CASE REPORT

A novel use for myocardial perfusion scans: diagnosis of bile duct injury

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SUMMARY

A 69-year-old woman was admitted to a tertiary care centre after suffering from an iatrogenic bile duct injury, diagnosed by the unexpected leakage of bile during laparotomy for a colectomy. On initial assessment the patient was clinically stable, although she remained intubated after her surgery. In order to diagnose whether or not she sustained a complete or partial bile duct injury, a finding that would determine if she underwent conservative management or surgical repair, a technetium-99m-hepatobiliary scan was requested.

Owing to a shortage in technetium-99m-iminodiacetic acids, the radiopharmaceutical (tracer) for this imaging test, a decision was made to employ technetium-99m-tetrofosmin, the tracer for cardiac scans (traditionally used for diagnosis of myocardial perfusion) as it has been established that this tracer is excreted in the biliary tract. The imaging showed flow of bile into the bowel, thereby establishing bile duct continuity and permitting conservative management.

BACKGROUND

Bile duct injuries constitute a small but significant portion of iatrogenic injuries associated with abdominal surgery, and therefore, the accurate diagnosis of these injuries is paramount. Despite the advances in cross-sectional imaging and diagnostic endoscopic methods, nuclear imaging in the form of technetium-99m-iminodiacetic acid (99mTc-IDA) scintigraphy continues to play an important role in the diagnostic algorithm. Technetium-99m, first reported in the 1970s, was found to be a non-toxic agent, which was metabolised by hepatocytes and excreted in bile within 10–30 min of injection.^{1–3} 99mTc-IDAs have been described for use in diagnosis of a variety of biliary tract pathology, including bile duct leaks, differentiation of medical and surgical (biliary tract obstruction) jaundice, and diagnosis of acute cholecystitis.^{1–4} Also, Henry *et al*⁵ found that “[e]xcretion of tracer into the gut excludes complete biliary tract obstruction” thereby providing utility in diagnosing continuity of the biliary tract.

The use of radiopharmaceuticals for diagnosis of pathology is common to other organ systems as well. A common examples of this is the technetium-99m-sestamibi (99mTc-MIBI) and technetium-99m-tetrofosmin (99mTc-tetrofosmin), used for diagnosis of myocardial ischaemia and other cardiac pathology^{6–7} (figure 1). One well-described drawback in using these radiopharmaceuticals is interference from the biliary excretion of this agent, which can affect the cardiac

images obtained.⁷ Although biliary excretion is a well-known characteristic of these radiopharmaceuticals, there have been no cases reported in the literature of using this for diagnosis of biliary tract pathology.

We describe a case of a 69-year-old woman with a bile leak that was diagnosed by performing a modified hepatobiliary scan, using the 99mTc-tetrofosmin traditionally reserved for cardiac perfusion studies.

CASE PRESENTATION

We present a case of a 69-year-old woman who sustained a bile duct injury after subtotal colectomy for ischaemic bowel at a peripheral hospital. On the night of surgery she required a second laparotomy for bleeding, and was found to have a bile leak. A Jackson-Pratt (JP) drain was placed and she was transferred to a tertiary care centre for further management of her bile duct injury. On admission to the academic centre, she was intubated and placed on minimal inotropes. Bile was draining through the JP drain.

INVESTIGATIONS

In order to investigate her bile leak and determine whether or not she had any drainage of bile into the bowel, a hepatobiliary scan was requested. In consultation with the nuclear medicine physicians, it was determined that there was a shortage of the hepatobiliary tracer, technetium-99m diisopropyl IDA (DISIDA), and the test was unavailable.

Figure 1 Hepatobiliary scan with technetium-99m-tetrofosmin showing renal excretion of tracer and activity in the left ventricle, which is the usual focus of imaging with this tracer.

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Further consultation was carried out between the nuclear medicine physicians and it was determined that she could undergo a nuclear imaging scan of the abdomen using the radiopharmaceutical traditionally used for myocardial perfusion imaging, ^{99m}Tc -tetrofosmin, as it is excreted in the bile and possibly provide the required information.

