Systematic review of clinical outcomes after prophylactic surgery

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ABSTRACT

INTRODUCTION Prophylactic appendicectomy is performed prior to military, polar and space expeditions to prevent acute appendicitis in the field. However, the risk–benefit ratio of prophylactic surgery is controversial. This study aimed to systematically review the evidence for prophylactic appendicectomy. It is supplemented by a clinical example of prophylactic surgery resulting in life-threatening complications.

METHODS A systematic review was performed using MEDLINE® and the Cochrane Central Register of Controlled Trials. Keyword variants of 'prophylaxis' and 'appendicectomy' were combined to identify potential papers for inclusion. Papers related to prophylactic appendicectomy risks and benefits were reviewed.

RESULTS Overall, 511 papers were identified, with 37 papers satisfying the inclusion criteria. Nine reported outcomes after incidental appendicectomy during concurrent surgical procedures. No papers focused explicitly on prophylactic appendicectomy in asymptomatic patients. The clinical example outlined acute obstruction secondary to adhesions from a prophylactic appendicectomy. Complications after elective appendicectomy versus the natural history of acute appendicitis in scenarios such as polar expeditions or covert operations suggest prophylactic appendicectomy may be appropriate prior to extreme situations. Nevertheless, the long-term risk of adhesion related complications render prophylactic appendicectomy feasible only when the short-term risk of acute appendicitis outweighs the long-term risks of surgery.

CONCLUSIONS Prophylactic appendicectomy is rarely performed and not without risk. This is the first documented evidence of long-term complications following prophylactic appendicectomy. Surgery should be considered on an individual basis by balancing the risks of acute appendicitis in the field with the potential consequences of an otherwise unnecessary surgical procedure in a healthy patient.

KEYWORDS

Prophylactic – Appendicectomy – Appendicitis – Complications

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Prophylactic appendicectomy is considered by government organisations for personnel embarking on military, polar and space expeditions.¹ Australian National Antarctic Research Expeditions have reported one mortality and a 40% complication rate after a diagnosis of acute appendicitis during field expeditions.² As a result, all expedition physicians undergo prophylactic appendicectomy prior to winter expeditions.¹ However, prophylactic practice remains controversial with many other Antarctic programmes, including that of the US, where prophylactic appendicectomy is not a mandatory prerequisite.

Prophylactic surgery remains a topic of high media interest following widely circulated reports of prophylactic mastectomy in genetically high risk individuals for breast cancer.³ The rationale for prophylactic surgery is balanced on a risk–benefit ratio. While a strong case has been made for prophylactic surgery in breast cancer for specific genetic predispositions, evidence for and against prophylactic appendicectomy is less well described.

Acute appendicitis is a clinical emergency with a global incidence of up to one in seven individuals.^{4,5} Surgical removal in uncomplicated acute appendicitis is the gold standard management with low complication rates.⁶ Many high impact studies support non-operative conservative measures through inpatient monitoring.^{7,8} Nevertheless, for individuals embarking on polar expeditions or space travel, where both surgical removal or inpatient conservative management are logistically impossible (and developing appendicitis would be catastrophic for both person and mission), an argument for prophylactic surgery can be made.

Performing incidental appendicectomies (defined as the surgical removal of a normal appendix during an operation primarily for a different condition) is well documented.^{9–14} However, the practice of elective prophylactic appendicectomy (defined as the surgical removal of a normal appendix in the absence of other procedures) is controversial. This paper examines the risks and benefits of prophylactic

surgery, and presents a case example where prophylactic appendicectomy was performed that resulted in fatal adhesion related long-term complications but without short-term compromise in the field.

Methods

MEDLINE® and the Cochrane Central Register of Controlled Trials were searched using keywords for prophylaxis (prophyla\$) and appendicectomy (appendicitis or appendix or append*ectomy), which were combined using the AND function. In an attempt to maximise the quality of this systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed.¹⁵

Prospective and retrospective studies reporting clinical outcomes in prophylactic appendicectomy were included. Studies were required to include prophylactic appendicectomies performed on fit and well patients or incidental appendicectomies performed during surgery for a different surgical pathology.

