zone. The vessels when exposed in this manner usually lie to the inner and upper aspect of the neck of the gallbladder and cystic duct and can be easily clamped and ligated. Nothing should be clamped, cut or ligated unless positively identified. Constant visualization is essential to avoid injury to the ducts. Blind and careless application of a clamp to control hemorrhage from the cystic vessels is unpardonable. The cystic duct is then visualized and cut between clamps. If the dissection is begun at the neck of the gallbladder or at the junction of the cystic and common ducts, it may be almost impossible to define and expose these structures clearly because of the deformity, thickening and contracture produced in this zone by inflammation. (Fig. 9.) Ligation of the cystic artery at this point is likewise fraught with great danger since

Fig. 16. Photo of the author's dissection of the junction of the cystic and common ducts. Note the usual length of the cystic duct. Note that the cystic duct is of smaller caliber than the common and enters same at right angles.

it can be confused with the right hepatic artery. After transfixion and double ligation of the cystic duct with chromic catgut, the bed of the gallbladder is sutured with fine plain catgut on an A-traumatic needle thus closing the raw surface of the gallbladder bed. Accessory bile ducts and variations of the normal bile ducts are so numerous that the writer always employs drainage following cholecystectomy. No harm is done by leaving a small Penrose drain in for several days and occasionally it saves a life. The terse saying of the late John B. Deaver is sufficiently emphatic in this respect. He stated that in a patient dying of bile peritonitis following cholecystectomy where no drainage had been employed, he would have inscribed on the tombstone, "Died following cholecystectomy without drainage."

Only a proper definition of the parts at operation combined with a detailed knowledge of the anatomy, particularly of the ductal and vascular structures, will prevent errors. Skill in cholecystectomy cannot be acquired in either ten easy lessons or five hard ones. The pitfalls of gallbladder surgery can be avoided

only through a detailed familiarity with the lay of the land coupled with experience and the ability to anticipate trouble.

## SUMMARY

The problems of cholecystectomy are discussed. The important variations and anomalies of the bile ducts and blood vessels are demonstrated and their surgical significance in cholecystectomy emphasized. With the increased number of cholecystectomies there has been an increased incidence of bile duct injuries. Since prevention of injury is of paramount importance, a thorough familiarity with every possible variation in the biliary tract is mandatory.

Any surgeon performing cholecystectomy must be qualified to recognize and deal with safely any pathological conditions involving the extrahepatic ducts as well. The extrahepatic ducts and their related blood vessels are, therefore, demonstrated by diagrams and photographs of the author's dissections. The right hepatic artery instead of the cystic not infrequently forms the base of Calot's triangle; it can, therefore, be mistaken for the cystic artery and ligated accidentally with death of the patient.

The author prefers cholecystectomy *from the fundus down* and believes this method safer than cholecystectomy *from the cystic duct up*. The reasons for this are given. Cholecystectomy should always be accompanied by drainage.

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Functional stenosis of the lower end of the esophagus is usually successfully treated by *dilatation methods*. An air-inflated rubber bag is commonly used. Mechanical digital dilatation through an incision in the stomach may be indicated in rare cases.

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