World Journal of Gastrointestinal Surgery

Online Submissions: http://www.wjgnet.com/esps/
bpgoffice@wjgnet.com
doi:10.4240/wjgs.v5.i11.300

World J Gastrointest Surg 2013 November 27; 5(11): 300-305
ISSN 1948-9366 (online)

BRIEF ARTICLE

Drainage *vs* no drainage in secondary peritonitis with sepsis following complicated appendicitis in adults in the modern era of antibiotics

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Received: May 25, 2013 Revised: October 13, 2013
Accepted: October 19, 2013
Published online: November 27, 2013

Abstract

AIM: To compare the profile of postoperative outcome in secondary peritonitis with sepsis due to complicated appendicitis in two cohorts (drainage *vs* no-drainage) after appendicectomy in adults in the modern era of effective antibiotics.

METHODS: A retrospective review of all adult patients who were operated for secondary peritonitis with sepsis due to complicated appendicitis was carried out. Total of 209 patients were identified from May 2005 to April 2009 with operative findings of gangrenous or perforated appendix. The patients were divided into two cohorts, those where prophylactic drainage was established (n = 88) and those where no drain was used (n = 121). Abdominal drain was removed once the drainage ceased or decreased (< 10-20 mL/d in closed system of drainage or when once daily dressing was minimally soaked in open system). Broad spectrum antibiotics to cover the gut flora were started in both cohorts at diagnosis and were stopped once septic features resolved. Peritoneal fluid for aerobic culture and sensitivity were routinely obtained intra operatively; however antibiotic regimens were not changed unless patient failed to respond to the antibiotics based on the institutional protocol. The co-morbidities and their influence on primary end points were noted. Immunocompromised patients, appendicitis complicated by inflammatory bowel disorder and tumors were excluded from the study.

RESULTS: Disease stratification and other demographic features were comparable in both cohorts. There was zero mortality in drainage group while as one patient (0.82%) died in the non-drainage group. The median duration (in days) of hospital stay (6.5 *vs* 4); antibiotic use (5 *vs* 3.5); regular parental analgesic use (5 *vs* 3.5) and paralytic ileus (2.5 *vs* 2) was more common in the drainage group. Incidence of major wound infection in patients 14 (15.9%) *vs* 22 (18.18%) and residual intra-abdominal sepsis (inter loop collection/abscess) -7 (8%) *vs* 13 (10.74%) requiring secondary intervention was not significantly different in drainage and non-drainage cohorts respectively. One patient in the drainage cohort had faecal fistula (1.1%).

CONCLUSION: The complicated appendicitis in the modern era of antibiotics does not necessitate the use of prophylactic drain placement which at times may even prove counterproductive.

Key words: Appendicitis; Antibiotics; Drainage; Gangerenous; Peritonitis

Core tip: The routine placement of the drain after appendicectomy irrespective of the severity of the appendicitis increases both the morbidity and the cost of treatment. The surgeons need to do away with the habits of riding on drains perhaps as a soup to their consciences. Post-operative management of the patient with the drain as compared to those without drain is troublesome, requiring increased work and manpower for the hospital.

Rather SA, Bari SUL, Malik AA, Khan A. Drainage *vs* no drainage in secondary peritonitis with sepsis following complicated appendicitis in adults in the modern era of antibiotics. *World J Gastrointest Surg* 2013; 5(11): 300-305 Available from: URL: http://www.wjgnet.com/1948-9366/full/v5/i11/300.htm DOI: http://dx.doi.org/10.4240/wjgs.v5.i11.300

INTRODUCTION

The untruthful trust on the functioning of drains as an agent in preventing the intra-abdominal sepsis is deeply seated in the minds of the surgeons. This belief is usually imbibed by the surgeons from their predecessors during their training period and the practice persists from one generation-surgeons to another. Robinson[1] aptly classified surgeons into three categories based on their use of drains: those who believe that all intraperitoneal operations should be drained, those who feel that drain is useless and those who sit on the fence and insert a drain as a safety valve or perhaps as a sop to their consciences. Even though there is enough evidence to discourage the use of prophylactic drains in different areas of gastrointestinal surgery[2] the literature for or against the use of drain after the complicated appendicitis is small and historical. Drainage following "simple" appendicitis has been assessed by two randomized trials[3,4] which do not favour the placement of drains.

There have been only few randomized trials so for to evaluate the role of drains when the appendix was eithe perforated or gangrenous[3-6]. However three of these studies have been reported in 1970s. Though the meta-analysis based on these studies by Petrowsky *et al*[7] did not recommend the use of intraperitoneal drains, no evidence exist as to whether this approach should be extrapolated in adult patients; and in the new era of antibiotics. Although, there is no universally accepted antibiotic regimen, however broad spectrum coverage with multiple drugs has been advocated[8-10].

