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Canadian Association of Radiologists Journal xx (2013) 1–6

CANADIAN ASSOCIATION OF RADIOLOGISTS JOURNAL

www.carjonline.org

Abdominal Imaging / Imagerie abdominale

Dilatation of the Bile Duct in Patients After Cholecystectomy: A Retrospective Study

David Landry, MD, B Eng[a], An Tang, MD, FRCPC[a], Jessica Murphy-Lavallée, MD, FRCPC[a,*], Luigi Lepanto, MD, FRCPC[a], Jean-Sébastien Billiard, MD[a], Damien Olivié, MD[a], Marie-Pierre Sylvestre, PhD[b]

[a]*Department of Radiology, University of Montréal and CRCHUM, Hôpital Saint-Luc, Montréal, Québec, Canada*
[b]*Biostatistics Services, University of Montreal Hospital Research Center (CRCHUM), Centre de recherche du CHUM, Montréal, Québec, Canada*

Abstract

Purpose: Retrospective assessment of impact of cholecystectomy, age, and sex on bile duct (BD) diameter.
Materials and Methods: We retrospectively reviewed abdominal contrast-enhanced multidetector computed tomography and laboratory reports of 290 consecutive patients (119 men; mean age, 55.9 years) who presented without cholestasis to the emergency department of our institution between June 2009 and August 2010. BD diameters were measured in 3 locations, by 2 independent observers, twice, at 1-month intervals. Reproducibility and agreement were evaluated by intraclass correlation coefficients and Bland-Altman analyses. The effects of cholecystectomy, age, and sex on BD diameter were analysed with linear mixed models.
Results: BD diameter inter-reader reproducibility and agreement were excellent at the level of the right hepatic artery (intraclass correlation coefficient, 0.94). Sixty-one patients (21.0%) had a history of cholecystectomy. Among them, the 95th percentile of BD diameters at hepatic artery level was 7.9 mm (<50 years) and 12.3 mm (≥50 years). Among those without cholecystectomy, BD diameter was 6.2 mm (<50 years) and 7.7 mm (≥50 years). Cholecystectomy was associated with significantly larger BD diameters in both age groups ($P < .001$). Older age was associated with larger BD diameters ($P = .004$). Sex had no impact on BD diameter ($P = .842$).
Conclusion: Patients after cholecystectomy may present with an enlarged BD unrelated to cholestasis. The BD diameter increases with age. Clinicians should rely on cholecystectomy status, age, and laboratory results to determine needs of further investigation.

Résumé

Objet: Évaluation rétrospective de l'incidence de la cholécystectomie, de l'âge et du sexe sur le diamètre du canal cholédoque.
Matériel et méthodes: De façon rétrospective, nous avons révisé les rapports de laboratoire et de tomodensitométrie abdominale à coupes multiples avec contraste de 290 patients consécutifs (119 hommes, âge moyen de 55,9 ans) qui se sont présentés sans cholestase au service d'urgence de notre établissement entre juin 2009 et août 2010. Le diamètre du cholédoque a été mesuré à trois endroits par deux observateurs indépendants, deux fois à un mois d'intervalle. La reproductibilité et la concordance ont été évaluées au moyen du coefficient de corrélation intraclasse et d'analyses de Bland-Altman. Des modèles linéaires mixtes ont été utilisés pour analyser les effets de la cholécystectomie, de l'âge et du sexe sur le diamètre du cholédoque.
Résultats: La reproductibilité et la concordance interévaluateur du diamètre du cholédoque étaient excellentes au niveau de l'artère hépatique droite (coefficient de corrélation intercalaire de 0,94). Parmi les patients, 61 (21 %) présentaient des antécédents de cholécystectomie. Le 95^{e} centile du diamètre du canal cholédoque au niveau de l'artère hépatique était de 7,9 mm (moins de 50 ans) et de 12,3 mm (50 ans ou plus) chez ces patients. Chez les patients qui n'avaient pas subi de cholécystectomie, le diamètre du cholédoque était de 6.2 mm (moins de 50 ans) et de 7,7 mm (50 ans ou plus). Des diamètres nettement supérieurs pour les deux groupes d'âge ($P < 0,001$) étaient associés à cette intervention. Les patients plus âgés présentaient des diamètres plus grands ($P = 0,004$). Le sexe n'avait aucune incidence sur le diamètre du canal cholédoque ($P = 0,842$).

* Address for correspondence: Jessica Murphy-Lavallée, MD, FRCPC, Department of Medical Imaging, University of Montreal and CRCHUM, Hôpital Saint-Luc, 1058 rue Saint-Denis, Montréal, Québec H2X 3J4, Canada.

E-mail address: jessica.murphy-lavallee.chum@ssss.gouv.qc.ca (J. Murphy-Lavallée).

