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LaparoLith

A new instrument for stone fragmentation in laparoscopic cholecystectomy

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Summary. Laparoscopic cholecystectomy can be performed with incisions of a maximum diameter of 10 mm. The removal of a stone-filled gallbladder at the end of an operation via the 10-mm port needs often-extensive tissue-consuming manipulations for stone removal or minilaparotomy. Stone fragmentation can be achieved by mechanical crushing and by ultrasound-, electrohydraulic-, and tunable dye laser lithotripsy. The clinical employment of the LaparoLith (Baxter Healthcare Corporation), an instrument which allows mechanical fragmentation of stones inside the gallbladder, is presented here. We have used the LaparoLith in nine patients and have been successful in stone fragmentation in seven of these. The LaparoLith seems to be helpful in laparoscopic cholecystectomy, preventing extension of the subnavel incision.

Key words: Laparoscopic cholecystectomy – Gallbladder removal – Mechanical lithotriptor

We present here the first clinical trial of a new device for mechanical intraoperative stone fragmentation in laparoscopic cholecystectomy. The need for this technique arises if the stone size does not allow the removal of the gallbladder without extension of the subnavel incision [1–4].

Materials and methods

We used the LaparoLith intraoperative lithotriptor system from Baxter Healthcare Corporation/USA in laparoscopic cholecystectomy.

The LaparoLith is designed for debulking gallstones to facilitate gallbladder removal. The system consists of a motor control, an autoclavable motor handpiece and sheath and a disposable drive shaft with a rotating impeller at its tip, rotating with up to 80,000 rpm (Fig. 1a–c).

When the gallbladder has been detached from its ductal, vascular, and hepatic attachments and the neck of the dissected gallbladder has been pulled through the laparoscopic incision and exposed on the anterior abdominal wall, a small incision is made in the neck of the gallbladder and the gallbladder is decompressed by aspirating the bile using a combined rinsing-aspiration instrument. If gentle traction on the gallbladder does not deliver the gallbladder through the laparoscopic incision, the disposable introducer is inserted and carefully advanced into the lumen while maintaining direct visualization of the gallbladder via the laparoscope. The drive shaft is introduced into the gallbladder until it locks in place, thus deploying the protective cage inside the gallbladder lumen. After rinsing and aspiration of saline into the gallbladder to remove all the air and complete filling with saline, the correct positioning of the cage above the gallstones is checked by direct vision laparoscopically. The device has to be kept stationary above the stones and is activated for 10–15 s several times (Fig. 2). Stones are moved into the impeller by water circulation induced by activating (Fig. 3), until complete stone fragmentation is achieved, which is detected acoustically and by touch. The vibration caused by stone crushing, which is heard and felt at the motor handpiece, will become smooth and steady. When fragmentation is completed, the debris is aspirated from the gallbladder using a syringe (Fig. 4). Afterward the instrument is retracted, and the gallbladder is pulled out through the laparoscopic incision.

Results

We used the LaparoLith in nine patients and have been successful in fragmentation of stones with up to 30-mm diameter in seven cases (Table 1). In two cases the procedure was unsuccessful. In one case the protective cage didn't open and no second cage was available; the LaparoLith use was stopped then. In the second case a leak in the gallbladder became visible after filling the gallbladder with saline. Consequently the procedure was stopped at that point as complete filling is necessary for fragmentation. In one additional patient two devices had to be used as the protective cage of the first device did not open. In one case two minor stones could not be fragmented as they were hidden in a small gallbladder diverticulum, but the other stones were

