Inpatient magnetic resonance cholangiopancreatography: does it increase the efficiency in emergency hepatopancreaticobiliary surgery services?

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ABSTRACT

INTRODUCTION Magnetic resonance cholangiopancreatography (MRCP) is commonly used to evaluate the biliary tree, although indications for patients who require inpatient imaging are not fully defined. The aim of this study was to evaluate inpatient MRCP performed on surgical patients and to devise a treatment pathway for these patients.

MATERIAL AND METHODS All adult inpatient MRCP examinations between January 2012 and December 2013 were reviewed. Demographic, clinical and radiological data were collated.

RESULTS During the study period, 271 inpatient MRCP were requested, of which 234 examinations were included. The majority of patients were female ($n=140$) and the median age was 63 years (range 16–93 years). Surgical admissions accounted for 171 (73%) of cases. Indications for inpatient MRCP include gallstone-related complications ($n=173$; 74%), malignant process ($n=17$; 7%) and other indications ($n=44$; 19%). Overall, inpatient MRCP led to further inpatient interventions in 22% (gallstone group, $n=32$, 18%; patients with malignancy, $n=8$, 47%; other indications, $n=12$, 27%). The median duration of inpatient MRCP from request to examination was 2 days (range 0–15 days) and median reporting after examination was 1 day (range 0–14 days).

DISCUSSION AND CONCLUSION Improved access and timely reporting of iMRCP may reduce length of hospital stay. Inpatient MRCP also led to further inpatient interventions, in particular, in patients with malignancy.

KEYWORDS

Magnetic resonance cholangiopancreatography – Cholelithiasis – Choledocholithiasis

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Introduction

The introduction of magnetic resonance cholangiopancreatography (MRCP) has greatly advanced the ability to accurately image the biliary tract.¹ Modern magnetic resonance imagers (MRI) provide excellent spatial resolution with shorter breath-hold techniques, and the addition of hepatocyte-specific contrast agents has provided additional methods of functional and anatomic assessment. The main indications for MRCP include the detection of choledocholithiasis, structural abnormalities of the biliary and pancreatic tract and staging of cancer.^{2,5} In many healthcare settings, access to MRI is restricted to weekday working hours with no out of hours or weekend provision. In

addition, it requires interpretation by subspecialist gastrointestinal radiologists, which can further delay in receipt of the imaging report.⁴ Financial pressures and bed shortages have led to increased pressure to minimise the duration of inpatient admissions and this has led to a trend for discharging patients for urgent outpatient investigations. Within the emergency setting, this must be balanced against the clinical condition of the patient and the risk of relapse of symptoms or complications. There are currently no guidelines to aid identification of those patients who would benefit from an inpatient MRCP and who could be investigated as an outpatient.

The aim of this study was to evaluate the role of inpatient MRCP in surgical patients and to assess the clinical

outcome. A secondary aim was to devise a treatment pathway for surgical patients who require MRCP as inpatients.

Materials and methods

Patients admitted at Nottingham University Hospitals NHS Trust, Nottingham, UK, who had a MRCP requested as an inpatient during the 2-year period from January 2012 to December 2013 were identified from the radiology database. Collated data included patient demographics, clinical presentation, biochemical analysis, radiological findings, further interventions and clinical outcome. Dilatation of the common bile duct (CBD) was defined as greater than 7 mm on ultrasound, computed tomography and MRCP.⁵ Laboratory measurements of serum samples were recorded for liver function tests (LFT) including alanine aminotransferase (0–35u/l), aspartate aminotransferase (0–30u/l), alkaline phosphatase (40–130u/l) and bilirubin (0–21µmol/l). Serum lipase samples were recorded as the first measurement made during the hospital admission (0–78u/l).

Exclusion criteria included paediatric patients (less than 16 years), patients unable to undergo MRCP because of patient-related factors (eg claustrophobia) or requests that were subsequently converted to an outpatient appointment.

The project was completed in accordance to guidelines set by the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) statement for observational studies. Data were collected and analysed in the relevant categories. This project evaluated clinical service provision within the department and in line with local policy and did not require prospective ethical approval.

Results

During the study period, 271 inpatient MRCP were requested, of which 37 cases were excluded (Fig 1): in 16 cases the request was converted to an outpatient investigation; 11 were duplicated requests; in 5 cases MRCP was not performed due to patient-related factors (3 for claustrophobia, 2 for obesity); and 5 were paediatric patients. Of the 234 inpatient MRCP requested, 171 (73%) were requested by the general surgery department and 63 (27%) by medical specialities.

