OPERATIVE CHOLANGIOGRAPHY*

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The argument about the value of operative cholangiography still remains unsettled. This communication is not an attempt to present a critical assessment of the value of cholangiography[1,2,3] but rather to describe some aspects of the method used by the authors which they believe greatly enhances the value of operative cholangiography.

There can be no doubt that operative cholangiography depends for its success on a high radiographic standard; and this paper describes a relatively simple apparatus which fulfils the requirements for successful operative cholangiography. The apparatus has the basic advantage of being inexpensive and it is well within the capacity of the hospital carpenter's shop to construct.

The desiderata of operative cholangiography may be grouped as: (1) surgical requirements and (2) radiographic requirements.

A. SURGICAL REQUIREMENTS

1. *Rapidity*

Any method which greatly prolongs the operation time must of necessity throw an added strain both on the operating team and the patient and is unlikely to be acceptable as a practical measure.

The use of a polythene catheter to canalize the cystic duct, the injection of water-soluble contrast medium, and the taking of the radiographs, have on an average occupied 7 minutes. In some cases the time has been greater and in others less. No surgeon would begrudge this additional time when the information that can be gained from this method is considered.

2. *Minimum Disturbance of Operating Field*

Any method which disturbs the routine performance of a surgical operation is unlikely to receive general acceptance. The removal of surgical towels etc. with the consequent risk of infection all add to the complexity of a surgical procedure and hamper the usefulness of the method. The apparatus used in this method has been so designed that no disturbance of the routine of cholecystectomy is necessary, no towels etc. have to be removed and, particularly, no disturbance of the surgical team is necessary.

As the dye is introduced *via* the cystic duct, no additional step is added to the operation because identification and isolation of the cystic duct and cystic artery forms one of the basic steps in a cholecystectomy. Whilst in some instances it has not been possible to catheterize the cystic duct because of its small size or because of obstruction from the spiral valve or stone formation within the duct, in the vast majority of cases cholangiography has been carried out *via* the cystic duct.

B. RADIOLOGICAL NECESSITIES

1. The films produced must be of high technical quality. For this reason a portable apparatus and an electrical supply capable of delivering at least 100 KV and 100 MA is essential. Undoubtedly, the disappointment of operative cholangiography as compared with post-operative cholangiography has been the quality of the films. It has been our practice to use a portable apparatus capable of delivering an output of 125 KV and 300 MA so as to obtain satisfactory films. The routine use of a stationary grid (Lysholm) has also immeasurably improved the quality of the films.

2. The portable X-ray unit must have an arm and tube and column of sufficient length so that it can be manipulated into position from the head end of the table without disturbing the surgeon or his assistants.

3. The means of injection of the cystic duct must be such that the surgeon and his team can be well outside the area of radiation and can thus obtain full protection from radiation effects. As any length of polythene tube can be used, it is reasonably easy to make the polythene tube of sufficient length to allow the surgeon to stand outside the radiation beam.

4. *Multiple Films.* A disadvantage of most methods of

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operative cholangiography is the limitation of the number of films obtained.[3] It is a cardinal rule that pathological defects or artefacts can be fairly readily resolved from one another if serial views are available. By the method described, at least 4 films showing various stages of filling of the common duct are obtained, thus enabling artefacts to be readily recognized.

5. *Contrast Medium.* The contrast medium employed must be of the water-soluble variety and one which is not harmful to the patient if extravasation or intravenous spill should occur.

6. *Artefacts.* Undoubtedly, one of the disadvantages of operative cholangiography has been the difficulty of differentiating gas bubbles from retained stones and, although the multiple films used in this method have to a large extent overcome these difficulties, nevertheless, it is obligatory that every effort should be made to prevent the introduction of such bubbles into the ducts. In this method the polythene catheter is fitted with a tap and gasket of the type described by Sven Seldinger,[4] which enables the system to be filled with sterile water, the tap to be closed and the system to remain filled until ready for use. Immediately before insertion of the catheter the tap is partly opened so that a constant drip of sterile water prevents the formation of an air bubble within the catheter during the manipulation necessary to insert the catheter into the cystic duct.

7. *Centering.* By centering slightly to the left of the spine and slightly angling the incident ray by 5° the common duct can be thrown clear of the lumbar spine. The rotation of the patient to the oblique position as advocated by some authors[3] unnecessarily complicates the procedure.

