Journal of Surgical Research **170,** 214–219 (2011)
doi:10.1016/j.jss.2011.03.040

ASSOCIATION FOR ACADEMIC SURGERY

Choledocholithiasis Management in Rural America: Health Disparity or Health Opportunity?[1]

Benjamin K. Poulose, M.D., M.P.H.,*,[2] Sharon Phillips, M.S.P.H.,† William Nealon, M.D.,* Julia Shelton, M.D.,* Kristy Kummerow, M.D.,* David Penson, M.D., M.P.H.,‡ and Michael D. Holzman, M.D., M.P.H.*

*Department of Surgery; †Department of Biostatistics; and ‡Department of Urologic Surgery, Vanderbilt University Medical Center Nashville, Tennessee

Submitted for publication January 8, 2011

Background. **Choledocholithiasis (CDL) management is dictated by local expertise, individual training, and availability of appropriate staff. This study evaluates the management of CDL between urban and rural communities.**

Materials and Methods. **Patients undergoing inpatient management of CDL were identified from the 2007 Healthcare Cost and Utilization Project. Availability of endoscopic retrograde cholangiopancreatography (ERCP) was determined from the 2007 American Hospital Association survey. The proportion of common bile duct exploration (CBDE), ERCP, or percutaneous (PERC) interventions were compared across census regions and National Centers for Health Statistics (NCHS) urban–rural classes. The NCHS urban–rural classification scheme divides counties from most populous (NCHS 1) to rural (NCHS 6). Proportions were compared using the 95% confidence interval (95%CI) approach.**

Results. **We estimated 111,021 CDL hospitalizations in the U.S. in 2007. Of these, 67% had a coded intervention. Intervention frequencies were similar across census regions. Comparisons across NCHS classes revealed higher proportions of ERCP in urban areas (NCHS 1–4) while a higher proportion of CBDE was seen in rural areas (NCHS 5–6). ERCP availability was high in metropolitan areas (available in 35%–44% of hospitals NCHS 1–4) and low in rural areas (25% of NCHS 5 hospitals and 5% NCHS 6). PERC management was similar across NCHS classes.**

Conclusions. **Rural hospitals and communities need surgeons trained in CBDE, where ERCP expertise may not be readily available. Feasible ways of expanding ERCP coverage to the nation's rural areas need to be explored. These observations may impact surgical training at least for those targeting careers in rural surgery.**

Key Words: **access to care; rural surgery; choledocholithiasis; common bile duct; endoscopic retrograde cholangiography.**

INTRODUCTION

The management of choledocholithiasis (CDL) remains a challenging problem, especially in areas where expertise is not readily available. With over 700,000 cholecystectomies performed in the United States each year, it is estimated that 10%–15% will have CDL [1, 2]. For these 70,000–105,000 patients, the particular management of their common bile duct stones will depend on local expertise, individual training, and availability of qualified operative and endoscopic staff. Interventional management for CDL includes endoscopic retrograde cholangiopancreatography (ERCP), operative common bile duct exploration (CBDE), or percutaneous (PERC) radiologic techniques.

An alarming trend projects a significant shortfall in general surgeons [3]. Rural communities will likely bear the brunt of this shortfall, as general surgeons often serve as the cornerstone for both surgical and endoscopic care [4]. ERCP remains the most performed intervention for CDL with laparoscopic CBDE gaining some popularity. Delays in providing definitive care can lead to avoidable complications, poor resource utilization, and patient dissatisfaction. It is unknown if CDL is managed in similar fashion between urban

[1] Manuscript presented at oral session during 2011 meeting of the Association for Academic Surgery.

[2] To whom correspondence and reprint requests should be addressed at Department of Surgery, Vanderbilt University Medical Center, D-5203 Medical Center North, VUMC, 1161 21st Avenue South, Nashville, TN 37232. E-mail: benjamin.poulose@vanderbilt.edu.

0022-4804/$36.00

and rural communities. The purpose of this study was to evaluate CDL management differences (ERCP, CBDE, or PERC) in urban and rural areas across the United States. Clarifying these relationships may have important implications for training and recruiting in both surgery and endoscopy—effectively tailoring services for a particular community's needs.

MATERIALS AND METHODS

Design Overview

In this observational study, patient discharges for the management of CDL were identified using the Healthcare Cost and Utilization Project 2007 Nationwide Inpatient Sample (NIS). Interventions for CDL including ERCP, CBDE, and PERC were determined and compared across National Centers for Health Statistics (NCHS) urban–rural classes. The availability of ERCP within these classes was further clarified with 2007 American Hospital Association (AHA) data. Proportions of patients within each stratum were analyzed using a 95% confidence interval approach, accounting for the complex sample survey scheme of the NIS. Performance of this study was approved by the Vanderbilt University Institutional Review Board.

