Inversion of the normal appendix during the course of abdominal surgery: 

A procedure not to be forgotten

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ABSTRACT

Objective: A retrospective study, assessing the safety and feasibility of inverting the normal appendix during the course of abdominal surgery.

Methods: Between early 1989 and early 1999 and during the course of open abdominal surgery 108 patients underwent total inversion of their normal looking appendix (74 cholecystectomies, 19 peptic ulcer operations, 12 splenectomies, 2 external hernias, one hydatid liver disease) and recently 2 laparoscopic inversions of the appendix were performed during the course of laparoscopic cholecystectomy.

Results: Inversion was easy and added 5-10 minutes to the operation time during open surgery cases. Early in the series there were three conversions to formal appendectomy because of fibrosis of the appendix in patients over 40 years of age, which led us to restrict inversion to patients under 40 years and with no fibrosis. There were 2 wound infections in cholecystectomy patients (2/74=2.7%) and 1 wound infection in peptic ulcer patients (1/19=5.3%). During the same period 306 patients underwent open cholecystectomy without appendicular inversion and of these 9 developed wound infection (9/306=2.9%). In 20 patients who underwent peptic ulcer surgery without appendicular inversion there was one case of wound infection (1/20=5%). Following the introduction of laparoscopic cholecystectomy in September 1995 2 patients underwent laparoscopic inversion of the appendix during laparoscopic cholecystectomy without any postoperative complications.

Conclusion: Total inversion of the appendix during the course of open abdominal surgery is a safe and useful adjuvant, obviates the risk of opening the intestine of formal appendectomy and eliminates the risk of future appendicitis which is significant especially in splenectomised patients. Laparoscopic inversion may have a place, but it needs further evaluation.

Keywords: Appendix, inversion, abdominal surgery, laparoscopy.


Inversion of the normal appendix (INA) is a technique, which ablates the appendix without the cutting of formal appendectomy (FA), thus avoiding the risk of contamination of the peritoneal cavity and of the wound. It is an old practice that has been performed by gynaecologists and obstetricians as early as 1895, followed later by general and pediatric surgeons.1-4

Despite being an old practice many are not using it and perform FA instead.5 Clearly the idea behind ablating the appendix by either method is to save the patient from developing acute appendicitis in the future. We present our experience with this technique together with review of the literature. We also report the first two cases that underwent laparoscopic inversion of the appendix during laparoscopic cholecystectomy (LC)

Methods. Between January 1989 and January 1999 and during the course of open abdominal surgery, 108 patients underwent INA, a further two

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female patients aged 27 and 32 years underwent INA laparoscopically during the course of LC.

Open inversion technique: The basic technique is the same as it was described elsewhere. After ensuring that the appendix is easily accessible through the surgical wound and that it has no apparent fibrosis, the mesoappendix with the appendicular artery within it, is divided and tied with 3/0 Vicryl (Ethicon, Edinburgh, UK). The appendix is milked from any fecolith. The fat is peeled off the appendix, and any small bleeding spots are gently cauterized. The base is then squeezed gently with an artery forceps to promote destruction at the base. The tip is slowly and gently inverted into the lumen using a probe or a straight mosquito forceps to the inside of the cecum. Once the whole appendix is inverted, a purse string suture with 2/0 Vicryl (Ethicon, Edinburgh, UK) is then applied as in FA.

In the first 15 cases we performed INA regardless of the age, during which three patients over 40 years of age who had fibrotic appendices needed conversion to FA. Barium enema (Figure 1) was needed in one of these patients who was complaining of tenesmus and mucus discharge which revealed a small polyp representing the inverted appendix together with an amebic inflammatory area in the sigmoid colon which cleared with Metronidazole. We then limited our inversion to patients under 40 years of age, without fibrosis in the appendix and modified our technique by applying light diathermy to the serosa of the base of the appendix after being inverted then applying purse string suture proximal to it.

