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# Gallbladder disease in northwestern Ontario: the case for Canada's first rural ERCP program

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**Introduction:** The rate of cholecystectomy in northwestern Ontario is double the provincial rate. This paper explores the demographics of cholecystectomy and the role for rural endoscopic retrograde cholangiopancreatography (ERCP) services in the central part of this region.
**Methods:** We conducted a literature review of ERCP services and cholecystectomy rates, as well as a hospital chart review of patients who underwent laparoscopic cholecystectomies in Sioux Lookout, Ont. We contacted surgeons and gastroenterologists from referral centres in Winnipeg, Man., and Thunder Bay, Ont., for the charts of patients from our catchment area who underwent ERCP.
**Results:** Patients in our region who require urgent and emergent surgery are flown by fixed-wing aircraft to referral centres in Winnipeg and Thunder Bay for assessment and surgery. The rate of ERCP in our population is 150 in 100 000, which is threefold that of other populations, and our cholecystectomy rate is the highest in Ontario.
**Conclusion:** Substantial savings in transportation expenses would offset the development costs of an ERCP program and provide more integrated patient care. The volume of patients would support maintenance of competency. This rural area with a high rate of gallbladder disease would benefit from the development of a rural ERCP program.

**Introduction :** Le taux de cholécystectomie dans le nord-ouest de l'Ontario est deux fois plus élevé que celui de la province dans son ensemble. Cet article explore les caractéristiques démographiques de la cholécystectomie et le rôle des services ruraux de cholangiopancréatographie rétrograde endoscopique (CPRE) dans le centre de cette région.
**Méthodes :** Nous avons effectué une étude documentaire des services de CPRE et des taux de cholécystectomie, ainsi que des dossiers hospitaliers des personnes qui ont subi une cholécystectomie par laparoscopie à Sioux Lookout (Ont.). Nous avons communiqué avec des chirurgiens et des gastroentérologues de centres de référence à Winnipeg (Man.) et Thunder Bay (Ont.) pour obtenir les dossiers des patients de notre bassin qui ont subi une CPRE.
**Résultats :** Les patients de notre région qui ont besoin d'interventions chirurgicales d'urgence et d'extrême urgence sont transportés par avion à des centres de référence à Winnipeg et Thunder Bay pour évaluation et chirurgie. Le taux de CPRE dans notre population s'établit à 150:100 000, ce qui est trois fois plus élevé que celui d'autres populations, et notre taux de cholécystectomie est le plus élevé en Ontario.
**Conclusion :** Des réductions importantes des dépenses en frais de transport compenseraient les coûts d'établissement d'un programme de CPRE et fourniraient aux patients des soins mieux intégrés. Le volume des patients appuierait le maintien de la compétence. Cette région rurale qui a un taux élevé d'affections de la vésicule biliaire bénéficierait de l'établissement d'un programme rural de CPRE.



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## INTRODUCTON

This paper explores the demographics of cholecystectomy and the role for a rural endoscopic retrograde cholangiopancreatography (ERCP) service in northwestern Ontario. We hypothesized that it would be economically feasible to establish an ERCP program in our rural hospital based on geography, patient demographics, current and expected surgical volumes, and past referral patterns.

The rate of cholecystectomy in the Kenora–Rainy River District of northwestern Ontario is double the provincial rate.[1] A large part of the Kenora–Rainy River District is served by the Sioux Lookout Meno Ya Win Health Centre, which has a vast service area of 385 000 km$^2$ (roughly one-third of Ontario's land mass). The 30 000 population served by our catchment area is 82% First Nation,[2] a population known to have high rates of gallbladder disease.[3]

Urgent and emergent surgery involves an airplane medevac from a remote northern community to Sioux Lookout, Ont., for assessment and surgery. If more specialized surgery or anesthesia are required, the patient is flown 300 km to a referral centre in Thunder Bay, Ont., or Winnipeg, Man. We presently have a full complement of 2 general surgeons funded through the Northwestern Ontario Regional Surgical Network who perform laparoscopic cholecystectomies but not ERCPs.

## METHODS

### Literature review

To understand the feasibility of an ERCP service in our area, we undertook a literature search on MEDLINE and Embase, 1950–present, for cholangiopancreatography, endoscopic retrograde; incidence; practice guideline; and quality control. We searched for cholecystectomy rates in publications of the Institute for Clinical Evaluative Sciences.