Identification of Patients with Choledocholithiasis and Interventions

The NIS is the largest all-payer inpatient dataset available, representing 20% of non-federal discharges within the United States [5]. In 2007, data were included from 1044 hospitals representing 42 states. The sampling design is structured so over 8 million raw discharges within the database represent a national estimate of over 39 million discharges when appropriate analyses are performed.

Adult patients with CDL were identified based on 2007 International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) codes. An individual discharge was identified as a CDL associated discharge if a diagnostic code for common bile duct stones was present and if any associated procedure code for endoscopic, surgical, or percutaneous intervention was identified. Interventions included ERCP (with possible sphincterotomy, stone extraction, or stent placement), CBDE (laparoscopic or open), or radiologically guided percutaneous procedure (PERC). Discharges associated with liver transplantation, chronic pancreatitis, pancreatic pseudocyst, or pancreaticobiliary malignancy were excluded. A detailed summary of the coding algorithm used to identify patients is summarized in Table 1.

Classification of Hospital Urban–Rural Status and Availability of ERCP

To appropriately group discharges and ERCP availability into urban and rural communities, the National Center for Health Statistics (NCHS) coding scheme for counties was used. This system classifies all U.S. counties into six groupings ranging from most urban to most rural; Table 2 details the definitions of each group [6].

Discharges were classified into one of the six NCHS urban–rural codes based on Federal Information Processing Standard (FIPS) county codes within the NIS. To help elucidate reasons behind possible differences in the management of CDL, the availability of ERCP among hospitals was compared. Data from the 2007 American Hospital Association (AHA) survey were used to identify hospitals with ERCP capability within hospitals systems [7]. Hospitals were deemed as having access to ERCP if this service was available at the hospital itself or with an affiliate, as defined by the AHA. Hospital FIPS county codes as reported by the AHA were used to classify institutions within each of the NCHS urban–rural classes.

To account for possible confounding regional effects (as opposed to effects solely based on urban–rural status), comparisons were also made based on United States Census regions (Northeast, Midwest, South, West).

Statistical Analysis

For evaluation of the three main procedures performed for CDL (ERCP, CBDE, and PERC), the cumulative incidence for each was calculated from the 2007 NIS. Complex-sample proportions were then determined based on the total number of CDL discharges with an associated intervention. A 95% confidence interval was calculated for this point estimate and NCHS regions were compared. Point estimates without overlapping confidence intervals were determined to be significantly different. For ERCP availability, simple proportions were calculated based on hospitals having ERCP capability divided by the total number of hospitals surveyed by the AHA. Data processing and statistical analyses were performed using SAS 9.2 (SAS Institute, Cary, NC).

TABLE 1

Inclusion and Exclusion Criteria for Identification of Choledocholithiasis Discharges

	Value
Inclusion criteria*	
Diagnostic codes for CDL†	574.3, 574.31, 574.4, 574.41, 574.5, 574.51
ERCP procedural codes†	51.10, 51.11, 51.64, 51.84, 51.85, 51.86, 51.87, 51.88
CBDE procedural codes†	51.02, 51.03, 51.04, 51.05, 51.31, 51.32, 51.33, 51.34, 51.35, 51.36, 51.37, 51.39, 51.41, 51.42, 51.43, 51.49, 51.51, 51.59, 51.61, 51.62, 51.63, 51.69, 51.71, 51.72, 51.79
PERC procedural codes†	51.01, 51.96, 51.98
Exclusion criteria – diagnostic codes†	
Obstruction of bile duct without stone	576.2
Complications of liver transplantation	996.82
Chronic pancreatitis	577.1
Pancreatic cyst or pseudocyst	577.2
Exclusion criteria – procedural codes†	
Liver transplantation	50.59
Auxiliary liver transplantation	50.5, 50.51
Exclusion criteria – CCS groupings‡	
Cancer of liver or intrahepatic bile ducts	16
Cancer of pancreas	17
Cancer of gallbladder or extrahepatic bile ducts	18

*Choledocholithiasis (CDL), endoscopic retrograde cholangiopancreatography (ERCP), common bile duct exploration (CBDE), radiologically guided percutaneous intervention (PERC).

†ICD-9-CM coding, 2007.

‡Clinical Classification Scheme (CCS) grouping, Agency for Healthcare Research and Quality.