Appendicectomy in Scotland: a 20-year epidemiological comparison

Ann F. Bisset

Abstract

Background The objective of the research was to study the pattern of appendicectomies in Scotland over the last 20 years.

Method Routine National Health Service data on patients discharged after appendicectomy in Scotland during 1973–1993 were analysed.

Results For all ages, the appendicectomy rate has fallen steadily from 1.97 per 1000 (10325 operations) in 1973 to 0.96 per 1000 (4906 operations) in 1993. The proportion of emergency operations increased from 76 to 80 per cent. The median age at operation rose from 18 to 22 years. The proportion of male patients remained higher for emergency operations, whereas the proportion of females, and age at operation, were both higher for non-emergency appendicectomies. In the period 1992–1995, appendicectomy rates were higher for patients with postcodes in areas of greater deprivation, particularly for children aged 0–14 years. Variation in childhood appendicectomy rates across Scotland has declined: apart from Ayrshire and Arran, which had a lower than expected rate, no Health Board had a rate significantly different from the rate in the rest of Scotland in 1993. The case fatality rate fell from 7.0 per 1000 to 1.6 per 1000 (with all the latter deaths in elderly patients).

Conclusion Over the last 20 years, appendicectomy rates have declined in Scotland and there is now greater uniformity of childhood appendicectomy rates across Scotland.

Keywords: appendicectomy, variation, epidemiology

Introduction

Many studies have shown local decline in appendicectomy rates.1–5 This study examines Scottish data on all appendicectomies performed in National Health Service (NHS) hospitals, as a number of interesting changes in the epidemiology of appendicectomy have occurred over the last 20 years.

Methods

This study used the Scottish Morbidity Records (SMR1), generated for all non-obstetric and non-psychiatric discharges from NHS hospitals in Scotland. The criterion for inclusion was a procedure code for appendicectomy [440–445 in Office of Population Censuses and Surveys (OPCS) 2nd and 3rd revision, and H01–H03 in OPCS 4th revision] occurring between 1973 and 1993. Summary statistics for each Health Board of residence were supplied by the Information and Statistics Division (ISD) of the Scottish Health Service Common Services Agency. Thirty-day mortality was calculated by ISD using record linkage between discharge data and death certificates. Rates were calculated using mid-year population estimates supplied by the General Register Office for Scotland (Population Statistics branch) for denominators. The 1973 population data were not available for Health Board areas, so 1974 figures were used instead. Postcodes of appendicectomy patients discharged between April 1992 and March 1995 (13284 patients) were compared with the distribution of Carstairs deprivation6 scores for all postcode sectors in Scotland (based on 1991 Census data). The Scottish population was divided into ten centiles ranging from the most affluent to the most deprived, with each group containing 10 per cent of the Scottish population. The observed number of cases in each deprivation category was compared with the number expected if rates had been distributed evenly across deprivation categories, giving a standardized ratio compared with 100. Statistical analysis was performed on a microcomputer using SPSS/PC+.7 Confidence intervals were calculated using the confidence interval analysis program.8 The three Island Health Boards were excluded from statistical analysis because of small numbers.

Results

Numbers of appendicectomies

Between 1973 and 1993, the total number and rate of appendicectomies for all ages in Scotland fell from 10325 to 4906, a 52 per cent decrease (see Table 1). The decline in numbers and rates occurred gradually in all age groups (see Fig. 1).
Table 1 Number of appendicectomy operations, age rates and sex ratios in 1993 compared with 1973 in Scotland

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>All ages</td>
<td>10325</td>
<td>1.94</td>
<td>0.89:1</td>
<td>4906</td>
<td>0.96</td>
<td>1.01:1</td>
<td>0.49 (0.49-0.55)</td>
</tr>
<tr>
<td>0–15</td>
<td>4099</td>
<td>2.9</td>
<td>1.18:1</td>
<td>1522</td>
<td>1.5</td>
<td>1.24:1</td>
<td>0.52 (0.49-0.55)</td>
</tr>
<tr>
<td>16–25</td>
<td>2978</td>
<td>3.8</td>
<td>0.76:1</td>
<td>1369</td>
<td>1.8</td>
<td>1.01:1</td>
<td>0.48 (0.45-0.51)</td>
</tr>
<tr>
<td>26–35</td>
<td>1178</td>
<td>1.9</td>
<td>0.72:1</td>
<td>859</td>
<td>1.1</td>
<td>0.86:1</td>
<td>0.57 (0.52-0.62)</td>
</tr>
<tr>
<td>36–45</td>
<td>805</td>
<td>1.3</td>
<td>0.69:1</td>
<td>461</td>
<td>0.7</td>
<td>0.95:1</td>
<td>0.52 (0.46-0.58)</td>
</tr>
<tr>
<td>46–55</td>
<td>555</td>
<td>0.9</td>
<td>0.78:1</td>
<td>283</td>
<td>0.5</td>
<td>1.04:1</td>
<td>0.55 (0.48-0.64)</td>
</tr>
<tr>
<td>56–65</td>
<td>391</td>
<td>0.6</td>
<td>0.64:1</td>
<td>182</td>
<td>0.3</td>
<td>0.80:1</td>
<td>0.53 (0.45-0.64)</td>
</tr>
<tr>
<td>66–75</td>
<td>225</td>
<td>0.5</td>
<td>0.76:1</td>
<td>150</td>
<td>0.3</td>
<td>0.74:1</td>
<td>0.63 (0.51-0.78)</td>
</tr>
<tr>
<td>76+</td>
<td>94</td>
<td>0.4</td>
<td>0.71:1</td>
<td>80</td>
<td>0.3</td>
<td>0.54:1</td>
<td>0.57 (0.42-0.77)</td>
</tr>
</tbody>
</table>