MATERIALS AND METHODS

The retrospective analysis of the medical records of adult patients who underwent open appendicectomy for complicated appendicitis (gangrenous and perforated appendix) at Sher-i-Kashmir institute of medical sciences Srinagar from May 2005 to April 2009 was done. The total number of patients encountered was 209. Prophylactic drainage was established in 88 patients while as in 121 patients no drain was used. Abdominal drain was removed once the drainage ceased or decreased (< 10-20 mL/d in closed system of drainage or when once daily dressing was minimally soaked in open system). Broad spectrum antibiotics to cover the gut flora were used in both cohorts at diagnosis and were stopped once sepsis got resolved. Peritoneal fluid for aerobic culture and sensitivity were routinely obtained intra operatively. The co-morbidities and their influence on primary end points were noted. Laparoscopic appendicectomy, immunocompromised patients and appendicitis complicated by inflammatory bowel disorder were excluded from the study. The fluid and electrolyte correction was done wherever necessary before surgery. The patients were put on 3rd generation cephalosporin with or without sulbactum plus metronidazole 7.5 mg/kg q8H at the time of diagnosis of complicated appendicitis. Postoperatively parenteral antibiotics were switched to oral therapy for 5 to 7 d when: (1) baseline signs and symptoms of infection were resolving or resolved; (2) resolution of fever (≤ 37.8 ℃) or hypothermia; (3) leukocytosis, leucopoenia resolving or normal; and (4) subjects able to maintain oral intake.

Patients were operated by one of the Registrars (advanced trainees) in 24 h-emergency theatre without much delay after the assessment by a senior consultant. Right iliac fossa standard muscle splitting/cutting transverse or oblique incision was utilised usually for localised peritonitis or for documented case of appendicitis. A right lower lateral para-median incision was usually used for generalised peritonitis or when diagnosis was in question. After appendicectomy stump burial was an individual preference of surgeon. A liberal lavage was performed by luke warm 0.9% normal saline. Drain placement was largely influenced by the surgeons own preference, understanding of the subject and belonging to a particular school of thought. No rigid departmental protocol has been formulated in this context. Drain was placed either in right para-colic gutter or in pelvis. All wounds were closed primarily after a thorough wound wash. Abdominal drain was removed once the drainage has ceased or decreased (< 10-20 mL/d in closed system of drainage or when once daily dressed was minimally soaked in open system).

In the post-operative period patients who failed to improve over a period of time underwent radiological evaluation (ultrasonography and/or computed tomography) of the abdomen and antibiotics were changed as per the culture sensitivity reports wherever necessary. Though only aerobic culture was obtained often but not routinely at the time of primary surgery. Subsequent cultures were drawn from the potential sources (infected wound or intra-abdominal collection) only if patients failed to respond to initial therapy.

RESULTS

Over a period of 4 years there were a total of 209 adult patients who underwent open appendicectomy for com-

Table 1 Preoperative status of the patients

Patient characteristics	Drainage cohort (*n* = 88)	Non-drainage cohort (*n* = 121)
Age[1] (yr)	29 (14-93)	26 (14-78)
Sex[2] (male: female)	1:1.2	1.3:1
Duration of symptoms[2] (d)	2.5 ± 1.3	2.1 ± 1.5
WBC count[2] (× 109/L)	16.8 ± 4.9	16.1 ± 5.3
Febrile %age (> 37.80 C)	68 (77%)	91 (75%)

[1]Expressed as median (years); [2]Expressed as an average with the standard deviation.

Table 2 Postoperative status of the patients *n* (%)

Post operative outcome	Drainage cohort (*n* = 88)	Non-drainage cohort (*n* = 121)
Hospital stay[1]	6.5 (4-8)	4.0 (3-8)
Antibiotic use (parenteral)[1]	5.0 (4-9)	3.5 (3-6)
Regular analgesic use[1]	5.0 (4-9)	3.5 (3-6)
Paralytic ileus[1] (passing of flatus)	2.5 (1-5)	2.0 (1-4)
Major wound infection	14.0 (15.9)	22.0 (18.18)
Residual intra-abdominal collection	7.0 (8)	13.0 (10.74)
Subacute intestinal obstruction	3.0 (3.4)	5.0 (4.13)
Faecal fistula	1.0 (1.1)	-
Incisional hernia	2.0 (2.2)	2.0 (1.6)
Mortality	1.0 (0.82)	

[1]Are expressed as median (d). $P > 0.05$ (insignificant).