### Chart reviews

We reviewed the hospital charts of all patients who underwent laparoscopic cholecystectomies in Sioux Lookout in the 2-year period from April 2007 to April 2009. Referral tertiary care surgeons and gastroenterologists in Winnipeg and Thunder Bay were contacted for the charts of ERCP patients from our catchment area, who were identified by postal codes. Ethics approval was granted by the Meno Ya Win Research Review Committee.

## RESULTS

### Literature review

We reviewed a total of 439 abstracts and chose 25 articles based on relevance to our setting.

*Provincial trends in cholecystectomies*

Historically, laparoscopic cholecystectomies began in Sioux Lookout in 1992, with 100 performed annually, each with an intraoperative cholangiogram.

A 2005 analysis of the global increase in cholecystectomy surgery with the introduction of laparoscopic technique in the 1990s found a subsequent reduction in the rate of acute cholecystitis because of earlier surgical intervention.[4]

The regional rate of laparoscopic cholecystectomies in Sioux Lookout is now the highest in the province (Table 1[1,5,6]). Since the introduction of laparoscopic cholecystectomies in the 1990s, times have changed again with the development of ERCP. Currently, any suggestion of stone in the duct or cholestatic increase in hepatic enzymes generally warrants an ERCP precholecystectomy, and intraoperative cholangiograms have become dramatically less common.

*Trends in ERCP*

Use of ERCP reached its peak in the United States in 1995, with a threefold increase from 1988.[7] It has declined since then. Much of that decline is because of decreased use of ERCP for diagnostic purposes when safer options exist: endoscopic ultrasonography and magnetic resonance cholangiopancreatography (MRCP). Most ERCPs are now done for therapeutic indications.[8,9] From 2002 to 2007, indications for the procedure changed dramatically. Stone retraction accounted for 94% of ERCPs in 2007 but only 38% in 2002.[8,10]

**Table 1. Characteristics of laparoscopic cholecystectomy in Ontario in 1990 and 1994**

| Characteristic | 1990 | 1994 |
|---|---|---|
| Length of stay, d[5] | 7.5 | 2.6 |
| Conversion to open surgery, %[6] | NA | 5.3 |
| Bile duct injury, %[6] | NA | 1.16 |
| LC rate, Ontario[1] | 311/100 000 | 339/100 000 |
| LC rate, northwestern Ontario[1] | 503/100 000 | 534/100 000 |

LC = laparoscopic cholecystectomy; NA = data not available.

Presently, the international rate of ERCPs pre-cholecystectomy is between 7% and 17%,[9,11] and the annual US population rate is 50 in 100 000.[7] Rates of post-ERCP pancreatitis vary internationally from 4% to 15%.[12,13]

A 10-year prospective analysis of a rural ERCP program in West Australia[12] was the only program identified as rural. This series of 700 consecutive ERCPs in a catchment area serving a population of 26 000 over 10 years demonstrated a 94% success rate and 4% pancreatitis rate. Seventy-eight percent were done for therapeutic reasons, mostly stone retrieval.[11]

*Training in ERCP*

ERCP is one of the "most technically demanding and highest risk procedures performed by endoscopists."[14] Training therefore requires the documented performance of a substantial volume (100[15]–200[14]) of successful (> 80% cannulations[16]) procedures for the training fellow. The present clinical training climate also favours therapeutic over diagnostic procedures.[16] Training benchmarks for an experienced endoscopist for ERCPs are undocumented. Maintenance of competency is felt to require at least 50 procedures annually.[16,17] The proposed competency threshold for sphincterotomies is 40–80 successful procedures.[14,17]

A review of 199 625 inpatient ERCPs in the US from 1998 to 2001 demonstrated that 70% of inpatient ERCPs in the US are done in hospitals that perform fewer than 100 procedures annually, and the mean number of inpatient ERCPs is 48 per hospital per year.[8] Numbers do not tell the whole story. Competence is widely agreed to rely on documented successful procedures and complication records of individual providers.[18]