The patient was taken to the nuclear medicine suite 3 days after her initial laparotomy and underwent a hepatobiliary study using ^{99m}Tc -tetrofosmin as the hepatobiliary imaging agent. She underwent dynamic images for 90 min with her JP drain clamped, after which the drain was unclamped and she underwent dynamic imaging for 30 min. The study showed that the patient had ongoing leakage of bile, which was controlled by the JP drain with transit of the tracer into the gut, thereby establishing bile duct continuity (figures 2 and 3).

OUTCOME AND FOLLOW-UP

After diagnosis of a partial bile duct injury, the patient went on to have an endoscopic retrograde cholangiopancreatography and stent placement. By postprocedure day 1, there was complete resolution of the bile leakage, as was evidenced by the serosanguinous drainage from the in situ drain. She was seen for a 6-week follow-up and was doing well, with no residual effects from the bile duct injury she sustained (figure 4).

DISCUSSION

Currently in the literature, there are no published cases that describe using ^{99m}Tc -tetrofosmin, the tracer traditionally used in cardiac imaging, to diagnose biliary pathology. Although the options for diagnosis of bile duct injuries are many, including ultrasound, CT and MRI, nuclear imaging studies remain an invaluable part of the diagnostic algorithm. These imaging modalities have the unique ability to provide dynamic imaging of bile flow under physiological conditions. Establishing the presence or absence of flow of bile into the gastrointestinal tract is important, as a complete transection of the bile duct mandates immediate intervention whereas continuity of the bile duct, as shown by the presence of the radiopharmaceutical in the bowel on a hepatobiliary scan, presents the option of conservative management.⁸

Figure 2 The hepatobiliary scan using technetium- ^{99m}Tc -tetrofosmin showing the presence of radiopharmaceutical activity in the small bowel, which confirms bile duct continuity.

Figure 3 Delayed images show technetium- ^{99m}Tc -tetrofosmin in external closed suction drains.

Hepatobiliary scans, using one of the ^{99m}Tc -IDA radiopharmaceuticals, have long been one of the preferred methods to diagnose biliary leaks.⁹ In the past, other radiopharmaceuticals were used to investigate bile leaks, but the use of ^{99m}Tc -IDAs supplanted them due to its ability to delineate the anatomy and extent of a bile leak.⁸ After injection, hepatocytes uptake the tracer within the first 10 min, followed by evidence of biliary excretion in the gallbladder and small bowel within the first hour.⁸ Currently in our province, there have been ongoing shortages of these radiopharmaceuticals, limiting the availability of this diagnostic test. At our institution, ^{99m}Tc -tetrofosmin is the current radiopharmaceutical used for myocardial perfusion imaging. From the perspective of cardiac investigation, one of the main drawbacks associated with this test is the interference from the hepatic excretion of the tracer. In fact, although it is used primarily for cardiac imaging due to its uptake in the

Figure 4 Delayed endoscopic retrograde cholangiopancreatography image showing resolution of the bile leak after conservative management with plastic stent.

heart, the main initial uptake is in the liver. The tracer is then excreted in the bile, which can interfere with the cardiac images, so much so that studies have been performed to determine optimal timing and patient positioning to decrease this complication.⁷

Although all prior case reports have used a 99 mTc-IDA, our case has shown that using 99 mTc-tetrofosmin can provide accurate information that can be used in clinical decision-making with regard to postoperative bile leaks. Although many other modalities have been developed to investigate bile leaks, the hepatobiliary scan remains as an important component of the algorithm as it can provide valuable functional information that cannot be determined using other investigations.

Learning points

- The radiopharmaceuticals used for myocardial perfusion scans may be used to perform modified hepatobiliary scans to diagnose bile duct injury, due to their uptake by hepatocytes and excretion in bile.
- Nuclear imaging studies continue to hold an important place in the diagnosis of the bile duct injuries.
- Accurate diagnosis of the bile duct injury is important to guide management decisions.

Contributors LD was involved in the design of the report, collection of data, creation of drafts, revising and finalisation of the report. DCB and IA were involved in the design of the report, collection and interpretation of the data, editing, revising and finalisation of the report.

Competing interests None.

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