On the road again: paediatric appendicectomy outcomes at a regional referral hospital

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Introduction

Paediatric presentations of acute appendicitis are often not in keeping with the defined classical migratory umbilical to right iliac fossa abdominal pain[1], and along with patient factors such as difficulties with examination and reduced meaningful history make the diagnosis more challenging. A negative appendix rate (NAR) has been published at 24% in an Australian cohort[2], with other countries ranging from 15 to 35%[3]. Surgical practice in rural and regional Australia is often complicated by patients residing long distances from available surgical services, thus requiring long-distance transport to access definitive management. Paediatric appendicectomy outcomes of Orange Health Service (OHS), a regional referral hospital with a large catchment area within western NSW, Australia, was analysed to investigate NAR in several population sub-groups.

The differential diagnosis of abdominal pain in the paediatric population is broad due to benign causes being the most prevalent[4], but more sinister pathology often being serious with a critically unwell patient. The decision to take a child to the operating room is nonetheless a major one, requiring significant clinical acumen as no single diagnostic test has the specificity to completely confirm or rule out appendicitis. Despite the best advances in medical technology becoming a routine part of the investigations for appendicitis, an accepted negative appendix rate still exists, i.e. the percentage of appendixes removed that do not show the histopathological signs of appendicitis. In these cases, the abdominal pain may have been caused by an alternative pathology. Issues that have been implicated in the causation of appendicitis include western diet[5], appendiceal lumen obstruction including by faecolith impaction, lymphoid hyperplasia, and parasite infestation[6], which were all noted within our dataset.

The aim of this retrospective analysis was to investigate whether regional referral centres are non-inferior for paediatric appendicectomy outcomes, and furthermore to investigate the possible interaction of the distance of residence from the major referral hospital and appendicectomy outcomes. We hypothesise the possibility that more remotely located patients may have a higher NAR due to the risks of discharging a patient with appendicitis who resides very remotely and is therefore not easily able to return to the hospital if further issues arise.

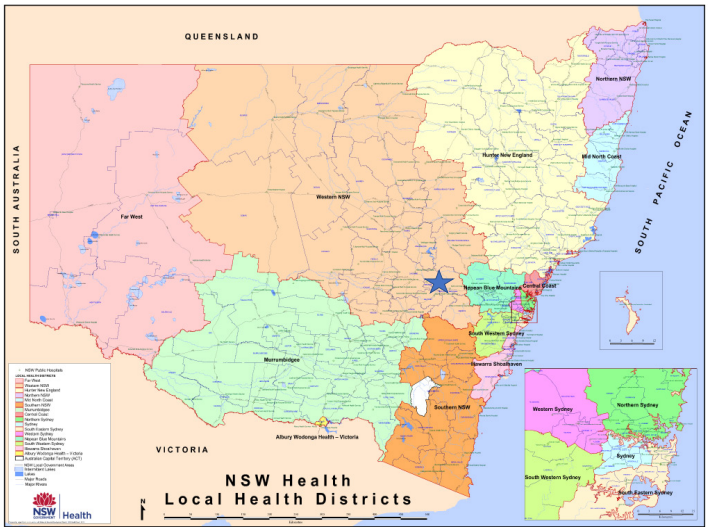

Figure 1: Map of NSW, with Western NSW local health district (WNSWLHD) indicated by the light orange area. This LHD covers approximately 250,000 square kilometres, the same size as Britain. Approximately 271,000 people live in this area according to the 2011 census. Orange is located in the south east of this area, indicated approximately by the centre of the blue star[7].

Methods

A retrospective analysis of existing electronic medical records was undertaken for all paediatric appendicectomy procedures completed in a five year period from 2014 to 2019 at OHS. The paediatric population of this analysis was defined as any person between the age of 0 and 16. Procedures undertaken where the diagnostic concern was acute appendicitis were included in this study, with procedures completed for other causes of abdominal pain, congenital abnormalities, procedures related to trauma, obstruction, and hernias all excluded from analysis. All required data for analysis of outcomes following routine laparoscopy for appendicitis was obtained from the Western NSW local health district (WNSWLHD) electronic medical record.

