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Research Paper

Risk factors for intra-abdominal abscess post laparoscopic appendicectomy for gangrenous or perforated appendicitis: A retrospective cohort study

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ABSTRACT

Introduction: Acute appendicitis is one of the most common causes of abdominal pain. Post-operative Intra-abdominal Abscess (PIA) frequently complicates appendicectomy and increases morbidity and cost (1). Its incidence is increased in perforated or gangrenous appendicitis (2). Risk factors for the development of PIA within this high-risk group have not been established in adults. This study aimed to identify risk factors associated with PIA following laparoscopic appendicectomy for gangrenous or perforated appendicitis in adults. Secondary aims were to describe the timing and anatomical location of PIA occurrence.

Methods: A retrospective cohort study was performed. The data of all adults that underwent laparoscopic appendicectomy for gangrenous or perforated appendicitis at Logan Hospital (Queensland, Australia) from July 2010 to June 2014 were reviewed using a database from a previous study (3). The Primary outcome was the association between the development of PIA and; age, gender, American Society of Anaesthesiologists class, Disease Severity Score (4), blood tests on admission (white cell count (WCC), C-reactive protein, total bilirubin) and histopathology of the appendix.

Results: Of 143 patients, 13 developed PIA (9.1%). There was a weakly positive association between elevated preoperative WCC and the risk of PIA (Spearman's correlation coefficient 0.174, $P = 0.038$). No other factors were significantly associated with increased risk of PIA. The median post-operative day of diagnosis was day nine (mean 7.9, range 2–17).

Conclusions: In this cohort, there was a weakly positive association between preoperative WCC and PIA. Prospective trials investigating other potential risk factors are required.

1. Introduction

1.1. Background

Acute appendicitis is one of the most common causes of acute abdominal pain. The annual incidence is approximately 90 per 100,000 population and the lifetime risk is 8% [1,2]. Obstruction of the appendiceal lumen by faecalith, faecal stasis, lymphoid hyperplasia or caecal neoplasia and numerous infectious agents have been proposed as precipitating factors [3]. It was previously thought that the natural history of appendicitis consisted of inflammation followed by necrosis then perforation, but it is now recognised that not all cases progress through this spectrum [1]. Gangrenous or perforated appendicitis occurs in approximately 25% of cases. It is more likely at the extremes of age, occurring in approximately 40% of patients under 10 years and 50% of those over 50 years [2]. Appendicectomy has been the preferred treatment of appendicitis for decades. For gangrenous or perforated appendicitis, laparoscopic appendicectomy has replaced open appendicectomy in many centres due to decreased blood loss, reduced postoperative pain and hospital stay, fewer overall complications, and an earlier return to usual activities [1,4].

Post-operative Intra-Abdominal Abscess (PIA) complicates 3%–25% of appendicectomies [5,6]. The risk is highest following perforated or gangrenous appendicitis [4,7–11]. Clinical features include fever, pain, ileus, leucocytosis and an intra-abdominal collection on ultrasound or computed tomography [12]. Management of PIA includes antibiotics, with or without

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percutaneous or operative drainage [12]. Fike et al. (2011) compared a cohort of 63 patients with appendicitis from previous prospective trials to a matched group of 61 patients that did not develop PIA. They found that in addition to inflicting considerable morbidity, PIA doubled the total length of stay (11.6 vs 5.1 days, $P < 0.001$) and total hospital charges ($P < 0.001$). To date, risk factors predicting PIA within the high-risk group of patients with gangrenous or perforated appendicitis have not been established in adults.

1.2. Aim

The primary objective of this study was to identify risk factors associated with PIA following laparoscopic appendicectomy for gangrenous or perforated appendicitis in adults. Secondary aims were to describe the timing and anatomical location of PIA occurrence.

2. Materials and methods

2.1. Study design

A retrospective cohort study was performed and is reported in accordance with the STROCSS criteria [13].

