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Resolution of pneumobilia as a predictor of biliary stent occlusion

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ABSTRACT

Objective: To predict biliary stent occlusion on computed tomography (CT) from the loss of pneumobilia.
Methods: A total of 66 patients with common bile duct stents with pneumobilia after initial stent placement had a follow-up CT and diagnostic endoscopic retrograde cholangiopancreatography (ERCP). Two readers evaluated all CT exams for pneumobilia. Resolution or decrease of pneumobilia on CT was compared with ERCP findings.
Results: Sensitivity and specificity was 60–64% and 95% with a positive predictive value of 97% and a negative predictive value of 49–51%.
Conclusion: Resolution or reduction of pneumobilia after stent placement is specific (95%) and is moderately accurate (70–73%) for predicting biliary stent occlusion.

1. Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) and biliary stenting are used in the treatment of biliary obstruction from choledocholithiasis or biliary stricture. The preferred method to treat benign or malignant biliary strictures is balloon dilatation and endoscopic retrograde biliary drainage using a stent [1]. Selective biliary endoscopic cannulation with stent placement is successful in treating biliary obstruction in at least 90% of cases [2].

Currently, there are several biliary stent options including large bore plastic stents and self-expandable covered or bare metal stents. Self-expandable metal stents provide a larger lumen, providing longer biliary patency and are used for palliation in malignant biliary obstruction [3]. Plastic biliary stents have a median patency of 4–5 months and metallic stents have a median patency of 8–10 months [4]. Pneumobilia in the intrahepatic biliary tree is present when there is reflux of gas from the bowel and can be present after a sphincterotomy, incompetent sphincter of oddi, biliary stent, or biliary-enteric anastomosis [5]. Pneumobilia can also be present in the setting of biliary infections or biliary-enteric fistulae [6,7].

Biliary obstruction following stenting may present with recurrent jaundice, cholangitis, pruritis, malabsorption, coagulopathy, and hepatocellular dysfunction. Stent obstruction can result from several causes including tumor ingrowth through the mesh of an uncovered stent or overgrowth at its extremities, formation of granulation tissue, luminal impaction from reflux of enteric contents, biliary sludge or stones, stent collapse or angulation, insufficient stent diameter, stent fracture, or stent migration [4,8]. As a result, repeat ERCP and stent exchange are necessary in 30–60% of patients with extrahepatic biliary obstruction [9].

Currently, ultrasound (US), computed tomography (CT), magnetic resonance cholangiopancreatography (MRCP) with or without hepatobiliary magnetic resonance contrast agents, and cholescintigraphy using hepatoiminodiacetic acid scan are imaging studies used to evaluate biliary ductal obstruction [10–12]. Evaluation of the biliary system for obstruction after stent placement is difficult as mild biliary dilation may persist despite adequate biliary drainage. Patients clinically suspected of biliary obstruction are evaluated for stent occlusion and treatment using ERCP.

Resolution or reduction of intrahepatic pneumobilia may be a useful sign to diagnose stent occlusion. The purpose of our study was to determine if the resolution or reduction in pneumobilia is a good predictor of biliary stent occlusion.

2. Subjects and methods

This retrospective study was compliant with the Health Insurance Portability and Accountability Act and was approved by our institutional review board, which waived the requirement for informed patient consent. A search of the radiology report database was performed for imaging reports with the terms "pneumobilia," "biliary stent," "common bile duct stent," or "CBD stent." To fit the scope of this study, only patients with endoscopically placed biliary stents with pneumobilia on their initial CT and had a follow-up CT and diagnostic ERCP were included. Patients with biliary-enteric anastomosis or percutaneous biliary catheters that may contribute to intrahepatic pneumobilia were excluded. A total of 66 patients (35 male and 31 female) were included in our analysis. A total of 25 had plastic and 41 had standard metal common duct stents placed for malignant and benign causes of biliary strictures.

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3. CT imaging technique

Examinations were performed either with a 16-MDCT or with a 64-MDCT (Brilliance, Philips Healthcare) scanner. Exams were done either without or with intravenous contrast. Contrast-enhanced imaging was done at the portal venous phase (70- to 80-s delay) after the intravenous administration of 90–120 ml of iohexol (Omnipaque 350; GE Healthcare) via a power injector (Stellant Injector System; Medrad) at 2–3 ml/s through peripheral venous access. For the 16-MDCT scanner, we used 16×1.5 mm collimation, 2-mm slice thickness, 1-mm slice interval, 120 kVp, and 300 mAs. For the 64-MDCT scanner, we used 64×0.625 mm collimation, 0.9-mm slice thickness, 0.45-mm slice interval, 120 kVp, and 300 mAs. For all patients, contiguous 3-mm-axial reconstructions from the dome of the diaphragm to the pubic symphysis with coronal reformations were produced and sent to PACS.

