



## Before and After Study

# The Established Acute Surgical Unit: A reduction in nighttime appendicectomy without increased morbidity



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## HIGHLIGHTS

- An ASU provided a significant decrease in nighttime surgery.
- There was no difference in morbidity or length of stay for patients.
- No difference in complications for night time surgery.

## ARTICLE INFO

### Article history:

Received 15 May 2017

Accepted 19 May 2017

Available online 24 May 2017

### Keywords:

Acute Surgical Unit

Appendicectomy

Outcomes

Nighttime

Surgery

Morbidity

## ABSTRACT

**Introduction:** Nighttime surgery for non-life threatening disease has been associated with poorer outcomes, but delaying surgery for acute appendicitis may also be detrimental. The aim was to assess the effect of the Acute Surgical Unit [ASU] model on nighttime surgery rates and outcomes for patients undergoing appendicectomy.

**Method:** A retrospective review of medical records of patients having an appendicectomy. Primary outcomes were nighttime surgery rate, time from presentation to surgery, perforation rate, complication rate and length of stay.

**Results:** There was a large increase in workload: Pre ASU 278, Early ASU 553 and Est. ASU 923. There was a significant decrease in nighttime surgery rates: Pre ASU 46.9%, Early ASU 30.2% and Established ASU 28.3% (Pre vs. Early  $p < 0.001$ ; Pre vs. Est.  $p < 0.001$ ; Early vs. Est  $p = 0.004$ ). When comparing the Pre ASU and Established ASU groups there was an increase in mean time from presentation to surgery (Pre 14.43 Hrs, Est. 18.65 Hrs;  $p = 0.001$ ), an increase in perforation rate that was not significant (Pre 9.8%, Est. 14.2%;  $p = 0.05$ ) and similar complication rates (Pre 8.66%, Est. 7.04%;  $p = 0.37$ ). There was a significant decrease in length of stay between the Early and Established ASU groups (Pre 3.1 D, Est. 2.8D,  $p = 0.01$ ). At our institution there was no statistically significant increase in complications for patients undergoing nighttime appendicectomy (Night 10.0%, Day 8.2%;  $p = 0.16$ ).

**Conclusion:** There was a significant decrease in nighttime surgery, without any difference in morbidity or length of stay for patients treated within the Established ASU (compared to Pre ASU group).

**Level of evidence:** IIb.

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## 1. Introduction

Appendicectomy for suspected acute appendicitis is one of the

most common urgent operations performed by general surgeons [1]. Despite the frequency of this operation, there is still considerable dispute regarding the optimal timing of surgery for those patients with suspected acute appendicitis.

The morbidity for acute appendicitis increases when there is gangrene and associated perforation [2]. Therefore, acute appendicitis has been considered as a surgical emergency, with appendicectomy being performed as soon as possible after clinical

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diagnosis due to concerns that any delay in surgery would increase the risk of perforation and be associated with an increase in morbidity. This view was challenged in the late twentieth century, with studies showing that “patient delay” rather than “in-hospital delay”, is responsible for disease progression [2,3]. Some studies have since demonstrated the safety of “delayed appendicectomy”, providing evidence that in-hospital delays of up to twenty-four hours do not increase morbidity [4–9]. This evidence, in conjunction with studies demonstrating the increased economic burden [10] and perioperative morbidity [11–14], associated with operations performed outside of routine business hours, particularly at nighttime, has raised the question: “Should we be performing appendicectomy at night for suspected acute appendicitis?”.

Our institute, a 520-bed teaching hospital, adopted an Acute Surgical Unit (ASU) model of care in November 2006 [15]. The ASU at our institute is a consultant led, protocol driven, independent surgical unit that manages all acute general surgical admissions. The ASU consultants work 24-h shifts, being on-site between 7am and 7pm, and on remote call outside these hours. During their shift the consultant’s sole responsibility is to the ASU. The day team is comprised of two surgical registrars, two residents and a nurse practitioner. After 7pm the team comprises of one-night registrar, who is also supported by a more experienced registrar on remote call. The ASU team is the same for weekdays, weekends and public holidays. Prior to this, the traditional “on-call” model was used. One of the aims of this change in model was to reduce “unnecessary” nighttime surgery such as appendicectomy. The preference being to defer nighttime surgery (including appendicectomy) to the following morning when clinically appropriate.

The aim of this study was to assess the impact of the ASU model on nighttime surgery rates and outcomes, (clinical and non-clinical) for patients undergoing appendicectomy for suspected acute appendicitis.