**Age and sex**

The median age at operation rose from 18 years in 1973 to 22 years in 1993. For all ages, the proportion of appendicectomies in males has risen gradually from 47 per cent in 1973, reaching 49 per cent in 1983, and 51.6 per cent in 1993 (the proportion of males in the population remained unchanged at 48 per cent). In the reproductive years (from age 13 to 45 years inclusive), the proportion of operations on females decreased from 57.4 per cent in 1973 to 50.9 per cent in 1993. The ratio of male: female operations was highest at ages 0–6 years (1.48:1 in 1973 and 1.44:1 in 1993).

**Social class**

Analysis of appendicectomies by postcode of residence showed an increase in appendicectomy rates with increasing deprivation, particularly at ages 0–14 years (see Fig. 2).

![Figure 1 Number of appendicectomies (all ages) and deaths by year.](https://academic.oup.com/jpubhealth/article-abstract/19/2/213/1500293/APPENDICECTOMIES+DEATHS)
APPENDICECTOMY IN SCOTLAND

Seasonality

There was no clear seasonal pattern in operations in either 1973 or 1993, or throughout the 20-year period.

Variation across Scottish Health Boards

In 1973, appendicectomy rates in children aged 0-15 years in Scotland ranged across Health Boards from 2.20 to 4.79 per 1000 – a 2.18 variation [95 per cent confidence interval (CI) 1.81–2.62] with a mean of 2.85 per 1000 (4099 operations). By 1993, the rate in children aged 0–15 years had fallen to 1.47 per 1000 (1522 operations). There was no significant difference between the rate in any Health Board compared with the rate in the rest of Scotland, apart from Ayrshire and Arran (see Fig. 3 and Table 2).

Operation performed

The types of procedures performed are shown in Table 3.

Deaths

The case-fatality rate declined from 7.0 per 1000 (95 per cent CI 5.5–8.7) in 1973 to 1.6 per 1000 (95 per cent CI 0.5–2.8) in 1993. In 1973 there were 72 hospital deaths after appendicectomy, 15 of which were aged 0–15 years, 40 were aged 16–59 years, and 17 were aged 60 and over. Thirty-six per cent (26) were male. In 1993 there were eight hospital deaths after appendicectomy, all occurring in patients aged 60 and over. Twenty-five per cent (two) were male. (According to data linkage, there were no additional later deaths in the community within 30 days of operation.) Thirty-two per cent (144/450) of the deaths in the 20-year period occurred in the two years 1973 and 1974. Deaths then fell to 25 per year in 1975, and have declined fairly steadily since then (see Fig. 1).

Discussion

The fall in appendicectomy rates and in variation across Scottish Health Boards is striking. This continues the trend noted by Howie, who estimated that the number of adult appendicectomies in Scotland declined from 17 270 in 1954 to 12 670 in 1963.9 Previous studies have found that coding of the principal operation was correct in 90 per cent of SMR1 forms, with fewer errors in general surgery than other specialties.10 From the study by Driver and Youngson1 in Grampian, the proportion of childhood appendicectomies for histologically proven appendicitis rose from 84 per cent in 1967 to 96 per cent in 1992, so the fall in the true rate of appendicitis may be rather less than the 52 per cent decline in appendicectomies. This contrasts with the 1960s when 'microscopical reports were rarely available, so any appendix not regarded by the clinician as clearly abnormal was classed as normal'.9 It is not known whether other Health Boards have the same positive histology rate, but it is interesting that the Scottish rates are almost twice those found in North Tees General Hospital, where the incidence of acute appendicitis fell from 100 to 52 per 100 000 between 1975 and 1991,2 and where histological evidence of appendicitis was recorded in each case. Part of the explanation may be that North Tees used the hospital catchment area as the denominator, whereas rates in this study use Health Board of residence.

