

Appendectomies in rural hospitals

Safe whether performed by specialist or GP surgeons

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ABSTRACT

OBJECTIVE To compare outcomes of appendectomies performed in rural hospitals by specialist surgeons and GP surgeons.

DESIGN Retrospective analysis of the Canadian Institute for Health Information's (CIHI) Discharge Abstract Database (DAD) 1996-1999.

SETTING Rural hospitals in Ontario, Saskatchewan, Alberta, and British Columbia.

PARTICIPANTS All surgeons who performed appendectomies in these hospitals during the study period.

MAIN OUTCOME MEASURES Mortality; diagnostic accuracy, perforation, and repeat laparotomy rates; length of stay; and need for transfer to another acute-care institution.

RESULTS Specialist surgeons performed 3624 appendectomies; GP surgeons performed 963. Rates of comorbidity, diagnostic accuracy, and transfer, and mean lengths of stay were similar for patients of GP and specialist surgeons. Patients operated on by specialists were older and more likely to have perforations and to require second intra-abdominal or pelvic procedures. Triage to a specialist, older age, and comorbidity all independently predicted perforation. Only perforation predicted a second intra-abdominal or pelvic procedure.

CONCLUSION Appendectomy is a safe procedure in rural hospitals, whether performed by specialist or GP surgeons. Some difficult cases are routinely referred to specialists.

RÉSUMÉ

OBJECTIF Comparer les résultats des appendicectomies effectuées dans les hôpitaux régionaux par des chirurgiens spécialisés ou généraux.

TYPE D'ÉTUDE Analyse rétrospective à partir de la Base de données sur les congés des patients (1996-1999) de l'Institut canadien d'information sur la santé (ICIS).

CONTEXTE Hôpitaux régionaux d'Ontario, de Saskatchewan, d'Alberta et de Colombie-Britannique.

PARTICIPANTS Tous les chirurgiens ayant effectué des appendicectomies dans ces hôpitaux durant la période mentionnée.

PRINCIPAUX PARAMÈTRES ÉTUDIÉS Mortalité; précision des diagnostics, taux de perforations et de ré-opérations; durée d'hospitalisation; besoin de transfert à un autre établissement de soins actifs.

RÉSULTATS Sur l'ensemble des appendicectomies, les chirurgiens spécialisés en avaient effectué 3624 et les chirurgiens généraux 963. Les taux de co-morbidité et de transfert, et la précision des diagnostics étaient semblables dans les deux groupes. Les patients opérés par les spécialistes étaient plus âgés et plus susceptibles d'avoir des perforations et de nécessiter des ré-interventions abdominales ou pelviennes. L'âge avancé, la présence de maladies préexistantes et le fait d'être dirigé vers un spécialiste étaient tous des indicateurs indépendants de perforation. La perforation était le seul indicateur d'une éventuelle ré-intervention abdominale ou pelvienne.

CONCLUSION L'appendicectomie effectuée dans un hôpital régional est peu risquée, qu'elle soit faite par un chirurgien général ou spécialisé. Certains cas difficiles sont systématiquement dirigés vers des spécialistes.

This article has been peer reviewed.

Cet article a fait l'objet d'une évaluation externe.

Can Fam Physician 2003;49:328-333.

In 1995-1996, 2605 appendectomies were performed in rural Canada.¹ Of these, 669 (25.7%) were performed by non-certified general practice surgeons. These GP surgeons were Canadian rural family physicians with additional training in surgery and international medical graduates (IMGs) with surgical training.

Currently two formal postgraduate training programs in general surgery for rural family physicians are offered at the University of Alberta and the University of British Columbia. Each program offers two training positions annually for 12 months' duration. Some IMG surgeons have training similar to the advanced skills programs provided to rural family physicians in Canada. Other IMGs have much more surgical training; some have fellowship training overseas that is not recognized in Canada.