plicated appendicitis. All the patients gave history of fever, vomiting and pain which had started initially in the umbilical area and later shifted to right iliac fossa. All the patients were febrile and had a pulse rate of more than 100/min. There was severe tenderness in the right iliac fossa with positive Mcburney's sign. All the patients had leukocytosis with neutroplilia. The patient demographics and disease parameters were not statistically different in drainage and non-drainage cohorts (Table 1). The post-operative outcome in two cohorts is shown in Table 2. Data was analyzed using SPSS version 10 using χ^2 test. A *P* value below 0.05 was considered statistically significant. The hospital stay in the two cohorts was significantly different, with a median of 6.5 and 4 d in the drainage and non-drainage cohorts respectively. The antibiotic use was longer in the drainage cohort as compared to the non-drainage cohort, *i.e.*, median of 5 d (range 4-29) *vs* 3.5 d (range 3-26) respectively. Similarly the regular analgesic use was also prolonged in the drainage cohort as compared to non-drainage cohort, *i.e.*, median of 5 d (range 2-17) *vs* 3.5 d (range 2-14). One 76-year-old obese female patient with a body mass index of 37.4, with diabetes and hypertension in the non-drainage cohort was operated with a delay of 4 d because of subclinical signs and symptoms. After appendicectomy patient continued to be in sepsis and underwent multiorgan dysfunction syndrome which ultimately resulted in death on 28th post-operative day. One 31-year-old male patient in the drainage cohort had a faecal fistula through the main wound after the removal of the drain on the 5th post operative day.

Table 3 Clinico-pathological profile of patients requiring second surgery *n* (%)

Indications	Duration[1] (*n* = 88)	Drainage cohort (*n* = 121)	Non-drainage cohort
Subacute intestinal obstruction	28-35 d	1 (1.1)	1 (0.82)
Incisional hernia	6-11 mo	2 (2.2)	2 (1.60)

[1]Period after the primary surgery.

Patient was managed conservatively and his fistula healed completely after 35 d. Residual intra-abdominal collection was noted in 7 (8%) patients and 13 (10.74%) patients in drainage and non-drainage cohorts respectively on USG and/or CECT abdomen.

Two patients in each cohort required radiological guided drainage and one patient in the non-drainage cohort drained spontaneously through the main wound. The patients who do not show clinical deterioration or whose intra-abdominal collections were not significant enough to be drained radiologically/surgically were managed conservatively. The clinico-pathological profile of the patients who require second surgery is shown in Table 3. One patient in each cohort failed to the conservative management and required multiple admissions for sub acute intestinal obstruction. Adhesinolysis was all that was required and patients were symptom free thereafter. Mesh hernioplasty was done in a patient with incisional hernia.

DISCUSSION

Hippocrates[11] ever since he first reported the use of an abdominal drain in empyema gallbladder, its usage has been extended to almost all surgical procedures. The very purpose of the drains, to reduce the potential source of infection, detect post-operative bleed and anastomotic leakage or to establish the tract for the drainage of the collected material even after its removal may not be always served. Likewise drainage following appendicectomy (one of the commonest gastrointestinal operation) is usually determined by whether the underlying appendicitis is simple/complicated and largely determined by the surgeons' belief.

In the absence of any universally accepted antibiotic regime for appendicitis, traditionally broad spectrum antibiotic coverage is routinely adopted[8-10]. However the choice of antibiotics in complicated appendicitis is largely influenced by the institutional protocols[12]. A commonly followed guideline[9] recommends triple antibiotics. However there has been a recent trend towards single or dual drug regimes in children[12,13], in order to reduce the cost and simplify dosing schedules. While these paediatric trials are not adequately powered[13-16], the randomised trials in adults have failed to show any difference in antibiotic regimes[17]. We have adopted a cost effective policy of two/three drug regimens (3th generation cephalosporin with or without salbactum plus metronidazole 7.5 mg/kg

q8H), which was instituted at the time of diagnosis of complicated appendicitis. It has been seen that post-operative abscesses occurred in patients who had organisms on culture that were sensitive to the treatment antibiotics[18,19]. Unlike Kokoska *et al*[19], Ong *et al*[18] found that culture of the postoperative abscess did correlate with the initial peritoneal culture, although this does not alter management. Contrary to the commonly held belief, recently, the natural history of immunological mechanisms of the peritoneum has been better understood and its natural defence mechanisms to clear the infection have been elucidated[20-23]. These studies highlight the importance of the peritoneal fluid, and its drainage can even prove counterproductive.

Two randomized controlled trials (RCT) investigated the value of prophylactic drainage after open appendicectomy for acute/simple appendicitis[4,24]. Although both arms (drainage, no-drainage) of the trials had a relatively large sample size (> 90 patients each group), the studies were performed without a power and sample size calculation and were therefore ranked as level 2b. One study reported a significantly higher wound infection rate in drained patients with acute/simple appendicitis[23], whereas the other study found similar wound and intra-abdominal infection rates in drained and non-drained patients[4].

