CHOLECYSTOGRAPHY

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In the last decade, it has been found that cholecystography is the most important single objective aid in the diagnosis of dysfunction or disease of the gallbladder, yet neither the evaluation nor the technique of this procedure has become standardized. Early in the development of this test, Nichols, after a consideration of certain fundamental principles, adopted a procedure which has stood the test of time, i. e., the oral method of administration of the dye combined with roentgen examination of the entire gastro-intestinal tract, which often is preceded by an examination of the urinary tract. These same procedures are used today—10 years later—and in the patients who have had operations at the Cleveland Clinic during the past five years, this procedure has proved accurate, whether in a positive or negative way, in 95 per cent of the cases. The purpose of this brief discussion is to present the features of this examination, which in our experience have been of the greatest value.

There have been countless discussions relative to the merits of the intravenous versus the oral method of administration of the dye, and now that the oral method has been adopted generally, the current discussions center on the merits of the single versus the double or fractional dose method of administration.

Formerly, importance was attached to the time required for the gallbladder to fill and empty after administration of the dye. Now, Stewart and Illick[1] report that their best visualization of the gallbladder is on the film made 40 hours after fractional administration of the dye is started. Most observers take films after the fat meal only for the purpose of disclosing gall stones or small tumors which might be obscured in the completely distended gallbladder. We have followed the latter procedure at various times but have failed to find evidence of any abnormality which was not disclosed when the gallbladder was completely distended or on the 24-hour film following examination of the stomach after the barium meal (combined method). We have found that either the gallbladder fails to empty completely or there is sufficient reabsorption of the dye by the time this 24-hour film is made to exclude any abnormality which might otherwise be missed. The choice of method depends somewhat on the time available for the examination, and our aim is to make the examinations which will be of the greatest practical benefit to the patient per unit of available time. Of course, if several days spent in doing a cholecystographic examination alone proves to be a superior method with practical significance, present methods will be altered accordingly.

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A diagnosis of biliary disease can be made by cholecystographic examination alone, irrespective of the patient's symptoms, when it reveals the presence of gall stones, calcific deposits in the wall of the gallbladder, opaque bile in the gallbladder which is due to the presence of calcium carbonate[2] or of papillomas or other tumor[3,4,5] in the gallbladder. But, unless there is a history of definite biliary colic, care should be used in ascribing this evidence as the cause of the patient's presenting symptoms unless a complete examination has excluded abnormality in adjacent organs.

In the absence of unquestioned biliary colic, the expression "typical biliary symptoms" needs close analysis. It often refers to vague indigestion or distress in the epigastrium or in the right upper abdominal quadrant which is associated with belching and bloating and which comes on soon after eating. Although these symptoms are found in patients who have biliary disease, including those who also have biliary colic, the same symptoms may be produced by abnormalities in adjacent organs. In our experience, the most frequent cause for these indefinite symptoms is a *functional* disturbance in the colon, particularly in patients who have had constipation or diarrhea, or one alternating with the other for a long time, and in whom catharsis or irritating enemas may be the etiologic factor. When a complete examination excludes the possibility of organic disease, and this frequently includes examination of the stool and proctoscopic examinations, we ascribe the condition to "irritable colon," a term originated by the late B. W. Sippy. Our experience coincides with that of Palmer[6] who believes that this so-called "gallbladder dyspepsia" is in reality independent of the gallbladder, and that it is not unlike the dyspepsia which occurs in patients who are not afflicted with cholecystic or other forms of organic disease.

It is generally agreed that biliary disease is the most common *organic* cause of chronic gastro-intestinal symptoms in a middle-aged person. Routine autopsies both here and abroad [7,8,9] show that more than half of the adults past 30 years of age had abnormal gallbladders and that approximately one-fifth had gall stones. However, the relatively low previous clinical evidence of biliary disease in the latter group makes one question the advisability of prescribing surgery on cholecystographic evidence alone. Emphasis should be placed on the fact that operations on the biliary tract are now seldom advised unless there is positive clinical as well as cholecystographic evidence. Nichols[10] has emphasized repeatedly the fact that since the sympathetic nervous system, through the superior and inferior mesenteric ganglia, receives fibers not only from the gallbladder, but also from the stomach, duodenum, right kidney, ureter, and colon, pain or distress in the

right upper abdominal quadrant may be due to abnormalities in any one or several organs.