How well do these GP surgeons do? There is almost no evidence in the literature. In a MEDLINE review using the terms outcomes, rural surgery, and family physicians, Humber and Iglesias found no relevant studies.² Two small, recent studies compared outcomes of appendectomies performed by local GP surgeons in two rural British Columbia communities with those performed by Canadian-certified specialist (CCS) surgeons in referral centres. The authors of both papers concluded there was no difference in outcomes.^{3,4}

Faced with a shortage of CCS surgeons,^{5,6} there is some controversy over policies to meet rural surgical needs. The College of Family Physicians of Canada's *Report on Postgraduate Medical Education for Rural Family Practice* recommended that rural family physicians continue to take training in advanced skills, including general surgery.⁷ The Canadian Association of General Surgeons, however, remains deeply skeptical about allowing rural family physicians to perform major surgical procedures, such as appendectomy and laparoscopy, which they believe should remain the responsibility of full-time CCS surgeons.⁸

The many issues in this debate are complex. It is clear, however, that resolving them will be assisted by

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further documentation of outcomes of surgical procedures performed by rural GP surgeons and CCS surgeons. This study was designed to provide such documentation.

METHODS

Data for this study were gathered from the Canadian Institute for Health Information's (CIHI) Discharge Abstract Database (DAD). This database includes all abstracted acute inpatient data for seven provinces, 85% of data for Prince Edward Island, 40% of data for Manitoba, and none for Quebec, which does not participate.

From a previous study¹ we learned that most rural surgical programs that included both GP surgeons and specialist surgeons were based in Ontario and western Canada. Hence, we chose to extract data from April 1, 1996, to March 31, 1999, on rural surgeries performed in Ontario, Saskatchewan, Alberta, and British Columbia.

Rural hospitals with surgical services were identified from our earlier study¹ that selected rural family physicians and specialists providing appendectomy services from the CIHI's National Physician Database. Rural hospitals were defined as hospitals where most or all specialist services provided locally were carried out by non-specialist medical staff. The hospitals were chosen by a network of family physicians across Canada who selected those that had, in most circumstances, two or fewer specialist physicians on active staff and residing in the community.

From these hospitals' records we extracted data for 4587 admissions for appendectomies (Canadian Classification of Procedures [CCP] code 59.0 in any of the 10 procedure fields). We sought information on patients' age, existing comorbidity (diagnosis type 1 in any of the 16 fields with a corresponding diagnosis that is not appendicitis [540-543]), and several measured outcomes (direct and indirect). Outcomes included:

- mortality: deaths identified by the "exit alive" field being blank and "patient death or stillbirth" noted;
- diagnostic accuracy rate: diagnostic codes 540.0, 540.1, or 540.9 in any of the 16 diagnostic fields. Codes are based on pathology reports from surgical specimens;
- perforations: diagnostic code 540.0, peritonitis, or 540.1, abscess, in any of the 16 diagnostic fields. Codes are based on pathology reports from surgical specimens;
- length of stay: number of days in hospital;

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- repeat laparotomy: a second intra-abdominal or pelvic procedure defined as an admission with CCP codes 54.00 to 66.99 (excluding 59.0) in any of the 10 procedure fields that was performed on a day subsequent to the appendectomy; and
- transfer to another acute care institution: transfers identified by "institution to type" field with code 1, transfer to acute care. Because length of stay is short for appendectomy, we inferred that postoperative transfers would be to a higher level of care because of complications.

General practice surgeons were defined using CIHI's doctor service codes 01 (family practitioner) and 07 (general practitioner). Specialist surgeons were defined using doctor service code 30 (general surgeon) designating CCS surgeons. While CCS surgeons' training is standardized by the Royal College of Physicians and Surgeons, GP surgeons' training varies enormously. A related study⁹ has identified two important subgroups of GP surgeons: the larger one (62%) comprises physicians with more than 12 months' postgraduate surgical training (most of these physicians are IMGs, some with full foreign fellowships); and the smaller (38%) comprises physicians with 12 months' or less of postgraduate surgical training (most of these physicians are Canadian-trained).