References from retrieved papers were searched manually for relevant studies. Studies were included if they were human English language studies from January 1950 to March 2015. Titles of papers were initially screened, followed by abstracts, with full text obtained for relevant papers. Duplicates were removed. Papers were excluded where non-primary data were reported or if the data series presented was reported concurrently in a separate paper. Abstracts and full texts were analysed independently by two authors. Data recorded included study design, whether appendicectomies were prophylactic or incidental, the number of patients, and both long and short-term clinical outcomes.

Results

Overall, 511 abstracts were identified from the search strategy. After applying inclusion/exclusion criteria, 37 full papers were retrieved and analysed, with 9 studies included in our review (Fig 1). There were more than 50 patients in all included studies. All of the papers included investigated

Figure 1 Flow chart of paper identification and inclusion in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines

outcomes following incidental appendicectomies, performed during cholecystectomy ($n=4$),^{14,16,17,18} gynaecological surgery ($n=3$),^{11,12,19} urological surgery ($n=1$)²⁰ and trauma surgery ($n=1$).¹⁵ One study investigated incidental appendicectomy during laparoscopic surgery,¹¹ with appendicectomies in the remaining eight studies performed during open surgery. No studies described prophylactic surgical removal of the appendix in otherwise well patients.

Incidental appendicectomy during cholecystectomy

Short-term complication rates in incidental appendicectomy during cholecystectomy were reported in four studies. Of these, one retrospective and two prospective non-randomised studies found no difference in complication rates compared with controls where adequate antibiotic cover was used.^{16–18} Conversely, one historical cohort study did report a small but definite increase in adverse postoperative outcomes.¹⁴

Incidental appendicectomy during gynaecological surgery

Short-term complication rates in incidental appendicectomy during gynaecological surgery were reported in one retrospective observational study¹¹ and two non-randomised prospective studies.^{12,19} No differences in short-term complication rates were reported compared with controls.

Incidental appendicectomy during urological surgery

One retrospective study investigated incidental appendicectomy in urological surgery.²⁰ No significant differences in short-term complications were found in those undergoing cystectomy and urinary diversion. However, there was a significant increase in infectious complications in those undergoing primary retroperitoneal lymphadenectomy.

Incidental appendicectomy during trauma surgery

One prospective randomised study found no significant difference in short-term complication rates compared with controls in incidental appendicectomies performed on patients with a negative abdominal exploration for trauma over a 22-month period at the same trauma centre.¹⁵ Wound infection rates were 1.8% in the incidental appendicectomy group (1 of 56) and 3.6% in the control group (3 of 83).

Clinical example

A 49-year-old ex-special forces operative underwent an open prophylactic appendicectomy in his 20s prior to an extended military operation overseas. Twenty years later, he presented with severe abdominal pain and tenderness in the right iliac fossa. On admission, his white cell count, lactate, and chest and abdominal films were unremarkable. The following day, the pain intensified, his white cell count increased to $12.3 \times 10^9/l$, and computed tomography demonstrated distal ileal dilation with fat stranding and intraperitoneal free fluid. An emergency laparotomy revealed necrotic small bowel secondary to a single adhesion above an appendix free caecum. The adhesion was

Figure 2 Pathological photograph of necrotic large bowel resected during laparotomy following prophylactic appendicectomy 20 years previously

divided and a 25cm segment of necrotic small bowel was resected (Fig 2).

Discussion

There are no published studies investigating clinical outcomes after prophylactic appendicectomy in otherwise healthy patients. Appendicitis in extreme scenarios such as polar expeditions can have severe consequences, hence the rationale for considering prophylactic surgery prior to embarking on a mission. Contained in this report is the first published case of an adhesion related complication secondary to a prophylactic appendicectomy. The potentially fatal nature of this complication highlights that prophylactic appendicectomy is far from a benign procedure. The consequences of appendicitis during a mission can only justify the risk of prophylactic surgery if the complication rates from prophylactic appendicectomy are sufficiently low and the incidence of appendicitis is sufficiently high.