In the absence of a history of unquestioned biliary colic, the possibility that organic causes for the patient's symptoms may originate in the urinary tract should have more general recognition. Urinary calculi as a cause of gastro-intestinal symptoms, particularly nausea and vomiting as well as pain, is well known. Patients have been operated upon for appendicitis or even intestinal obstruction when the trouble was in the urinary tract. Normal findings in examinations of the urine do not exclude abnormalities in the urinary tract. In our cases of hypernephroma, the incidence of hematuria has not been greater than 50 per cent. Thirty-four per cent of our patients with hydronephrosis have had previous abdominal operations without relief from symptoms. Although hydronephrosis due to aberrant blood vessels apparently is a rare condition, it may simulate biliary disease, and almost invariably normal urinary findings are revealed at examination. In 19 per cent of a series of cases of kidney tumor, there was no history which was indicative of disease of the urinary tract. With the above facts in mind, the basis for our view that the diagnosis of disease of the gastro-intestinal tract is largely a matter of exclusion, is obvious.

Unless the cholescystographic examination gives definite evidence of biliary disease, as mentioned above, how may the findings of this examination alone be evaluated? A normally functioning gallbladder may be pathologic even though stones are not present. Kirklin[11,12] has found this to be true in from 10 to 12 per cent of the patients who have had operations. It would seem logical to believe that the routine use of the double-dose or fractional method of administering the dye would increase this error, while the use of the smallest possible adequate dose should decrease this error. We should not forget that pathologic gallbladders which are filled with gall stones, commonly function normally with cholecystographic dye. Hence, cholecystographic evidence of a normally functioning gallbladder does not exclude the possibility of a pathologic gallbladder. On the other hand, we believe that in the presence of a normally functioning gallbladder in which there is no evidence of calculi, convincing clinical evidence is required before surgical interference is warranted.

When the cholecystogram results in non-visualization of the gallbladder without evidence of opaque calculi, the diagnosis of biliary disease is not warranted unless there is a suggestive history and all other possible causes for the symptoms have been excluded by a complete examination. It is true that this finding often indicates a non-functioning gallbladder which contains non-opaque (cholesterin type) stones, in which the cystic duct is blocked. But the possibility of other causes of

non-visualization must receive due consideration, such as diseases of the liver or diseases in adjacent organs which may cause a reflex disturbance in the dye-concentrating ability of the gallbladder at least at the time the examination is made. The presence of hepatitis or other causes for diminished liver function is an obvious reason for non-visualization of the gallbladder by cholecystogram. Patients who have not had a roentgen examination of the stomach but who had "suggestive symptoms" plus non-visualization of the gallbladder by cholecystogram, have been found at operation to have a penetrating ulcer on the posterior wall of the duodenum. In our experience, the presence of an early non-obstructing carcinoma of the stomach often causes non-visualization of the gallbladder by cholecystogram, even though operation reveals no evidence of metastasis in the liver. We have had patients in whom the only disorder to which we could attribute non-visualization of the gallbladder was a functional disturbance of the colon which was mentioned above. When the latter condition was improved by the use of a bland, low-residue diet, general hygienic measures, such as rest, adequate sleep and exercise, and restoration of normal bowel function, a subsequent examination revealed normal cholecystographic findings. Hence, cholecystographic evidence of a normally functioning gallbladder does not exclude a pathologic gallbladder, nor does non-visualization always indicate a pathologic gallbladder. At the same time, when the cholecystograms reveal definite impairment of function of the gallbladder, the absence of symptoms does not preclude the existence of biliary disease, for the clinician realizes that "silent gall stones" are not mythical, and that often they are disclosed only by cholecystography.[18]

We believe the only solution of these many and often perplexing questions is the proper evaluation of the history of the patient's symptoms, plus a complete roentgen examination of all organs which may cause these symptoms. If the pain or distress is in the right upper abdominal quadrant but if it is not "typical" for biliary disease, we believe an investigation of the urinary tract should be the first special examination, before barium is administered, regardless of normal urinary findings. A stereo-roentgenographic study of the urinary tract is made, and from the roentgen standpoint, intravenous urograms or a retrograde pyelogram may be necessary for exclusion of disease in the urinary tract.

After the urinary tract is excluded as a cause for the patient's symptoms, roentgen examinations of the gallbladder, stomach, small intestine, and colon are made. Plain stereo-roentgenograms of the gallbladder always are made before the dye is administered. The single dose, oral method is used as a routine procedure, but in those patients

in whom the gallbladder is not visualized, a second dose is given the following evening even though the stomach and small intestine have been examined in the meantime. In those patients to whom dye is administered a second time, the barium enema is delayed the following morning until sufficient time for visualization of the gallbladder has elapsed. On a rare occasion, where the findings are still questionable, we advise a re-check cholecystogram after medical treatment has been administered for one month or longer.