This study differs from other studies comparing the effect of an ASU [16–19], in that in addition to a group prior to and immediately after the change in model, it includes a group of patients treated more than five years after the ASU implementation. The intention was to examine how the model has functioned over an extended time period to assess the sustainability of any change in outcome and see if there was continued improvement in outcomes.

## 2. Methods

The study was undertaken as a retrospective review of medical records. Data was collected for all patients who underwent an appendicectomy at our institute for suspected appendicitis within the following two-year time periods:

1. “Pre-ASU”: November 2004 to October 2006 (two-year period immediately prior to the implementation of the ASU model).
2. “Early-ASU”: November 2006 to October 2008 (two-year period immediately after the commencement of the ASU model).
3. “Established-ASU”: January 2012 to December 2013 (two-year period representing a well-established ASU).

Patients who had an appendicectomy as part of an unrelated operation such as a right hemicolectomy, or those who had interval/elective appendicectomy were excluded.

Ethics approval was obtained from the Human Research Ethics Committee prior to study commencement. Data was collected using electronic medical records (Power Chart, Cerner Australia), paper medical records and the ASU database at our institute. The same data set was collected for patients in all three groups and was entered into a computerized spreadsheet (Microsoft Excel, Microsoft Corporation). Data was de-identified and stored according to

the Local Health District Human Research Ethics Committee protocol. Collected data included patient age, sex, dates and times of presentation, operation and discharge; and operation technique (laparoscopic or open). Histopathology results were reviewed for each patient and classified as either appendicitis or normal appendix. The appendicitis data was then further divided into inflamed, suppurative or perforated/gangrenous subgroups based on the pathological assessment. Morbidity and mortality data was also collected; this data included all medical or surgical complications occurring within 30 days of surgery.

Primary outcomes were: nighttime operation rate with “nighttime” being defined as operation starting time between 7pm and 6:59 a.m., time from presentation to surgery, perforation rate, complication rate and length of stay.

## 3. Results

There were 1753 patients included in the study. Over time there was a large, progressive increase in workload with the Pre, Early and Established ASU groups being comprised of 277, 553 and 923 patients in each respective two-year time period. There were no statistically significant differences between the groups with respect to the baseline characteristics of mean age and sex (Table 1).

There was a significant reduction in nighttime surgery when comparing the Pre ASU group with both the Early and Established ASU groups (46.9%, 30.2% and 28.3% respectively). Even when using an alternate definition of ‘overnight’ surgery (10 p.m.–6.59 a.m.), the reduction remained significant between Pre, Early and Established ASU groups (Table 1). Consistent with the reduction in nighttime operating there was a significant increase in median time from presentation to surgery when comparing the Pre ASU group with both the Early and Established ASU groups. The mean time from presentation to surgery was the same for the 2 ASU groups (Table 1).

During the 3 study periods the operative technique used for appendicectomy changed significantly, with the proportion of laparoscopic appendicectomy increasing from 48.8% Pre-ASU to 68.6% Early ASU then to 97% in the Established ASU period (Table 1).

Of all patients included in the study, 1162 (66.1%) had histopathologically confirmed appendicitis. The negative appendicectomy rate was 27.8% in the Pre-ASU group. This increased to 33.6% in the Early-ASU group and to 35.5% in the Established-ASU group. The only significant difference being between the pre-ASU and established ASU group (Table 1).

There was an increase in the incidence of perforated appendicitis between the Pre-ASU and Established ASU period, which was not significant ( $p = 0.05$ ). Although the complication rate rose from 8.7% in the Pre ASU period to 12.1% in the early ASU group, this too was not significant ( $p = 0.13$ ). From the early ASU period to the established ASU period the overall complication rate reduced to 7% which was significantly less than the early ASU, but not significantly different from the Pre ASU group. When comparing rates of wound infections there was a significant decrease in the established ASU group compared to both the Pre and Early groups. There was no difference in intra-abdominal abscess incidence between the three groups despite the variations in the incidence of perforation (Table 1).

There was one mortality, this was an 88-year-old male treated in the Early-ASU group who had cardiac arrest immediately following anaesthetic induction and was unable to be resuscitated.

The mean length of stay (LOS) gradually decreased between the three periods, with a significant reduction noted when comparing the Early ASU and Established ASU groups (Table 1).

Outcomes were compared for patients based on nighttime vs. daytime surgery (Table 2). The time from presentation to surgery

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