APPARATUS AND METHODS

The apparatus consists of a wooden cassette tunnel (6×2 feet) exactly the same size as the operating table (Fig. 2). The upper surface of the tunnel is made of lead plywood with the exception of a perspex window in the lead ply. The cassette tunnel does not extend the whole width of the apparatus but only a central tunnel 12 inches in width, slightly eccentrically placed within the apparatus, remains. This tunnel and the perspex window are so decentered in the apparatus that it lies to the right of the midline. (Figs. 1 and 2).

A linen runner is arranged with six pockets, each 12 inches long, so that 12×10 inch cassettes can be accommodated within the runner. Four 12×10 inch cassettes are loaded within the runner so that the first cassette lies in position under the perspex window. The first two pockets in the linen runner are filled with dummy cassettes. The whole apparatus is placed on the operating table and the patient placed in position on top of this apparatus.

The portable X-ray machine is arranged near the head of the table so that the tube arm can be swung into position when required without disturbing any of the surgical team except the anaesthetist, who has to move slightly to the right whilst the linen runner and films are withdrawn from the head end of the table.

Dye is introduced into the biliary system via a polythene catheter, of which the point is coned down in the manner

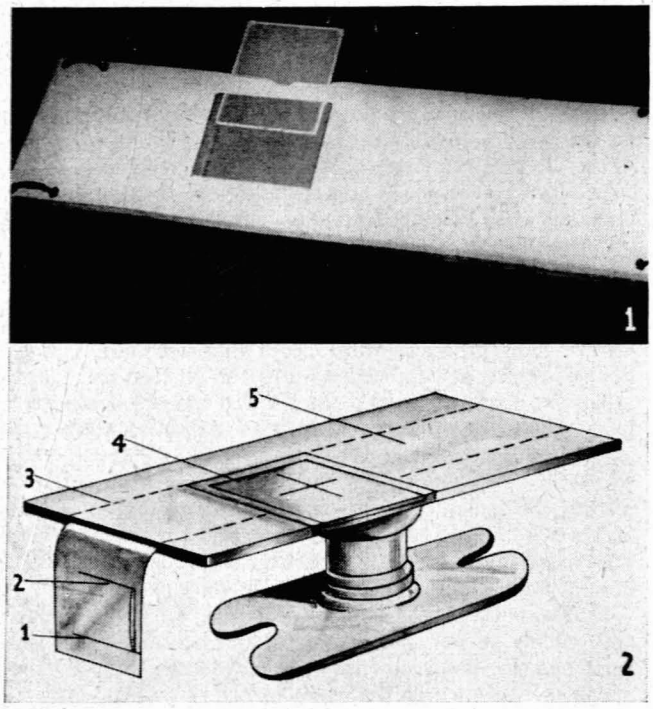

Fig. 1. Cassette tunnel, showing the Lysholm grid partly inserted beneath the perspex window.

Fig. 2. Showing the cassette tunnel in place on the operating table. (1) Linen runner with pockets. (2) Pocket with dummy cassette. (3) Lead-covered upper surface of tunnel; the dotted lines indicate the free portion of the tunnel. (4) Perspex window 12×10 inches with fixed grid beneath the perspex. (5) The lead-covered portion which houses the three unexposed 12×10 inch cassettes.

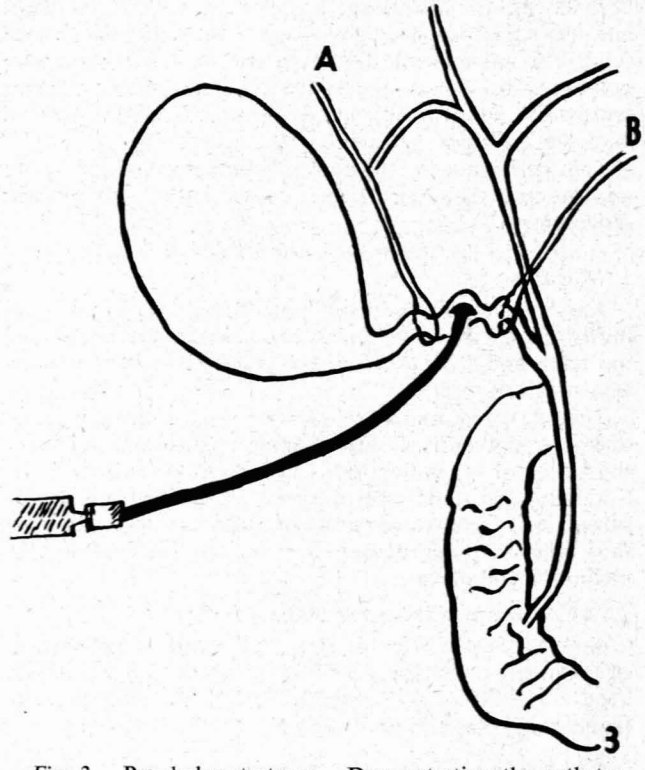

Fig. 3. Pre-cholecystectomy. Demonstrating the catheter in the cystic duct with the two ligatures (A and B) in place.