The median age of patients was 63 years (range 16–93 years); 140 patients (51%) were female. The majority of patients included were emergency admissions ($n=223$, 95%). Five patients undergoing inpatient MRCP died during their admission, three of whom were from advanced malignancy. The overall median inpatient hospital stay was 12 days (range 1–89 days).

Indications for inpatient MRCP and clinical outcome

The most common indication for inpatient MRCP was gallstone-related complications ($n=173$, 74%), followed by suspicion of an underlying malignant process ($n=17$, 7%).

Gallstone-related complications

For gallstone-related complications, there were 100 patients (58%) with abnormal LFT (normal bilirubin levels), while

28 (16%) patients presented with clinical jaundice (elevated bilirubin levels). A further 45 (26%) patients presented with a clinical history and biochemical evidence of acute pancreatitis (serum lipase elevated three times the upper limit of normal).

Irrespective of bilirubin levels, all 128 patients with deranged LFT had cholelithiasis confirmed before admission or during the index admission on imaging. In addition, 29 patients from this group had previously undergone a cholecystectomy. For patients presenting with acute pancreatitis, 38 patients were known to have gallstones confirmed on imaging. In this group of patients, seven patients had previously had a cholecystectomy. For the remaining seven patients there was no documented cholelithiasis on either previous or concurrent admissions (Fig 1).

Overall, 53 (31%) patients with gallstone-related complications had an abnormality detected on MRCP. In the remaining 120 patients without identifiable pathology on MRCP, 11 proceeded to inpatient cholecystectomy (10 laparoscopic, 1 laparoscopic converted to open and 1 open).

For patients presenting with an abnormal LFT in the presence of normal bilirubin, 29 patients had an abnormality identified on MRCP, which consisted of choledocholithiasis ($n=27$) and CBD stricture ($n=2$). The clinical outcome for these 27 patients with CBD stones were: inpatient endoscopic retrograde cholangiopancreatography (ERCP, 9 inpatient, 10 outpatient); cholecystectomy and common bile duct exploration (CBDE, 1 inpatient, 1 outpatient); 2 were treated conservatively because of significant comorbidities; 2 did not attend planned ERCP; 1 died of unrelated causes prior to ERCP; and 1 was lost to follow-up. Two patients with biliary stricture on MRCP were diagnosed with primary sclerosing cholangitis and an ampullary tumour, in addition to gallstones.

In patients presenting with clinical jaundice, choledocholithiasis and biliary stricture were identified in 13 (46%) and 5 (18%) patients, respectively. All 13 were treated with ERCP (8 inpatient, 5 outpatient). In one inpatient, ERCP was unsuccessful and proceeded to percutaneous trans-hepatic cholangiography (PTC). Evaluation of the five patients with biliary stricture suggested benign disease in two patients, with two further patients dying before further assessment of their probable malignant strictures and one patient declining further investigation.

For patients undergoing inpatient MRCP investigation for acute pancreatitis, choledocholithiasis was identified in six patients, of whom four were treated with ERCP (2 inpatient, 2 outpatient), one underwent a cholecystectomy with CBDE following discharge and one was lost to follow-up. One patient who underwent inpatient ERCP then proceeded to laparoscopic cholecystectomy during the same admission.

Suspected underlying malignancy

Seventeen patients underwent inpatient MRCP for either known or suspected underlying malignancy based upon their clinical history and/or previous investigations. Peri-ampullary or pancreatic malignancy was a new diagnosis in ten patients, while two were suspected of having hilar cholangiocarcinoma. A further five patients had evidence of biliary abnormalities from local lymphadenopathy or

metastatic spread from a known distant primary. Eight patients proceeded to inpatient interventions which included PTC and stenting ($n=5$); inpatient ERCP ($n=2$) and PTC and stenting following failed ERCP ($n=1$).

Other indications

Of the remaining 44 patients who had inpatient MRCP, three were admitted electively and 41 patients while being admitted as an emergency. Three patients admitted electively were for liver transplantation assessment ($n=1$), assessment of a previously transplanted liver ($n=1$) and investigation for protein losing enteropathy ($n=1$).

Other indications for the 41 patients who had MRCP during their emergency admission included: persistent symptoms following elective laparoscopic cholecystectomy ($n=15$); dilated duct on ultrasound with normal LFT ($n=6$); abdominal pain with normal LFT ($n=13$); assessment of the pancreatic duct following trauma ($n=2$); determining the position of a cholecystostomy drainage tube ($n=2$); assessment of a suspected intrahepatic ductal stricture ($n=2$); and determining the placement of a T-tube originally sited

within the CBD at previous operative intervention ($n=1$). Following MRCP, 12 patients proceeded to undergo inpatient procedures, which included ERCP ($n=7$), PTC and stenting ($n=4$) and surgery for intra-abdominal sepsis that was not related to biliary pathology ($n=1$).