2.2. Participants, setting and data sources

All adults were included that underwent laparoscopic appendicectomy at Logan Hospital and had an intraoperative diagnosis of gangrenous or perforated appendicitis over a four-year period from July 2010 to June 2014. Logan Hospital is a 330-bed, outer metropolitan teaching hospital in Queensland, Australia. The data was sourced from a database collated by the author by reviewing the medical records and outpatient notes of eligible patients during a previous study examining the relationship between intravenous antibiotic duration and the incidence of PIA [14]. The operation reports and discharge summaries of patients that developed PIA were examined to enable subgroup observations.

2.3. Exclusion criteria

Children (less than 18 years of age) were excluded. Patients undergoing open appendicectomy, laparoscopic converted to open appendicectomy or laparotomy were excluded.

2.4. Variables and outcome measures

The primary outcome of this study was the association between the development of PIA and the following independent variables; age, gender, American Society of Anaesthesiologists (ASA) class, preoperative blood tests including white cell count (WCC), C-reactive protein (CRP) and total bilirubin, Disease Severity Score (DSS) as described by Garst et al. (2013) and the histopathology of the appendix (normal, inflamed, gangrenous/necrotic or perforated) [15,16].

The diagnosis of necrotic or perforated appendicitis was defined by the surgeon at laparoscopy as documented. Histopathology was recorded as per the pathologist's report. Cases of PIA were identified either as inpatients, on representation to the emergency department or on outpatient follow-up review within 60 days. PIA was defined as an intra-abdominal abscess as reported by a radiologist on computed tomography or ultrasound scan or reported by the operating surgeon on relook laparoscopy/laparotomy.

2.5. Data analysis

Categorical variables were presented as frequencies and continuous variables as descriptive statistics. Statistical tests were applied for association between the dependent variable (PIA) and the independent variables listed previously. Pearson's correlation or Spearman's Rho was used for continuous variables. Chi-square test was used for dichotomous variables. Where an association was found, the Mann-Whitney *U* test was applied to assess the difference in the independent variables between those that did develop PIA and those that did not. Logistic regression was used to assess the predictive value of the independent variables. Analysis was performed using IBM SPSS statistics version 23. A *P* value < 0.05 was considered statistically significant. Power was calculated using the calculator available from the Australia and New Zealand Melanoma Trials Group (ANZMTG) [17] with α set at 0.05. With a sample size of 143 the study was >90% powered to detect a correlation of 0.3 using Spearman's correlation coefficient and effect size 0.3 for the Chi-Square and Mann-Whitney *U* tests.

2.6. Ethics

Human Research Ethics Committee (HREC) approval for this study was granted by the Metro South HREC, Queensland, Australia (reference number HREC/16/QPAH/861). The study is registered at ResearchRegistry.com (UIN researchregistry3398).

3. Results

3.1. Participants and descriptive data

Of 1310 patients who underwent laparoscopic appendicectomy during the study period, 143 (10.9%) were adults who had necrotic or perforated appendicitis on laparoscopy and formed the cohort for this study (Appendix A). PIA occurred in 13 of these patients (9.1%). The cohort included 66 (46.2%) females and 77 (53.8%) males aged 18–86 with a median age of 37 years. The incidence of the independent variables is outlined in Figs. 1–3 and Table 1.

3.2. Primary outcome: the association between the independent variables and PIA

Pearson's correlation coefficient demonstrated no statistically significant linear relationship between the continuous independent variables and PIA. The Chi-squared test for association similarly demonstrated no statistically significant association for dichotomous variables. Nonparametric testing (Spearman's Rho) revealed a very weakly positive association between increasing preoperative WCC and the development of PIA (correlation coefficient 0.174, $P = 0.038$). No other variable showed a statistically significant correlation (Table 2). PIA occurred in patients with WCC between 11.5-20.8 $\times$ 10^9/L (reference range = 3.5-11 $\times$ 10^9/L). The Mann-Whitney *U* test demonstrated a significant difference between the mean WCC in those that did not develop PIA and those that did (15.08 $\times$ 10^9/L, SD 4.2 $\times$ 10^9/L versus 16.82 $\times$ 10^9/L, SD 2.9 $\times$ 10^9/L respectively, $P = .038$). Fig. 4 depicts histograms of the distribution of the frequencies of preoperative WCC in those that did not develop PIA and those that did. Logistic regression demonstrated no statistically significant predictive relationship between the independent variables and PIA (Table 3).