Mean outcomes of GP surgeons' patients were compared using *t* tests with those of CCS surgeons' patients with and without comorbidity. Fisher's exact test was used to compare proportions and rates of outcomes between groups. Logistic regression models were constructed to identify predictors of perforations and of second intra-abdominal or pelvic procedures. All analyses were performed using Statistical Package for the Social Sciences, version 10.0.¹⁰ *P* value was set at <.05.

RESULTS

During the study period 4587 appendectomies were performed (963 by GP surgeons and 3624 by CCS surgeons) in the chosen hospitals. Average age of patients undergoing appendectomy was 27.7 years. Of all patients undergoing appendectomy, 12.8% had one or more comorbid diagnoses on admission. The diagnostic accuracy rate was 77.6%. The perforation rate was 30.6%. Only one patient died (due to Gram-negative septicemia).

Pre-existing comorbidity, diagnostic accuracy, and transfer rates and mean length of stay (overall and for patients with perforations) were similar for patients of

GP and CCS surgeons. Patients operated on by CCS surgeons were older and were more likely to have perforations and to require second intra-abdominal or pelvic procedures following appendectomy (**Table 1**). In logistic regression models, having a CCS surgeon, being older (>50 years), and having comorbidity all independently predicted perforation (**Table 2**). Only perforation was a statistically significant, independent predictor of a second intra-abdominal or pelvic procedure (**Table 3**).

Patients with at least one comorbid condition were older on average than patients without comorbidity, had lower diagnostic accuracy rates, had higher perforation rates, and were in hospital on average longer whether their cases were complicated or uncomplicated. Although rates of second intra-abdominal or pelvic procedure and transfer were higher among patients with comorbidity, the difference was not statistically significant (**Table 4**).

Table 1. Appendectomies performed by Canadian-certified specialist (CCS) and GP surgeons, 1996-1998

PATIENT CHARACTERISTICS	OVERALL N = 4587	GP SURGEONS N = 963	CCS SURGEONS N = 3624	P VALUE
Average age (y)	27.7	25.9	28.1	.000*
With comorbidities (%)	12.8	11.9	13.1	.358†
Appendicitis confirmed (%)	77.6	77.8	77.6	.931†
Perforation (%)	30.6	23.4	32.5	.000†
Average length of stay (days)				
• All cases	3.5	3.4	3.6	.095*
• Perforations only	5.3	5.2	5.4	.526*
Second procedure required (n, %)	31, 0.7	2, 0.2	29, 0.8	.046†
Transferred (n, %)	96, 2.1	18, 1.9	78, 2.2	.704†
No. who died	1	0	1	1.000†

*Using *t* test.

†Using Fisher's exact test.

Table 2. Logistic regression model: predictors of perforations

PREDICTOR	ODDS RATIO	95% CONFIDENCE INTERVAL	P VALUE
Specialist surgeon	1.48	1.22-1.79	.000
Age (y) (categorical)			
• 0-49	0.0(reference)		
• 50-74	0.60	0.46-0.77	.000
• ≥75	1.97	1.44-2.68	.000
Comorbidity	1.55	1.21-1.97	.000

Table 3. Logistic regression model: predictors of second intra-abdominal or pelvic procedure

PREDICTOR	ODDS RATIO	95% CONFIDENCE INTERVAL	P VALUE
Specialist surgeon	3.36	0.80-14.18	.099
Age (y) (categorical)			
• 0-49	0.0 (reference)		
• 50-74	0.56	0.19-1.65	.291
• ≥75	0.86	0.25-3.02	.813
Comorbidity	1.85	0.78-4.39	.165
Perforation	3.45	1.66-7.17	.001

Table 4. Influence of comorbidity on outcomes: Average age of patients with and without comorbid diagnoses was 33.8 years and 26.8 years, respectively (P = .000).