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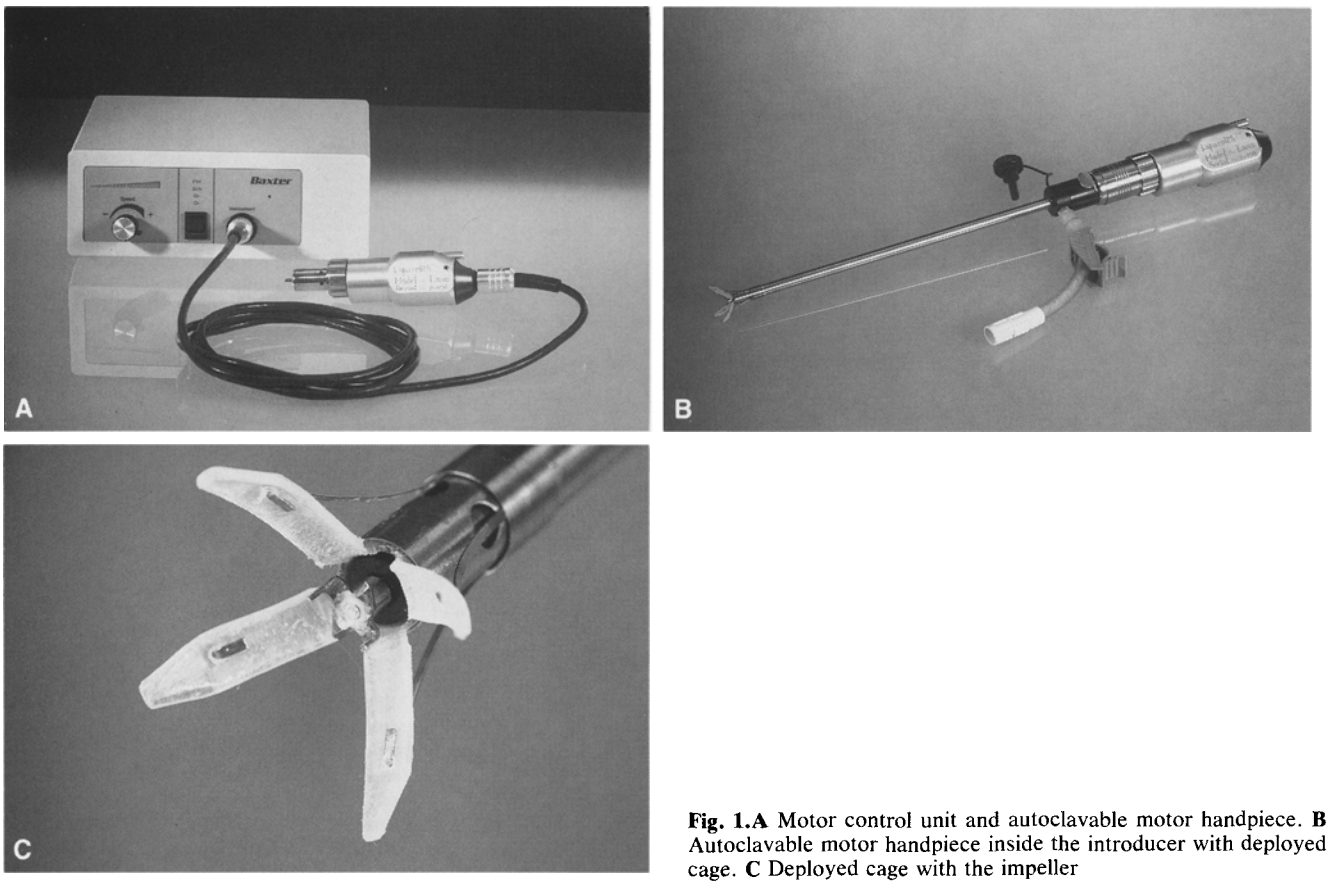

Fig. 1.A Motor control unit and autoclavable motor handpiece. **B** Autoclavable motor handpiece inside the introducer with deployed cage. **C** Deployed cage with the impeller

fragmented, thus allowing the removal of the gallbladder through the subnaval incision. In one patient, in order to achieve stone contact, the LaparoLith was not kept stationary inside the gallbladder. Because of this movement the gallbladder wall was caught by the blade and a 4-mm hole was cut into the gallbladder. After removal of the gallbladder no remaining stone fragments could be detected. The postoperative course of the patient was without complication.

The whole LaparoLith procedure took 15 min (4–25 min); the running time was 86 s (18–521 s).