Each patient that was identified as having had an appendicectomy during this time period had their medical record analysed, including an in-depth review of their procedure report, pre-operative investigations including imaging and biochemical investigations, as well as an analysis of patient geographical location in relation to distance from OHS, and re-presentations and complications of the procedure. The electronic medical record accounts for all public health facilities within greater western NSW and therefore the authors are confident of capturing the vast majority of re-presentations and delayed complications.

No differentiation between procedures booked as an appendicectomy, and those booked as a diagnostic laparoscopy where the appendix was removed was made for this analysis.

Aims

The aim of this retrospective analysis was to ascertain if patients residing more remotely from the Orange health service had an increased NAR. In addition to this, several sub-groups were analysed to investigate any differences in NAR by sex, ultrasound result, and inflammatory marker parameters.

Results

A total of 248 paediatric appendicectomy procedures were identified as having occurred over the five year period analysed. The median age of patients was 11, with an age range from 2 to 15 years of age. The majority of the patients were male (152 patients, 61.3% of cohort). Under half of the patients resided in post codes included within the city of Orange (111 patients, 44.8% of cohort), the location of OHS. The median distance of residence away from the health service for the overall cohort was 45 kilometres. However, for a patient that did not live in a postcode within Orange, the median distance of residence away from the hospital was 97 kilometres. Patients resided within an overall range from 21 to 452 kilometres away from OHS. One-in-five patients (55 patients, 22.1% of cohort) were located more than 100 kilometres from the health service, with a similar proportion (53 patients, 21.4% of cohort) being located between 50 and 99 kilometres from OHS.

Obtaining an ultrasound prior to the decision to operate occurred for 46% of patients (114 patients). Of the patients who had an ultrasound, 73.7% had histopathology proven appendicitis (84 of the 114 patients who had an ultrasound). Patients from increased distances of residence away from the health service were not found to have increased prevalence of ultrasound scans as part of their pre-operative workup. 72.6% of patients (180 patients out of the cohort of 248) had raised inflammatory markers in the form a white cell count found on their pre-operative investigations. Eight cases were completed as open appendicectomies (3.2% of total cohort).

The NAR for the overall cohort was 30.5% on histopathology (75 patients out of the total cohort of 248 had negative histopathology). Patients were significantly less likely to have a negative appendicectomy with an ultrasound result indicating a diagnosis of appendicitis (p=0.018), or with a raised white cell count (p<0.001). No significant difference was found in NAR for patients residing over 50 (24.5%) or over 100 kilometres (34.5%) from the health service. However, significant increase in NAR was found for female sex at 45.7% (p<0.001) in this patient cohort.

Investigation sub-group	NAR %
Abdominal ultrasound	26.3%
Raised white cell count	15.6%

Table 1: NAR within sub-groups that had an abdominal ultrasound, and those with raised inflammatory markers. Both were statistically significant for decreased NAR.

Distance from OHS	NAR %
<50 kilometres	31.2%
50 – 99 kilometres	24.5%
>100 kilometres	34.5%
Overall	30.5%

Table 2: NAR within sub-groups separated by distance of residence from OHS. For patients residing between 50 and 99 kilometres, and over 100 kilometres from OHS there was no statistically significant difference in NAR versus patients from within 50 kilometres. Overall NAR was within published rates.

Sex	NAR %
Male	21.1%
Female	45.7%

Table 3: Table of negative appendicectomy rates in males and females. There was a statistically significant increase in risk of negative appendicectomy in females (p<0.001).

Conclusion

Although the tyranny of distance from definitive care can complicate surgical decision making, OHS as a regional referral hospital did not have an increased NAR for patients from increasingly remote locations. The overall NAR for this regional referral hospital was within the range of published figures, giving further support for the safety and efficacy of acute surgical services in remote and regional Australia. A statistically significant increased NAR was identified for patients of female sex, which may warrant further investigation. The lack of differentiation between cases booked as a paediatric appendicectomy, and those booked as a diagnostic laparoscopy where the appendix was removed, may provide some explanation for this significantly increased NAR in female sex. A further study could be designed to retrospectively or prospectively analyse any difference in NAR found between cases booked as an appendicectomy versus those booked as diagnostic laparoscopy. An ultrasound concerning for appendicitis, as well as raised inflammatory markers were both found to have statistically significant decreased occurrence of a negative appendicectomy, giving further support to their inclusion in the routine investigation of abdominal pain in children.

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