Despite different theories about the role of diet and infection,11,12 the cause of appendicitis remains elusive. It is therefore uncertain whether there has been a real change in the incidence of appendicitis, or whether the presentation and course of the disease has changed; for example, it has been suggested that the course of appendicitis owing to faecoliths may be more acute than that owing to lymphoid hyperplasia.13 Technological changes, such as laparoscopy14 and ultrasound,15
may avoid some unnecessary operations. The proportion of operations performed as an emergency has increased, and refinement of operation codes now gives more detail about appendicectomy procedures. Greater accuracy of diagnosis (and differentiation from gynaecological disease) may explain the fall in the proportion of non-emergency appendicectomies in females of reproductive age. However, non-emergency appendicectomies have continued to show a different epidemiology, with preponderance of females, and older age at operation. This pattern also pertains for ‘emergency appendicectomy with removal of a normal appendix’, raising questions about whether assessment criteria for these patients need further refinement.¹⁵,¹⁶

Table 2 The 95% CIs for appendicectomy rates in children aged 0–15 years in 1973 and 1993 by Health Board of residence (Island Boards are included in Scottish total, but not analysed separately)

<table>
<thead>
<tr>
<th>Board</th>
<th>1973 Rate/1000 (No. of ops.)</th>
<th>1993 Rate/1000 (No. of ops.)</th>
<th>95% CI for difference from rest of Scotland in 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scotland</td>
<td>2.89 (4099)</td>
<td>1.47 (1522)</td>
<td>-0.19 to +0.03</td>
</tr>
<tr>
<td>Argyll &amp; Clyde</td>
<td>2.36 (303)</td>
<td>1.31 (117)</td>
<td>-0.70 to -0.21</td>
</tr>
<tr>
<td>Ayrshire &amp; Arran</td>
<td>2.20 (222)</td>
<td>1.06 (82)</td>
<td>-0.81 to +0.15</td>
</tr>
<tr>
<td>Borders</td>
<td>3.16 (74)</td>
<td>1.15 (23)</td>
<td>-0.14 to +0.85</td>
</tr>
<tr>
<td>Dumfries &amp; Galloway</td>
<td>4.38 (163)</td>
<td>1.82 (53)</td>
<td>-0.49 to +0.04</td>
</tr>
<tr>
<td>Fife</td>
<td>2.98 (266)</td>
<td>1.26 (91)</td>
<td>-0.18 to +0.51</td>
</tr>
<tr>
<td>Forth Valley</td>
<td>3.28 (238)</td>
<td>1.63 (69)</td>
<td>-0.23 to +0.16</td>
</tr>
<tr>
<td>Greater Glasgow</td>
<td>2.65 (613)</td>
<td>1.45 (264)</td>
<td>-0.25 to +0.23</td>
</tr>
<tr>
<td>Grampian</td>
<td>2.90 (322)</td>
<td>1.46 (157)</td>
<td>-0.47 to +0.24</td>
</tr>
<tr>
<td>Highland</td>
<td>4.79 (228)</td>
<td>1.36 (60)</td>
<td>-0.09 to +0.39</td>
</tr>
<tr>
<td>Lanarkshire</td>
<td>2.95 (495)</td>
<td>1.61 (193)</td>
<td>-0.17 to +0.27</td>
</tr>
<tr>
<td>Lothian</td>
<td>2.49 (476)</td>
<td>1.52 (215)</td>
<td>0.00 to 0.62</td>
</tr>
<tr>
<td>Tayside</td>
<td>3.81 (387)</td>
<td>1.76 (136)</td>
<td>(99% CI -0.09 to 0.71)</td>
</tr>
</tbody>
</table>
The proportion of male operations in Scotland differs from US data, where appendicitis rates are quoted as 1.2–2.3-fold higher in males.

The gradual increase in the median age of incidence is also unexplained. This contrasts with a US study between 1985 and 1990 where the number of children aged under 13 years with appendicitis increased, and particularly those aged less than six years. In the United Kingdom, appendicectomy used to be more common in the more affluent socio-economic groups, but this study found that the incidence in 1993 tended to increase with increasing deprivation, as is the case for tonsillectomy. This study found no evidence of seasonality, in contrast to a US study which found a higher incidence from May to August, compared with November to February.

The increasing uniformity of childhood appendicectomy rates across Scottish Health Boards in 1993 is similar to Wennberg’s findings in Vermont, and the incidence for all ages is close to US rates of 0.96–1.2 per 1000 for all ages. This uniformity of rates contrasts with the two-fold variation across Scotland in 1973. Such variation still persists for other common childhood operations (e.g. tonsillectomy rates varied two-fold, and grommet rates varied four-fold in Scottish children in 199020,21). The lack of variation in appendicectomy accords with the high positive histology rate in Grampian, and supports the view that improved management policies may have helped to reduce ‘professional uncertainty’, unnecessary operations and variation in surgical practice. However, there are still interesting epidemiological contrasts within the United Kingdom, and with the United States, which merit further research and audit.

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7 SPSS/PC+. Chicago, IL: SPCC Inc. 1990.


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