In complicated appendicitis (gangrenous/perforated), the role of prophylactic drainage has been studied in five RCTs. Because of the same reasons mentioned above, the level of evidence was classified as 2b in each RCT. The results showed higher wound infection rates in drained patients (range 43%-85%) than in non-drained patients (29%-54%). The pattern of intra-abdominal infection was not uniform among the studies, as two studies reported slightly higher intra-abdominal infection rates in non drained patients[24,25], one study a higher rate in drained patients[4], and another a similar rate in both groups[6]. Interestingly, the development of fecal fistulas was only observed in drained patients with a rate ranging from 4.2% to 7.5%.

Petrowsky *et al*[7] performed meta-analysis including series of gangrenous or perforated appendicitis only. Four RTCs (all level 2b) were included in the meta-analysis with the end point wound infection, whereas data from 3 RTCs were available for the end points intra-abdominal infection and fecal fistula. The analysis calculated an odds ratio for wound infection of 1.75 (CI: 0.96-3.19). The odds ratio for fecal fistula of 12.4 (CI: 1.14-1.35) favours the no drainage group; whereas the odds ratio for the end point intra-abdominal infection of 1.43 (CI: 0.39-5.29) favours neither group.

We observed almost similar incidence of major wound infection in patients in the drainage (15.9%) and non-drainage (18.18%) cohorts which is not statistically significant ($P > 0.05$). Dandapat *et al*[5] also showed that peritoneal drainage does not prevent wound infection. The author believes that protection of the wound during the primary surgery is of utmost priority, and the effective antibiotics compliment to the aseptic precautions in reducing the incidence of wound infection. Ciftci *et al*[15] observed that the most crucial point to avoid the wound infection is the application of antibiotics with aerobic and anaerobic coverage. In our study all the wounds were closed primarily in both the cohorts. There is an apprehension that primary closure of surgical incision after appendicectomy for complicated appendicitis may result in increased incidence of surgical site infection[26,27]. These incisions are often managed with delayed closure. However Rucinski *et al*[28] did a meta-analytic study of 2532 patients with gangrenous and perforated appendicitis. They concluded that primary closure of the skin and subcutaneous tissue after appendicectomy for gangrenous or perforated appendicitis, combined with the use of antibiotics in the perioperative period, is not associated with an increased risk of incision infection when compared with delayed closure.

On the one hand there seems to be a tendency on the part of the treating physician to continue the parental antibiotics and analgesics longer in the drainage cohort than in the non-drainage cohort and thus delay the discharge of the former[29,30]. On the other hand there seems to be tendency on the part of the patient to continue to assume the sick role until the drains are removed. Furthermore the post-operative care of the patients with the drain as compared to those without drain is troublesome, requiring increased work and manpower for the hospital. We had one patient (1.1%) in the drainage cohort whose postoperative course was complicated by the fecal fistulae. The exact cause of the fistulae remained unsolved in our series. However, these drains themselves are also a potential source of infection; may induce anastomotic leakage and may cause damage by mechanical pressure and suction[31,32].

The incidence of paralytic ileus and intra-abdominal collection in the two cohorts is not statistically different in our series. Also the incidence and indications of the second operation is not significantly different in the two cohorts in our series.

In a conclusion, the routine placement of the drain after appendicectomy is not indicated regardless of the severity of the appendicitis. It not only increases the morbidity, but is also not a cost effective method. The surgeons need to shun away the deeply inculcated habits of riding on drains perhaps as a soup to their consciences. The criticism of the study is that it is not a randomised controlled prospective trial and thus cannot generate the level 1 evidence. The results cannot be translated completely into the laparoscopic era, where the profile of postoperative outcome would be certainly different. However the author maintains that these patients were diagnosed and operated as secondary peritonitis with sepsis where the role of laparoscopy is still not fully defined. But the power of the study is adequate enough to validate the end points of the study.

COMMENTS

Background

Although there is lot of evidence that discourages the use of prophylactic drains in different types of gastrointestinal surgeries, enough studies have not been

conducted that would favour or disfavour the use of drain after the complicated appendicitis.

Research frontiers

The principal aim of the study was to compare the postoperative outcome in secondary peritonitis with sepsis due to complicated appendicitis in two groups of patients, one with drainage and another without drainage, after appendicectomy in adults in the modern era of effective antibiotics.

Innovations and breakthroughs

Regardless of the severity of the appendicitis, the routine use of the drain after appendicectomy is not indicated. It not only increases the morbidity, but is also not a cost effective method.

Applications

In the modern era when wide range of antibiotics with a very broad spectrum of action are available, the patients with peritonitis secondary to appendicitis does not necessitate the use of prophylactic drain, rather it may at times may even prove counterproductive.

Peer review

The authors have conducted the present study to evaluate the effectiveness of drain in patients with complicated appendicitis. The results are interesting and may form the basis of further study.

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