OUTCOMES	WITH COMORBIDITY	WITHOUT COMORBIDITY	P
Appendicitis confirmed (%)	55.5	80.9	.000*
Perforations (%)	42.8	29.3	.000*
Average length of stay (days)			
• All cases	5.1	3.3	.000†
• Perforations only	8.0	5.0	.000†
Second procedure required (n, %)	7, 1.2	24, 0.6	.107*
Transferred (n, %)	16, 2.7	80, 2.0	.278*
No. of deaths (n, %)	1, 0.2	0	.128*

*Using Fisher's exact test.

†Using t test.

DISCUSSION

Comparing GP and CCS surgeons

Patients operated on by CCS surgeons were older and were more likely to have perforations and to require second intra-abdominal or pelvic procedures. Average length of stay, diagnostic accuracy rates, and rates of transfer were similar for patients of GP and CCS surgeons. One patient of a CCS surgeon died.

Higher perforation and repeat procedure rates among CCS surgeons' patients are likely due to these patients' being at higher risk. The literature clearly shows that the likelihood of perforation is much higher in very young, elderly, and very ill patients,¹¹⁻¹⁴ precisely those more likely to be referred to CCS surgeons. Although GP and CCS surgeons had similar proportions of patients with at least one comorbid condition,

differences in types, number, and severity of comorbidity were not examined. Patients of CCS surgeons might well have had more serious comorbidity. The persistence of surgeon designation as an independent predictor of perforation in the logistic regression analysis could be due to inadequate adjustment for patients' comorbidity. It would seem logical that the higher repeat laparotomy rate among CCS surgeons' patients is partly due to their higher rate of perforations. Logistic regression analyses confirm this.

Other explanations should be considered. There is consensus in the literature that the most important explanatory factor in incidence of perforation is delay in definitive surgical therapy.¹¹⁻¹⁴ Delays could be due to patients' tardiness in seeking medical attention or to delays between hospitals before surgery. Our database gives no information on either "time to presentation" or "time to surgery." There is no reason to expect patients would present earlier or later depending on whether the surgical service was GP or specialist. Nor would we expect any subsequent time-to-surgery difference. There is an association between delay in laparotomy (due to improved clinical diagnosis) and perforation.^{11,12} The virtually identical diagnostic accuracy rates suggest that there were no significant differences in delays between GP and CCS surgeon groups.

Comparisons with other studies

In our study, appendectomy was found to be a safe procedure; only one among 4587 (0.02%) patients died. This rate is similar to other reported series.^{11,12} Diagnostic accuracy (77.6%) and perforation (30.6%) rates are also similar to those in other major studies (67% to 85% and 17% to 39%, respectively).^{11,12}

Transfers to urban centres

Comorbidity marks a distinct group of patients for whom diagnostic accuracy rates are significantly lower (55.5%), perforation rates are higher (42.8%), and associated complications are more likely. These patients might be better served in urban surgical services with access to advanced diagnostic technology, such as computed tomography.

Limitations

Our study has several potential limitations. First, the GP surgeons were a heterogeneous collection of Canadian physicians and IMGs with large variations in surgical training. The DAD did not list amount of surgical training. Hence, we can conclude that, as a group, the GP surgeons had outcomes that were

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safe and comparable to those of CCS surgeons, and, by inference, that some lesser level of training than that of a Canadian fellowship is acceptable for rural practice. The data do not allow us to examine whether there were differences in outcomes between Canadian graduates from the 12-month third-year postgraduate program and their IMG colleagues with much more extensive training. There were, however, no deaths among the patients of any of these surgeons.

Second, the medical records staff responsible for abstracting hospital discharge data are required to distinguish between IMG fellowship surgeons practising as full-time rural surgical specialists (still GP surgeons) and CCS surgeons. We worried that this might be prone to error. Telephone interviews with the rural hospitals where we thought mistakes in assigning specialist status might have been made, however, confirmed that the classifications were appropriate.