*First Nation patients and gallbladder disease*

First Nation patients are known to have high rates of gallbladder disease in many constituencies in North America:[3] Micmac in Nova Scotia,[19] Ojibwa and Cree of Manitoba[20] and Ontario,[3] Chippewa in Minnesota[21] and Pima in Arizona.[22] Genetic and environmental factors are involved. Traditionally, pregnancy, obesity and female sex are associated with gallbladder disease. Biochemical analyses of bile assays in First Nation patients in the 1970s noted "lithogenic bile."[23,24] Early and increased multiparity in many First Nation women accompanied by a Western diet high in calories and low in fibre also predispose First Nation people to risk for gallbladder disease.[24] Metabolic syndrome, a defined constellation of obesity, type 2 diabetes, hypertension and hypercholesterolemia may also play a role.[3]

A 1984 study in Manitoba that compared First Nation people to the general population found that First Nation women with gallbladder disease had a younger mean age (39.9 v. 52 yr).[19] The latter age is consistent with other non-Aboriginal series that identify the mean age of women with gallbladder disease as 46–52 years.[25–28] In 1989, a community-based research initiative in northwestern Ontario and northern Manitoba First Nation communities demonstrated a prevalence of all gallbladder disease of 18.5% in women aged 20–64 years.[3] At that time, the mean age of women with gallbladder disease in Canada was 42.4 years. Interestingly, total cholesterol and low-density lipoprotein were lower in patients with gallbladder disease, compared with patients without gallbladder disease.[3] There was also no association with obesity or diabetes in the 395 cases studied.[3]

**Chart reviews**

*Cholecystectomy and ERCP in Sioux Lookout*

From 2007 to 2009, 74 cholecystectomies were performed annually in Sioux Lookout. Because we have recently recruited our second surgeon to complete our complement, we expect this number will increase. In the first quarter of 2009 we had already performed more than 50 laparoscopic cholecystectomies, and we anticipate we will soon be performing more than 200 procedures annually. Of the patients who underwent cholecystectomy in the 2-year time frame, 14% required an ERCP ($n$ = 21 interventions in 17 patients). Patient characteristics are shown in Tables 2 and 3.

*ERCP in patients from our catchment area*

A survey of our referral centres in Winnipeg and Thunder Bay found a 2-year total of 89 ERCPs performed

**Table 2. Sex of 148 patients who underwent laparoscopic cholecystectomy in Sioux Lookout from 2007 to 2009, by age**

| Age, yr | Male | Female |
|---|---|---|
| < 18 | 1 | 8 |
| 18–44 | 15 | 90 |
| 45–64 | 16 | 13 |
| ≥ 65 | 4 | 1 |
| Total | 36 (25%) | 112 (75%) |

on patients from our catchment area, showing an annual rate of 150 in 100 000. This number included the 21 procedures mentioned above and patients who were referred to a tertiary care centre for both ERCP and cholecystectomy.

*Patient transportation*

Medical transportation of patients was important because the 148 patients who underwent cholecystectomies and ERCPs during this 2-year period required an average of 2.2 medevacs per patient. These medevacs are by airplane with air ambulance paramedics in attendance. The 17 ERCP patients alone had an average of 6 medical transportations, because their care was initiated in a northern community and progressed to Sioux Lookout for diagnosis and referral, at an average cost of $3200 per flight (Dr. Jonathon Morgan, medical director, northern region, Ornge, Sioux Lookout; personal communication: 2010). They were then transferred to and from a tertiary care centre for ERPC and then for a postoperative observation period before their cholecystectomies were performed in Sioux Lookout, often with an intervening trip back to their home community.

## DISCUSSION

The cholecystectomy patients in our catchment area were more numerous and younger than those in all other reported estimates.

The mean age of our female patients was 32 years. This is much younger than a similar population in northern Manitoba studied in 1984, which had a mean female age of 39.4 years.[12] Both of these findings contrast with the generally quoted mean female age of 46 to 52 years.[12,25–28]

The largest demographic age group in our population profile is 10–14 years of age, with 35% of our population under age 15.[2] Because we have no reason to anticipate a decline in multiple parity, obesity and type 2 diabetes, the incidence of gallbladder disease will likely remain high.