Discussion

Gallbladder removal in laparoscopic cholecystectomy can be difficult because of the stone size. The conventional procedures dealing with this problem are extension of the subnaval incision or removal of the stones by means of grasping forceps. The LaparoLith intraoperative mechanical lithotriptor system is a modification of the RotoLith (Baxter Healthcare Corporation) mechanism used for laparoscopic cholecystectomy.

With improvement in technique and handling the

Table 1. Results of intraoperative LaparoLith use

Patient (No.)	Largest stone size (mm)	Fragmentation success	Complication
1	10	Yes	None
2	15	Yes	None
3	25	Yes	Two devices used, protective cage of the first did not open
4	15	No	Protective cage did not open
5	15	No	Leak in the gallbladder became visible after filling
6	25	Yes	None
7	15	Partially	Two stones remained in a gallbladder diverticulum
8	20	Yes	None
9	30	Yes	Hole in the gallbladder was made by movements

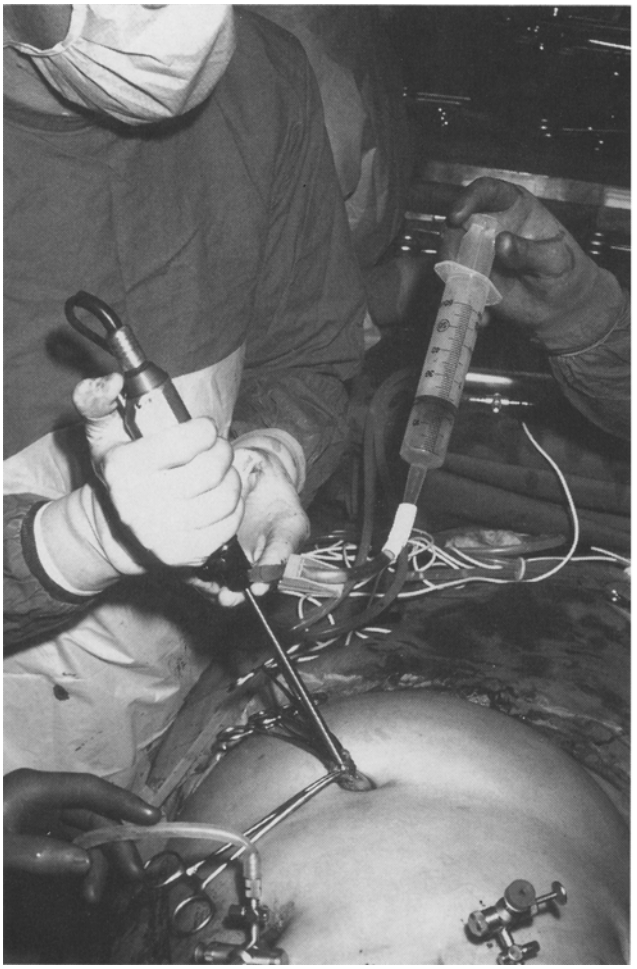

Fig. 2. Running the LaparoLith in laparoscopic cholecystectomy

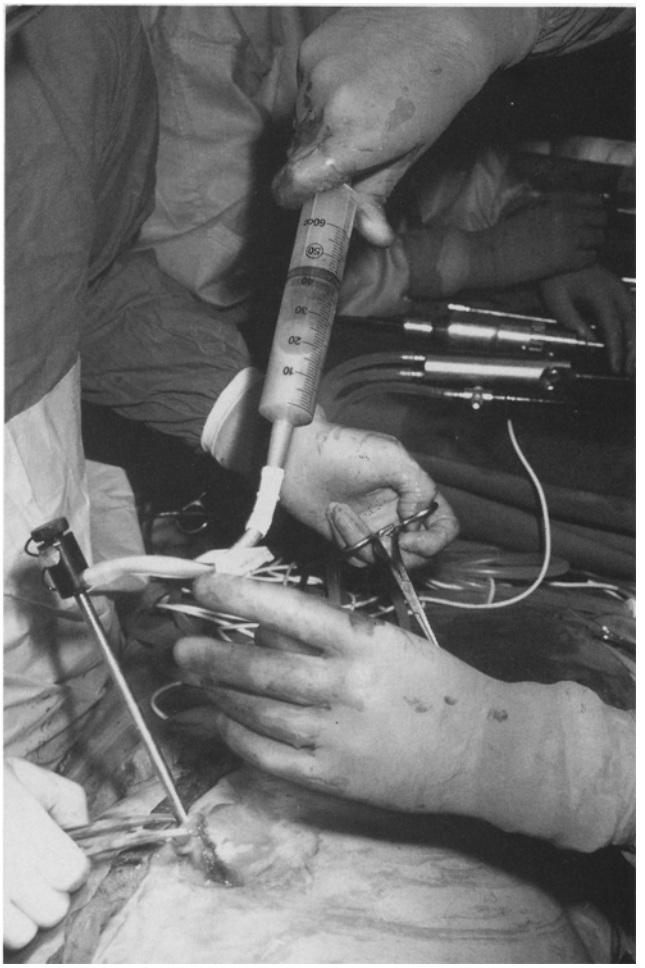

Fig. 4. Aspirating the debris after stone fragmentation

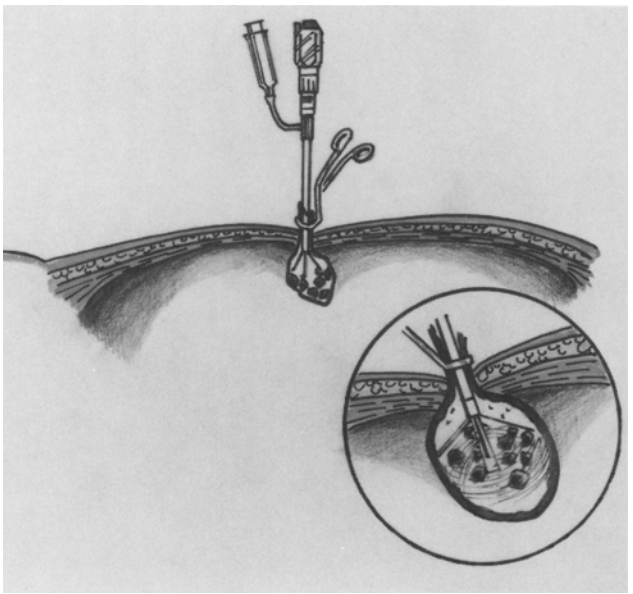

Fig. 3. Showing the LaparoLith working inside the abdomen

LaparoLith procedure could become faster. The use of LaparoLith is an elegant method that allows the laparoscopic cholecystectomy to be as minimally invasive as possible, preventing extension of the subnavel incison.

The surgeon who uses the LaparoLith should first train in the handling of it with a model in order to reduce the theoretical risks. The conditions for safe use are constant water filling of the gallbladder, stable pneumoperitoneum and constant laparoscopic control of the procedure. The effect is limited in stones that are relatively big compared to the size of the gallstones. These stones might not move due to circulation. No effect is possible in the moment, if a stone fills out the complete lumen of the gallbladder. Large stones can also pose problems during the use of grasping forceps, as the extension of the subnaval incision.

In the meantime the LaparoBag (Baxter) has been developed, which is a plastic bag that can be placed into the abdomen laparoscopically and that enables one to keep the dissected gallbladder inside. This makes the use of the LaparoLith in the case of a hole in the gallbladder wall or of big stones that are adhesive to

the gallbladder wall possible by means of the following procedure: The dissected gallbladder is put in the LaparoBag, the fundus of the gallbladder is opened, and a Roeder loop is knotted to the cystic stump. The empty gallbladder is pulled out and the stones inside the LaparoBag are fragmented by the normal LaparoLith procedure.

A final statement of the advantages of the LaparoLith will require more experience in using it and should take into account the system of LaparoLith and LaparoBag.

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