Third, the accuracy of the data on appendectomy and related comorbidity and complications has not been confirmed. Recent studies¹⁵⁻¹⁷ have examined the accuracy of Canadian hospital discharge data on knee replacement surgery,¹⁵ myocardial infarctions,¹⁶ and percutaneous coronary interventions.¹⁷ Data on demographics,¹⁵ primary diagnosis,¹⁶ and procedures¹⁵ were found to be accurate. Comorbidity¹⁵⁻¹⁷ and in-hospital complications¹⁵ were found to be underreported. Because our study relied principally on demographics, primary diagnosis, and procedures, we would expect the data to be, in general, accurate. Two diagnostic variables in our study, appendicitis and perforation, were extracted from pathology reports. Differences in comorbidity (measured by presence of any comorbid diagnosis) and severity of illness between patients of GP surgeons and CCS surgeons might not be adequately captured.

Fourth, we assessed only the index reason for hospitalization. Therefore, comparison of postdischarge occurrences, such as wound infections and readmission rates, could not be made. By capturing length of stay; perforation, repeat laparotomy, and death rates; and patient transfers to another level of care, however, we expect we captured most of the serious complications associated with appendectomies performed in rural Canada.

Opportunities for future research

While the CIHI's DAD data have, to some extent, been validated for other major procedures and diagnoses, the accuracy and completeness of data on appendectomy and related comorbidity and

Editor's key points

- This study compared outcomes of appendectomy performed by non-specialist (GP) and Canadian-certified specialist surgeons in four Canadian provinces.
- Pre-existing diseases, diagnostic accuracy, transfer rates, and mean length of stay were similar for patients of GP and specialist surgeons.
- Patients operated on by specialists tended to be older and were more likely to have complications of perforations and to require second operations.
- More difficult cases seemed to be referred to specialist surgeons.

Points de repère du rédacteur

- Cette étude compare les résultats d'appendicectomies effectuées par des chirurgiens généraux ou spécialisés (diplôme canadien) dans quatre provinces canadiennes.
- La présence de maladies préexistantes, la précision des diagnostics, les taux de transfert et les durées moyennes d'hospitalisation étaient les mêmes dans les deux groupes.
- Les patients opérés par les spécialistes étaient généralement plus âgés et plus susceptibles d'avoir des complications de perforation et de nécessiter des ré-interventions.
- Les cas plus difficiles étaient apparemment dirigés aux chirurgiens spécialisés.

complications has not been studied. Also, while this paper looks at the outcomes of GP surgeons as a group, we are aware that there were considerable variations in these physicians' training backgrounds. It will be important to design a study to explore associations between outcomes and length of training program. Finally, a prospective study should closely examine differences in comorbidity, severity of illness, and post-discharge events, such as wound infections and readmissions, of patients cared for by different types of surgeons.

Conclusion

Appendectomy is a safe procedure in rural hospitals whether it is performed by CCS surgeons or GP surgeons with less postgraduate training. Some practical risk management, in the form of referring more difficult cases to CCS surgeons, is apparent. Patients operated on by CCS surgeons are older and are more likely to experience perforations and repeat laparotomies. Length of stay, diagnostic accuracy rates, and rates of transfer to other acute care hospitals are similar for patients of GP and CCS surgeons. ❁

Acknowledgment

This project was generously supported by the Canadian Institute for Health Information (CIHI). The authors particularly wish to acknowledge the support and contribution of Ms J. Strachan, Manager of Health Human Resources at the CIHI.

Contributors

All the authors contributed substantially to each stage of the project and provided feedback and critical commentary on the final manuscript. As principal author, **Dr Iglesias** was fully involved at each stage of the project. **Ms Tracy** gathered the data. **Dr Saunders** and **Ms Thangisalam** contributed to project design and analyzed and interpreted the data. **Ms Jones** took part in initial study design.

Competing interests

None declared

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