Provision and reporting of inpatient MRCP

The median duration from request to examination was 2 days (range 0–15 days). MRCP was performed on the same and the following day as requested in 25 and 69 inpatients, respectively. MRCP was performed on the second and third day following request in 55 and 25 inpatients, respectively; in 47 inpatients, MRCP was performed within days 5–7, and the remaining 13 inpatients had MRCP after 1 week.

The median duration of inpatient MRCP examination to report was 1 day (range 0–14 days). Almost half of all inpatient MRCP reports were available on the same day as the examination ($n=109$, 47%), while 75 and 13 reports were available on the first and second day, respectively. Of the remaining 38 cases, reports were available within 1 week of examination, with the exception of one report (14 days).

Discussion

There is currently no consensus on the optimal biliary imaging for acute hepatobiliary disease and it is known from surveys of specialist physicians that significant differences exist in common clinical scenarios.⁶ This study investigated the local practice in the provision and outcomes of inpatient MRCP to determine the indications for patients admitted in an acute setting.

Cholelithiasis and management

For patients with gallstone-related indications who had MRCP as an inpatient, only one-third of identifiable pathology. Previous studies attempting to predict choledocholithiasis or structural abnormalities based upon clinical, biochemical and radiological criteria to generate an accurate algorithm have produced inconsistent results.^{7,8} Nevertheless, there are groups of patients who are more likely to have an underlying pathology detected on MRCP; for example, patients who present with clinical jaundice and have a dilated biliary tree on ultrasound.^{9–11} In contrast, an MRCP in patients with a normal biliary tree on ultrasound and normal LFT are less likely to have an underlying pathology and are considered a low-risk group. MRCP is often the preferred imaging strategy for those patients at moderate risk. These include patients with abnormal LFT (not clinically jaundiced, normal bilirubin levels) and a non-dilated biliary tree on ultrasound or patients admitted with pancreatitis with a history of previous cholecystectomy.^{9–11} It has previously been reported that approximately 7–9% of patients with choledocholithiasis manifest with no biochemical or radiological abnormality.^{12,13} A raised gamma glutamyl transferase (GGT) level may be the most sensitive and specific marker for CBD stones, although GGT levels are not routinely measured in the majority of hospitals.^{14,15} In patients with suspected spontaneous passage of a CBD stone following resolution of both symptoms and biochemical parameters, around one-third will have choledocholithiasis on MRCP.¹⁶

The emphasis on biliary dilatation is controversial, as it is recognised that more than 50% of patients with choledocholithiasis have a non-dilated CBD.¹² In the present cohort, a dilated CBD as a sole indication for inpatient MRCP was uncommon. It is generally considered that a dilated biliary tree in isolation with normal LFT gives a low probability of identifying pathology and, in a recent survey, 58% of upper gastrointestinal surgeons would consider intraoperative cholangiogram sufficient for a dilated biliary tract in isolation.¹⁷ The need to perform preoperative inpatient MRCP or intraoperative cholangiogram for patients with gallstone-induced pancreatitis is uncertain, although choledocholithiasis was detected in 15% of cases in the present study, similar to other studies.¹⁸

Determining the clinical effect of an MRCP that does not show any abnormalities is difficult in the absence of detailed knowledge of the patient's clinical condition and social circumstances at the time of request. For patients with symptomatic cholelithiasis as an index presentation, proceeding to inpatient cholecystectomy in the absence of

CBD pathology is recognised as the optimal management. In the present study, inpatients with symptomatic gallstones with a normal MRCP report were less likely to proceed to an inpatient cholecystectomy, suggesting a potential delay to definitive surgical intervention. Only one-third of inpatients were discharged within 24 hours of a normal MRCP report, suggesting that either clinical or social circumstances prolonged their admission.