Technique of laparoscopic inversion: This procedure was carried out in two female patients who were of normal weight, with a mobile cecum and non-fibrotic appendix. The gall bladder is removed from the epigastric port site using Reddick and Olsen technique, but with diathermy instead of laser for dissection. The epigastric 10-mm trocar is then reintroduced to prevent leakage of gas from the abdomen. The right iliac fossa port is dilated to accommodate a 20 mm trocar and through it the appendix is grasped with non-traumatic forceps and brought out through the trocar after deflecting the abdomen. The trocar is removed leaving the appendix with part of the cecum and the mesoappendix outside the wound. Inversion is carried out as described in the open technique and pushed back into the abdomen, which is inflated again and the cecum is inspected through the laparoscope. Closure of the ports is carried out using O PDS (Ethicon, Edinburgh, UK) to all the ports except the 5 mm port in the mid-clavicular line. The skin is closed with mono-filament non-absorbable suture.

From early 1989 till late 1995, 306 patients underwent open cholecystectomy without inversion of the appendix, then LC was introduced and performed for the majority of cholecystectomies. A further 20 patients underwent peptic ulcer surgery without inversion. All patients who underwent splenectomy had inversion of the appendix.

**Results.** For open surgery the procedure was easy especially in the younger age group where there was no fibrosis. (Table 1). It added 5-10 minutes to

**Table 1 - Details of 108 patients who underwent inversion of their normal appendix.**

<table>
<thead>
<tr>
<th>Operation</th>
<th>M</th>
<th>F</th>
<th>Age Range</th>
<th>Median</th>
<th>Incision of surgery</th>
<th>Wound infection No.</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peptic ulcer: HSV=9 patients</td>
<td>14</td>
<td>5</td>
<td>14-49</td>
<td>27</td>
<td>Midline</td>
<td>1</td>
<td>drainage of pus</td>
</tr>
<tr>
<td>Patients V+P=10 patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholecystectomy</td>
<td>4</td>
<td>70</td>
<td>18-50</td>
<td>31</td>
<td>Kocher</td>
<td>2</td>
<td>1 drainage of pus 1 antibiotics</td>
</tr>
<tr>
<td>Splenectomy: Thalasemia Trauma</td>
<td>4</td>
<td>3</td>
<td>4.6/12-2</td>
<td>5.6/12</td>
<td>UT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Private bilical hernia</td>
<td>0</td>
<td>1</td>
<td>21</td>
<td></td>
<td>Transverse</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Femoral hernia</td>
<td>0</td>
<td>1</td>
<td>32</td>
<td></td>
<td>Groin</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hydatid liver disease</td>
<td>0</td>
<td>1</td>
<td>21</td>
<td></td>
<td>Midline</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

M=Male, F=Female, HSV=Highly Selective Vagotomy, V&P=Vagotomy & Pyloroplasty, No.=Number, Age in years, UT=Upper Transverse.

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the operation time and was carried out at the end of surgery. In the two laparoscopic cases it added 35-40 minutes to the operation time.

In the cholecystectomy group with inversion, two patients developed wound infection (2/74=2.7%), one of which followed surgery for acute empyema and needed drainage of pus, while the other one had cellulitis which settled with antibiotics. In the patients with peptic ulcer surgery that underwent inversion there was one instance of wound infection (1/19=5.3%) at the umbilical end (which was dirty prior to surgery) and needed drainage for a small umbilical abscess. There were no infective complications in the splenectomy group.

In the cholecystectomy patients without inversion, nine patients developed wound infection (9/306=2.9%), three of which had cellulitis which settled with antibiotics, while the other six needed drainage of pus, three of these six patients presented with acute empyema. In the patients who had peptic ulcer surgery without inversion one patient developed stitch abscess that cleared once the stitch was removed (1/20=5%).

Outpatient follow-up was carried out routinely at 2 weeks, 6 weeks, 12 weeks and one year postoperatively. The patient was then advised to report to us when needed. Because our hospital is the main referral center for our area, we feel that if any patient should develop any abdominal problems, it is reasonable to assume that the patient would be referred to us and so far none of our patients have been admitted with any related problems such as intestinal obstruction, rectal bleeding or intussusception.

**Discussion.** Our study has demonstrated that INA is feasible during open abdominal surgery, without adding to the morbidity or mortality. The feasibility and safety of laparoscopic inversion could not be evaluated because of the small numbers studied. INA is an old method, which has been known since 1895, when professor Edebohls of gynecology and obstetrics recommended it in acute appendicitis and in normal appendectomy during abdominal operations, because it is less dangerous than FA. The basic technique which we described before in the first 15 patients, had few modifications based on the idea that the appendicular artery supplies around 70-80% of the appendix and that blood vessels from the cecal wall supply the rest. Thus, part of the appendix may be left protruding inside the lumen of the cecum as a polyp when using the basic technique alone. The modification we followed was applying light diathermy to the seromuscular layer at the base of the appendix as we mentioned before.