0846-5371/$ - see front matter
http://dx.doi.org/10.1016/j.carj.2012.09.004

Conclusion: Le cholédoque des patients qui ont subi une cholécystectomie peut être plus large sans qu'il n'y ait de lien avec une cholestase. Le diamètre augmente toutefois avec l'âge. Les cliniciens devraient se fier à l'état de la cholécystectomie, à l'âge et aux résultats de laboratoire pour déterminer si une investigation plus poussée est nécessaire.

Key Words: Bile duct; Cholecystectomy; Cholestasis; Dilatation

It is a widely accepted concept that the bile duct (BD) increases in diameter after cholecystectomy. However, there is little consensus in the available literature on this subject. The opinion dates back to the late 19th century, when Oddi [1] postulated that the choledochus dilates after removal of the gallbladder to serve as a reservoir for bile [2]. This phenomenon was explained by the hypothesis that one function of the gallbladder is to act as a tension bulb to maintain stable bile pressure when the sphincter of Oddi is closed [3]. Hence, once removed, the pressure gradients would be applied directly to the BD, which would dilate in response. Subsequent research on animals and postmortem studies on humans seemed to validate this hypothesis [2−5]. However, the advent of sonographic technology and subsequent analyses of the biliary tree in the mid-20th century provided inconsistent and often contradictory evidence [4,6−14].

Radiologists can be confronted with unanticipated dilated extrahepatic BDs in patients in whom the necessity for further cholestatic investigation is unclear. Hence, knowing whether it is expected that patients who had a cholecystectomy, who do not present with cholestasis, have more prominent extrahepatic BDs than the general population would be of value and help prevent unnecessary further, potentially invasive and costly, investigation of the biliary system.

The purpose of this study was to retrospectively assess the impact of cholecystectomy status, age, and sex on the BD diameter by measuring the BD diameter in patients who underwent an abdominal multidetector computed tomography (MDCT) for reasons unrelated to cholestasis.

Materials and Methods

Our institutional review board approved this retrospective study and waived the need for informed consent.

Study Population

We reviewed the laboratory results and contrast-enhanced MDCT images of 290 consecutive patients admitted to the emergency department of a tertiary care university-affiliated hospital between June 2009 and August 2010. A systematic electronic chart review for each patient was conducted. Patients were included if they were (a) 18 years old or older, (b) had a contrast-enhanced abdomen MDCT, (c) presented with symptoms unrelated to cholestasis (eg, appendicitis workup, suspected diverticulitis, suspected occlusion or subocclusion, epigastric discomfort, vague abdominal pain), (d) had proven absence of cholestasis by normal laboratory values of both total blood bilirubin level (reference range, 7-23 μmol/L) and blood levels of alkaline phosphatase (reference range, 36-110 IU), obtained within 24 hours of the contrast-enhanced MDCT. Patients were not included if they had proven liver or pancreatic malignancy or disease. Patients chronically taking opioid medication and those who had received morphine before the computed tomography (CT) were also excluded. A total of 354 patients were initially recruited, of whom, 29 had liver cancer, 6 had pancreatic cancer, 5 had a biliary stent, 10 had cholecystitis, 4 had liver transplantations, 2 had benefited from a Whipple surgery, and 8 had received morphine before imaging. Thus, these 64 patients were excluded.

Scanning Technique

Abdominal CT studies were performed on 64-row detector MDCT scanners (Philips Brillance 64 [Philips Healthcare, Celveland, OH]; Somatom Sensation 64 [Siemens Healthcare, Forchheim, Germany]). The single portal venous-phase protocol consisted of images of the abdomen and pelvis acquired by using a 2.5-mm collimation 70 seconds after intravenous injection of a bolus of 100 mL iohexol contrast medium (Omnipaque 300; Bracco, Milan, Italy) with a power injector at a rate of 3.0 mL/s.

Image Evaluation

The diameters of the extrahepatic BD were measured at 3 distinct locations: immediately superior to the pancreas ($d_{pancreas}$), adjacent to the right hepatic artery (d_{artery}), and immediately below the first hepatic hilar bifurcation (d_{bifurc}) (Figure 1). To minimize interobserver variations, all measurements were taken only on axial images, perpendicular to the cephalocaudal direction of the BD. The measurements were performed independently by a radiology resident in his fourth year of training (reader A [D.L.]) and a fellowship-trained body-imaging radiologist with 6 years of experience (reader B [J.M.L.]) by using our picture archiving and communication system (AGFA Impax ES; AGFA Technical Imaging Systems, Ridgefield Park, NJ). Both readers took the measurements twice, at a 1-month interval and were blinded to their previous reported values as well as the values taken by their colleague. This permitted us to evaluate inter- and intrareader reproducibility and agreement.

Statistical Analyses

Quantitative variables were summarized as means (standard deviations [SD]), and categorical variables were