described by Seldinger,[4] and the distal end is flanged and connected to a gasket (Fig. 4). The polythene tube is filled with sterile water and the tap closed; no fluid will leak from the catheter and it is placed on the instrument tray until required.

The cystic duct is exposed during the routine performance of a cholecystectomy and two thread ligatures are placed around it, the distal one being tied and held and the proximal one allowed loose (Figs. 3 and 5). An incision is made in the cystic duct and the polythene catheter is introduced after the gasket has been connected to a syringe containing 10 ml. of water-soluble contrast medium (Endografin).

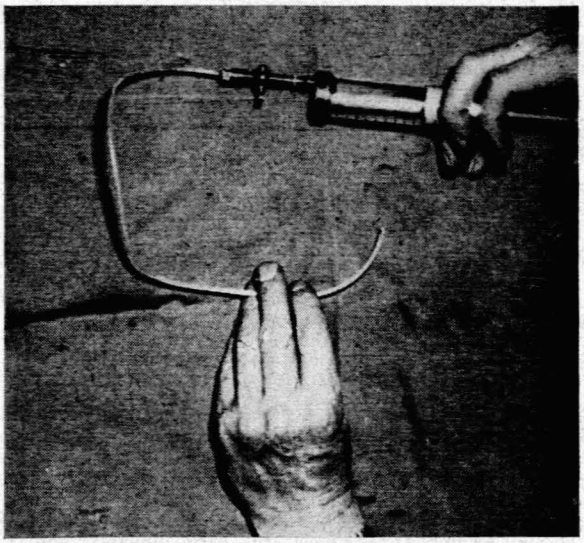

Fig. 4. Showing the polythene catheter affixed to the gasket and tap and the syringe containing contrast medium.

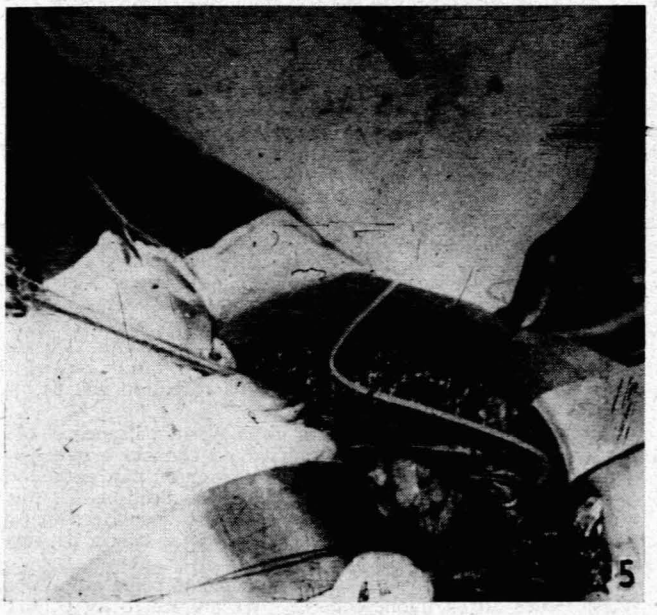

Fig. 5. Demonstrating the catheter entering the cystic duct; the proximal ligature around the cystic duct is seen in the lower left-hand corner. The forceps fixed to the gall-bladder are seen on the left of the illustration.