If the appendix was found to be fibrotic, inversion may be started from the base or as in our patients FA may be carried out. Within 8-12 days after inversion the appendix sloughs. This was confirmed by previous studies which used radio-opaque markers inside the pouch of the inverted appendix, by barium enema or by colonoscopy. Depending on the technique involved in disrupting the blood supply of the appendix, sloughing is either complete or a small polyp is left protruding inside the cecum.

The advantage of INA over FA during the course of different abdominal operations is to avoid breaching the mucosa, which carries a higher risk of infective complications.

Furthermore, FA even for a normal appendix has a wound infection rate of 1.8%. Although rare, there are reports of complications related to the stump in FA as abscess, breakdown, stump appendicitis and fistula, which were not reported with INA. Ablating the appendix by either method avoids future surgery for acute appendicitis, which affects over 7% of the population, with the highest incidence in the age group from 10-30 years.

When INA was introduced it was carried out in all types of abdominal and pelvic surgery of all age groups. In the last twenty years however, we reviewed the literature through the Medline and Index Medicus and could find only three studies reporting INA alone. A further study from the national Wilms' tumor study groups in USA on 1910 children who underwent nephrectomy for Wilms' tumor, INA was performed upon 188 children and FA in 267 patients. During the same period however, more studies reported FA in abdominal surgery of all age groups. Recently laparoscopic appendectomy was performed during laparoscopic abdominal surgery. We wonder, if the wider practice of FA over INA is due to the unawareness of the procedure of INA and from our observation we agree with this. The rate of wound infection in the patients who underwent open cholecystectomy and INA in our series was within the normal range of that in the reported literature in the patients who
underwent open cholecystectomy alone which may be as high as 10%. Our series of patients who had peptic ulcer surgery was small (39 patients), thus no conclusions could be drawn. Nowadays we are not performing as many INA as before because LC is replacing open cholecystectomy and peptic ulcer surgery is becoming uncommon. Splectomy, however, is still needed for trauma and other condition such as thalassemia, which is common in our area. Post splenectomy sepsis is a serious problem, especially when it is well established. It is more common in children, with the highest incidence in thalassemia and lowest in the trauma patients. Thus, eliminating a potential source of sepsis is justified in these patients.

In one study, 221 thalasemic patients underwent splenectomy, out of which 150 patients underwent FA. In follow up there was one fatality due to diffuse peritonitis from a perforated appendix in a patient where the appendix was not removed. We had a similar mortality from peritonitis due to perforated appendix in a 15-year-old boy who previously underwent splenectomy elsewhere. Could these fatalities have been avoided if inversion or FA had been carried out during splenectomy?

Drawbacks of ablating the appendix were reported. Intussusception following INA was reported in children, but primary intussusception of the intact appendix is a well-recognized condition in all age groups and intussusception of the appendicular stump following FA has been reported. Intussusception following INA should be extremely unlikely if there is complete infarction of the appendix. Although rare, but hemorrhage following INA has been reported. Hemorrhage, however, following FA may even be more commonly reported.

A small polyp may be left following INA and could be mistaken for an intrarectal tumor. This may also occur following FA. Even in a normal person the appearance of the projecting ileocecal valve into the lumen of the cecum may simulate an intrarectal tumor. It is important therefore to inform the patient, his relatives and the family doctor of the procedure. Recently the appendix has been used as a conduit for urinary diversion in urinary incontinence or following cystectomy, and for fecal diversion in fecal incontinence. These are rare indications and taking into consideration the availability of other alternatives that have been suggested such as the cecum, ileum, ureter, urethra, skin tube or fallopian tube, we feel that it does not merit preserving the appendix. Interestingly, recent reports suggested that appendectomy might be protective against developing ulcerative colitis.

In conclusion we feel that INA is a safe and useful procedure that can replace FA if the surgeon is in favor of ablating the appendix during open abdominal surgery, especially in splenectomy patients. In the era of laparoscopic surgery it may have a place, but needs further evaluation.

References