Unfortunately, there is a paucity of evidence quantifying the risks and complication rates of prophylactic appendicectomy. Furthermore, there is no true predictor of when appendicitis might occur. Prophylactic surgery risks can therefore only be inferred from partially analogous procedures such as incidental appendicectomy or appendicectomy following acute appendicitis.

Nine studies reporting outcomes following incidental appendicectomy were included in this review. Seven of these studies (including one prospective randomised trial) found no significant difference in short-term postoperative complications following incidental appendicectomy compared with controls. One retrospective study found a small but significant increase in postoperative infectious complications in incidental appendicectomy performed during

cholecystectomy. Another retrospective study found an increase in postoperative infectious complications during primary retroperitoneal lymphadenectomy but not other urological procedures.

Since removal of a non-inflamed appendix does not appear to be associated with any inherent short-term risk other than that of the primary procedure, it seems likely that short-term outcomes after a prophylactic appendectomy in well patients are comparable with those after an appendectomy secondary to appendicitis. Open and laparoscopic appendectomy in appendicitis is associated with wound infection rates of up to 7.2% and 2.9% respectively.²¹ Patients may experience postoperative pain and intra-abdominal abscess formation after either procedure. No studies investigated long-term complications of laparoscopic appendectomy in appendicitis but it has been reported that after open appendectomy, small bowel obstruction incidence approaches 1.5%.²²

Among the general US population, the incidence of appendicitis varies from 3.7/1,000,000 person-days in 30–34-year-olds to 1.8/1,000,000 person days in 50–54-year-olds.¹ In a six-member crew with an age range of 30–55 years, this represents a risk of 0.8% per year. However, using global incidence data to estimate incidence in extreme scenarios may not be appropriate owing to the increased environmental stresses likely to be present and the heterogeneous study population. In the Australian Arctic programme, there has been an incidence of 43.0/1,000,000 person-days, equalling a risk of 9.4% per year.¹ While these data suggest a raised incidence of appendicitis in stressful environments, small patient numbers from these studies necessitate a degree of caution in data interpretation.

With limited data hindering precise and accurate evidence-based comparisons of risk versus benefit, surgeons must consider cases on an individual basis. Ethical issues surrounding prophylactic surgery prior to an expedition must be considered. Patient autonomy may be limited owing to corporate, institutional or peer pressure to undergo the procedure, particularly if it is prerequisite for selection.² Furthermore, evidence suggests uncomplicated appendicitis can be managed conservatively with antibiotics.^{7,23} It is acknowledged that surgical management of uncomplicated appendicitis has improved 30-day survival compared with conservative management.²⁴ Nevertheless, in scenarios where hospital admission is logistically impossible, acute appendicitis is potentially life threatening in the absence of either an emergency appendectomy or inpatient observation. In such cases, an argument for planned, predictable, prophylactic surgery could be put forward as a more acceptable risk than the grave prognostic picture of developing acute appendicitis in the field.

For this small subset of individuals engaged in military, humanitarian or politically extreme missions, appendicitis could be catastrophic to both person and mission. It is ultimately a joint surgeon–patient decision to appraise the merits of each individual case from an ethical, clinical and mission perspective.

Study limitations

Limitations include a paucity of data in this field, preventing extensive analysis of evidence. However, the quality of the data has been maximised by using broad search terms, hand searching references of similar articles and complying with PRISMA guidelines.¹⁵ We have also presented a rare surgical procedure – prophylactic appendectomy – and highlighted the potential (and unnecessary) long-term complications.

Conclusions

Prophylactic appendectomy may be appropriate prior to an individual spending long periods of time without access to healthcare. Despite this, it should not be undertaken without careful consideration of the potential complications as well as a balanced discussion between the surgeon and potential patient to weigh up the risks and benefits. This systematic review contains the first published case of prophylactic appendectomy and its related complications. It highlights the severity of adhesion related complications and provides a note of caution to anyone considering prophylactic surgery.

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