The present study showed that one-quarter of inpatients proceeded to a therapeutic procedure following MRCP and this affected their clinical outcome. Inappropriate investigations can not only lead to potential delays in therapeutic intervention but also increase the length of hospital stay and procedure costs. A recent cost-effective analysis in the management of asymptomatic CBD stones favoured laparoscopic cholecystectomy with routine intraoperative cholangiogram as the preferable strategy over routine preoperative MRCP for patients with no clinical features of CBD stones.¹⁹ MRCP was shown to be more costly and less effective compared with the laparoscopic cholecystectomy with intraoperative cholangiogram approach, which also shortened time to definitive treatment.¹⁹ Nevertheless, in comparison to the present study, all patients were admitted with symptomatic gallstones disease. The management of patients with acute admissions for gallstone-related complications is different from that of patients with asymptomatic CBD stones. Performing a laparoscopic cholecystectomy with intraoperative cholangiogram which can be potentially converted to a CBD exploration in the background of underlying sepsis would be considered high risk in this subgroup of patients.²⁰

With respect to gallstone-related indications where inpatient MRCP confirmed choledocholithiasis, almost half of these patients proceeded to an inpatient ERCP. Indications for discharge prior to therapeutic intervention may be related to clinical or biochemical improvement and the availability of inpatient ERCP. This may suggest that improved case selection for outpatient rather than inpatient MRCP could reduce length of hospital stay when, despite positive identification of pathology such as CBD stones, patients were discharged for an outpatient therapeutic procedure.

Suspected pancreatobiliary malignancy

In the present study, the highest intervention rate was observed in inpatients with suspected underlying malignancy following their MRCP to assess potential biliary obstruction following an emergency presentation. MRCP is recognised to have an important role in the staging of hepatobiliary malignant diseases and almost half of these patients proceeded to an inpatient procedure, primarily palliative PTC and biliary stenting.¹ This highlights the need for a subgroup of patients with suspected underlying malignancy who may require urgent inpatient MRCP in preference to outpatient investigations to enable intervention procedures to be performed at the index admission.

Radiology provision

Current international recommendations suggest MRCP to be the optimal imaging modality for elucidating the aetiology of

cholangitis, although computed tomography and ultrasound are commonly used to identify radiological features suggestive of acute biliary disease.²¹ A recent Cochrane review has shown that both endoscopic ultrasound and MRCP demonstrated similar clinical equivalence and suggested that their relative utility should depend upon local expertise and availability.²⁵ One of the limitations of MRCP is the failure to identify CBD stones less than 3 mm in diameter, thereby giving false negative results.^{25,24}

The time to inpatient MRCP is dependent upon institutional factors and previous large series of emergency admissions have reported 2 days as the longest interval to assessment, although without specifying local protocols for prioritising requests.²⁵ In the present study, only two-thirds of patients had an inpatient MRCP within 48 hours of request and this may reflect the absence of availability of MRCP over weekends and out of hours. However, other large institutions that aim to perform all interventions for mild gallstone pancreatitis on the index admission report a median time to MRCP of 4 days, with an additional 2.5 days for further intervention, which included either therapeutic ERCP or cholecystectomy with bile duct exploration.²⁶ The limitations in providing

MRCP investigations outside standard working hours have been recognised. In a recent cost-utility analysis, the lack of availability of inpatient MRCP was a significant factor in restricting an emergency cholecystectomy for mild acute gallstone pancreatitis during the patient's index admission.²⁷ Improving the availability of inpatient MRCP by increasing access, especially out of standard working hours and including weekends, may assist in the clinical decision process and patient outcome. Having appropriate therapeutic interventions in a timely manner would potentially reduce costs with respect to length of stay, as well as costs associated with readmissions. Nevertheless, this approach needs to be balanced against local resources and service demands, which include timely reporting and instigation of further management.

Current UK guidelines recommends a maximum of 2 days for reporting of imaging studies, although recent national audits have identified over 3,000 studies waiting more than 30 days prior to a report being issued.²⁸ This is likely to worsen in the future, given increasing demand for radiological investigations without a parallel rise in reporting capacity.²⁸

Figure 2 Suggested algorithm for inpatient magnetic resonance cholangiopancreatography (iMRCP) for patients presenting as an acute surgical admission

Limitations of this study

The present institution has a dedicated HPB emergency service that is consultant-led, and all inpatient MRCP were requested following consultant review. However, this may not reflect the practice in other healthcare settings. World-wide, non-dedicated HPB surgical specialists are often responsible for surgical admissions and in some healthcare settings admission may be the responsibility of medical physicians, often gastroenterologists.^{6,29}

Clinical algorithm for inpatient MRCP

An algorithm for inpatient MRCP was constructed based upon results of the present study (Fig 2).

Conclusions

Inpatient MRCP may lead to improved efficiency within the HPB service for patients presenting as acute surgical admissions. Patient selection is crucial, as this will lead to further interventions that could potentially be cost beneficial.

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