The patient takes the dye immediately after a full-sized evening meal, from which only butter, cream, and other fats are omitted. Various forms and amounts of the dye, and various medications have been used with the dye, but in our hands, the plain dye taken in grape juice or other fruit juices has caused the patient the least discomfort and has given the most satisfactory results from the standpoint of absorption of the dye. The druggist places 5 grams of sodium tetraiodophenolphthalein in a colored bottle which holds one ounce, adds 1½ drachms of paregoric, fills the bottle with distilled water and shakes it just before handing to patient (the dye must be freshly prepared when given in this way). The patient empties the contents of the bottle into a glass containing 4 ounces of grape juice or other fruit juice, stirs thoroughly, and drinks it all quickly.

The following morning only black coffee or clear tea is permitted, and the first cholecystograms are taken at 9 o'clock. If the cholecystograms show normal visualization of the gallbladder, we routinely proceed at once to the roentgen examination of the stomach. If not, we take further cholecystograms at 11 o'clock and then start the stomach examination, regardless of the cholecystographic findings. The simultaneous visualization, both fluoroscopically and on films of the position and mobility of the gallbladder as related to the stomach and duodenum, has proved a valuable procedure of itself. When the cholecystograms as well as the stomach films are interpreted in conjunction with the fluoroscopic findings, if the evidence is not conclusive, further films are taken at 3 p. m. at the time of the retention studies. Using this method, this 21-hour film often shows our best visualization of the gallbladder. If it is thought advisable, a fat meal then is given and the patient is asked to return for further cholecystograms, but this is not done as a routine procedure. Usually after the retention studies, the patient is advised to eat as usual and to return the next morning for the 24-hour study (subsequent to the barium meal administration) and barium enema examination. As already mentioned, the 24-hour film or the film taken after the expulsion of the enema often shows sufficient dye in the gallbladder to reveal a gall stone or tumor which might have been obscured in the completely distended gallbladder.

Other attempts at the study of the partially emptied gallbladder without taking a separate day for cholecystography alone, have been made by giving cream with the barium meal used in the stomach examination. This results in visualization of a contracted gallbladder on the retention film, but, as mentioned above, the best visualization of the fully distended gallbladder at retention time when the cream is not used is sacrificed. For a time, we used 15 to 30 cc. of a mixture of egg yolk, lecithin, glycerine and alcohol, as recommended by Levyn[14] immediately after the gallbladder was visualized, which was followed by additional cholecystograms before examination of the stomach was begun. This procedure did not interfere with the efficiency of the latter examination, but the delay in the starting time occasionally resulted in interference with desirable retention studies of the stomach. We do not believe the use of these procedures increased the accuracy of the cholecystographic examination.

It is agreed by all that attention to details of technique is essential, and this has been emphasized repeatedly by Kirklin.[11] We have not required patients to take enemas routinely on the morning of the examination because the results were disappointing. When black coffee is taken in the morning, it seems to reduce the incidence of intestinal gas in the right upper quadrant, but if this still remains a troublesome feature, films are taken in different respiratory phases at later intervals, or a small anterior-posterior kidney film is taken. This changes the position of the gallbladder upward and outward and has been used by Nichols for years, particularly in the differentiation of gall stones from kidney stones when the appearance or location of the calcification is questionable. From a consideration of x-ray physics, it is realized that if the calcification is in or near the gallbladder it will be smaller and more distinct on the posterior-anterior gallbladder film, whereas if it is in or near the kidney it will be smaller and more distinct on the anterior-posterior kidney film.

Conclusions

1. In making a diagnosis of biliary disease, unless a patient gives a history of unquestionable biliary colic, the exclusion of abnormality in adjacent organs is equal to if not of more importance than the cholecystographic examination alone.

2. Although a diagnosis of biliary disease can be made from the cholecystographic data alone, regardless of the symptoms, care should be used in ascribing this evidence as the cause of the patient's presenting symptoms.

3. Non-visualization of the gallbladder by cholecystogram does not warrant the diagnosis of biliary disease unless the symptoms are

suggestive, and unless all other possible causes for the symptoms have been excluded by a complete examination.

4. A method of examination which has proved satisfactory during the past 10 years is described.

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