Other than being younger, our patients were similar to those studied in our region by Young and Roche[3] in 1984. Our patients' average total cholesterol was 4.3 mmol/L, which was lower than the values Young and Roche found. This is consistent with Young and Roche's observation that total cholesterol values were inversely correlated with gallbladder disease. They also found high rates of hypertension and diabetes.[3]

Our patients travelled great distances for medical care. Because patients need to be transported to Sioux Lookout for assessment, diagnosis and triage, the provision of complete surgical care at that site would be optimal.

Transportation for ERCP services in our region is very expensive. Simply eliminating 5 of the 6 medevacs our 17 ERCP patients each incurred in the past 2 years could have saved more than $272 000. The potential savings on 40–50 of the 89 ERCPs done on patients from our region would be greater.

Shorter lengths of stay in hospital, which are now spread between 2 hospitals (including a 3- to 5-day stay awaiting the tertiary care hospital's "ERCP day"), would also decrease global costs.

Global cost savings from each of the above would more than compensate for the training and equipment costs involved in having one of our surgeons learn ERCP skills.

The challenge of a rural ERCP program would be in surgical capacity. For a program to have sufficient volume for maintenance of ERCP competency, we would have to increase our laparoscopic cholecystectomy workload. With a full complement of 2 surgeons for our population of 30 000, we estimate an annual volume of 200 cholecystectomies.

An acceptable ERCP volume (45–50 annually) would be achieved by capturing most of our catchment area's cholecystectomy patients requiring ERCPs as well as referrals from nearby towns in the Northwestern Ontario Surgical Network that presently refer their ERCP patients longer distances to tertiary care centres.

Maintenance of competency would be feasible with an expected annual rate of 45–50 procedures. This compares favourably with the mean volume in US hospitals doing inpatient ERCPs.[8] The only rural program cited in the literature maintained high-quality outcomes and at a higher average of 75 procedures per year.[12]

Training at high-volume tertiary care centres would be required for a rural surgeon to achieve the

**Table 3. Patient profile for laparoscopic cholecystectomies performed in Sioux Lookout from 2007 to 2009**

| Characteristic | % of patients* |
|---|---|
| Mean age, yr | 32.2 |
| Female:male ratio | 3:1 |
| Type 2 diabetes | 16 |
| High blood pressure | 18 |
| Total cholesterol, mmol/L | 4.3 |

*Unless otherwise stated.

required number of procedures and to fit well within the regional network and referral patterns. Additionally, annual updates in higher-volume centres may be required for skill and volume supplementation.

Gallbladder disease requiring ERCP intervention is higher in our region for unknown reasons. Our ERCP population rate of 150 in 100 000 is threefold higher than US inpatient rates and is only partially explained by the higher incidence of gallbladder disease.[7]

Although the rate of precholecystectomy ERCP in patients who received surgery in Sioux Lookout was normal at 14%, the total ERCP population rate is 3 times that seen in other populations. Our laparoscopic cholecystectomy numbers are supplemented by patients referred around us directly for ERCP in other centres. The high number of ERCPs includes some retrieval of retained stones from distant surgeries, but primarily comprises an increased incidence of choledocholithiasis in our region. We wonder if genetic, dietary or other mechanisms lead to gallstones entering the common bile ducts more commonly in our population. A local MRCP service might lower the number of suspected cases, but is not economically feasible.

### Limitations

We were able to get accurate data from manual reviews of our own hospital charts. Data gathered electronically from other sites had less oversight. Identification of patients from our typical referral area was made difficult by the presence of a provincial border and recent changes in surgeon staffing levels. Nonetheless, every effort was made to underestimate rather than overestimate the relevant case burden of ERCP work for our program. Ideally, we would like to have had information on the ERCP findings done in the 3 tertiary centres by 4 providers, but those data were not readily available.

The data cited in the literature changed dramatically depending on the year of the surgeries because this field of surgery has been evolving rapidly. Many studies were therefore not used if they occurred before a shift in procedure adoption. Several studies referenced gallbladder disease and others pure rates of laparoscopic cholecystectomies, making comparisons difficult.

## CONCLUSION

The patients in our catchment area who undergo cholecystectomy are young, widely distributed geographically and require expensive medical transportation for surgical consultations and procedures. These patients require an ERCP intervention at rates several times higher than other populations. From the perspective of both maintenance of surgical competence and best patient care, the volume of ERCPs done on patients in our catchment area of 30 000 justifies the establishment of a rural ERCP program.

**Competing interests:** None declared.

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