4. ERCP technique

ERCP was performed under fluoroscopy at a hospital-based endoscopy suite by board-certified interventional gastroenterologists specializing in biliary diseases. In all cases, ERCP was performed in patients clinically suspected of having biliary obstruction. ERCP was performed after the second CT exam was performed. Biliary stent patency was evaluated with a cholangiogram following biliary cannulation and documented in the patient's chart. All patients in our study had successful biliary cannulation and cholangiography to evaluate stent patency.

5. Image interpretation

An attending radiologist (with 5 years of abdominal imaging experience) and a radiology resident in their final year of training reviewed all CT examinations on a PACS workstation (iSite; Philips Medical Systems) as axial and coronal images on both abdominal and lung windows. The reviewers were blinded to the ERCP results, which were obtained from the patient's medical chart. Initial CT after stent placement and follow-up CT were qualitatively evaluated in pairs for the presence, decrease, or absence of pneumobilia. Cases with only few residual locules of pneumobilia on the follow-up CT where there was previous lobar pneumobilia were considered as significant reduction in the pneumobilia and grouped with patients who had resolution of pneumobilia for analysis.

6. Reference standard

For all patients, the patency of the biliary stent on follow-up ERCP was considered the gold standard and was obtained from the ERCP report in the patient's chart. The biliary stent was considered occluded by the interventional gastroenterologists if the intrahepatic biliary tree could not be demonstrated on ERCP or there was significant narrowing of the stent lumen causing a functional obstruction and requiring recanalization or replacement.

The average time between the initial and follow-up CT examinations was 46 days, with a median of 34.5 days. The average time between the follow-up CT and ERCP was 4.2 days, with a median of 3 days (range, 0–18 days).

7. Statistical methods

The results of the CT (presence or absence of pneumobilia) were coded as either biliary stent patency or occlusion on CT and compared with the results from ERCP. The sensitivity, specificity, positive and negative predictive value, and likelihood ratio positive and likelihood ratio negative of the resolution of pneumobilia as a predictor of stent occlusion were calculated. Statistical analysis was performed with SPSS statistical software (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.)

8. Results

Sixty-six patients with biliary stents, pneumobilia on initial poststent placement CT with a follow-up CT and ERCP, were evaluated. Per our reference standard (ERCP), 19 of 25 (76%) patients with plastic stents and 28 of 41 (68%) with metal stents (all types of stents 47 of 66 or 71%) had stent occlusion.

Interobserver agreement regarding the presence or absence of pneumobilia was very good (kappa=0.94). A total of 44–47% patients had resolution or significant decrease of pneumobilia on the follow-up CT and were interpreted as stent occlusion (Figs. 1 and 2). A total of 53–56% had stable biliary gas in the intrahepatic biliary tree and were interpreted as having a patent stent. Comparing the CT interpretation with the ERCP results, we report the following: the sensitivity was

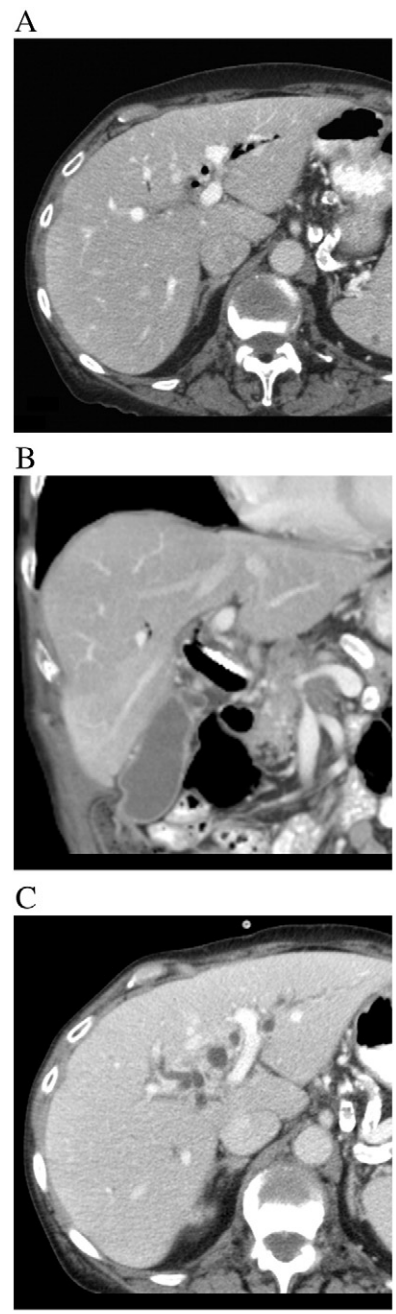

Fig. 1. A 77-year-old woman with biliary stricture from pancreatic adenocarcinoma. (A) Axial and (B) coronal contrast-enhanced CT shows intrahepatic pneumobilia with plastic stent in common bile duct. (C) Follow-up CT shows resolution of intrahepatic pneumobilia. Stent occlusion was found at ERCP due to tumor ingrowth.