The proximal ligature on the cystic duct is now tied around the catheter and the dye injected. A technical point during the insertion of the polythene catheter is to partly open the tap, which allows the contained sterile water to slowly

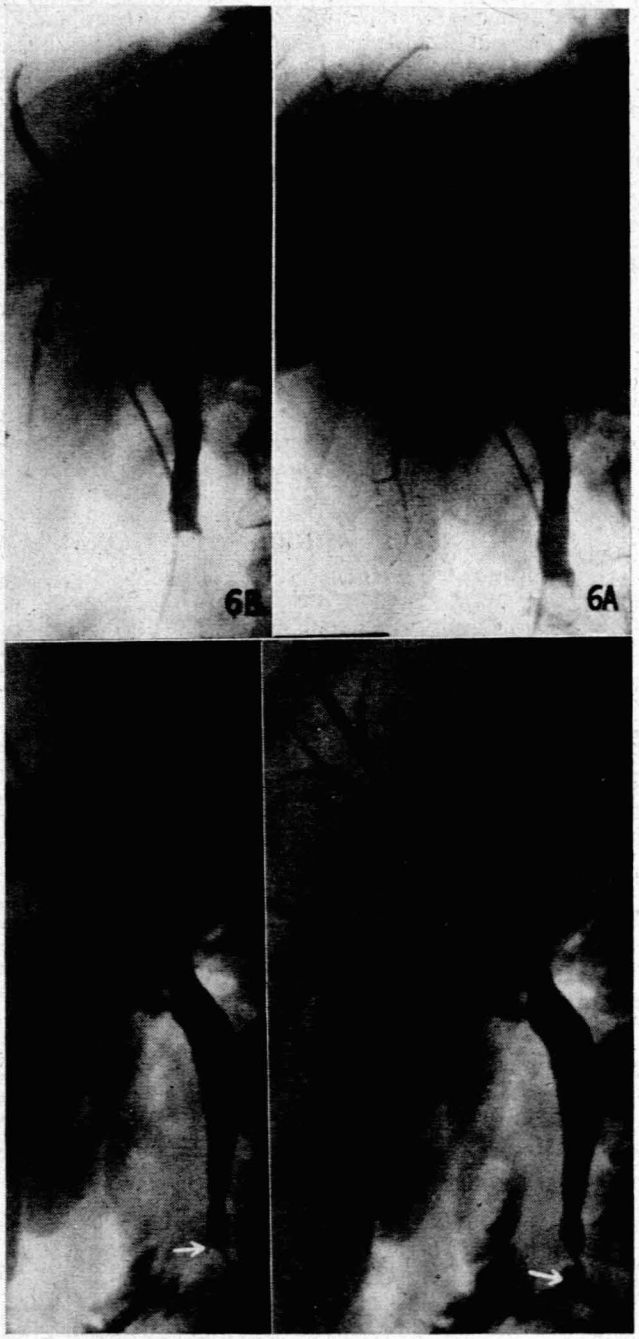

Fig. 6 (A and B). Serial films obtained by this method demonstrating a filling defect present at the lower end of the common bile-duct and indicating a stone lodged at the lower end of the duct.

Fig. 7 (A and B). Films indicating the value of serial films. A negative shadow in the lower end of the duct (7A) is seen in the subsequent films (7B) to be a gas bubble lying in the duodenum.

drop out, thus preventing any bubbles from entering the system. Films are then taken after 5 ml., 7·5 ml. and 10 ml. have been injected and serial films of the differential filling of the ducts are obtained. The catheter is then withdrawn and the cholecystectomy proceeds; the films are developed and are available for inspection immediately (Figs. 6 and 7). When the gall-bladder has been removed and the cystic duct is not available, the bile-ducts are filled by inserting directly into the common duct a needle connected *via* a polythene catheter to the syringe. The insertion of the flexible tube between the penetrating needle and the syringe enables the surgeon's hands to be well outside the range of radiation and also greatly minimizes the risks of the spill of dye which so frequently occurs from a fixed needle and syringe.

No claim for originality is made for the method of using a polythene catheter to inject dye into the cystic duct, but we believe that the method of keeping a system free of air bubbles and the method of obtaining serial films of the filled duct are original in operative cholangiography.

Difficulties have been encountered in the canalization of the cystic duct, and the spiral valve frequently causes unexpected difficulties in inserting the catheter. Nevertheless, in a vast majority of cases a satisfactory canalization can be obtained.

SUMMARY

1. A simple apparatus for the performance of operative cholangiography is described.

2. The apparatus is easy to make, is inexpensive, and allows the taking of serial films of the various phases of filling of the bile-ducts.

3. The apparatus is so designed that no interference with the accepted technique of cholecystectomy occurs.

4. The safeguards from radiation hazards and the production of artefacts on the radiographs are considered.

5. The essential radiographic criteria for the adequate performance of operative cholangiography are discussed and the manner by which they can be obtained is indicated.

6. On an average the performance of a complete cholangiogram by this method adds 5 minutes to the operating time.

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