Testing the Integrity of a Roux-en-Y Hepaticojejunostomy: The Air Insufflation Test

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Hepaticojejunostomy (HJ) is a technically challenging surgical procedure, especially in the setting of a benign biliary stricture or a thin-walled duct in a choledochal cyst. Despite refinement in technique over a period of time, postoperative bile leak occurs in 2.3% to 12% of patients.[1,2] A leak after HJ can have varied consequences, ranging from a small self-limiting bile leak to a persistent, high output, external biliary fistula leading to sepsis, fluid electrolyte and nutritional problems, severe morbidity, and even mortality. The cause of a leak can be either a technical factor or patient- or disease-related factors. The latter includes inflammation or edema at the site of the anastomosis, small duct diameter, or multiple anastomoses. Most of these factors are not modifiable. But postoperative bile leak due to technical factors is largely preventable. Many of the leaks due to technical factors can be detected intraoperatively if the anastomotic integrity is tested on the table and corrected, thereby avoiding postoperative bile leak.

There have been reports of an air leak test to confirm anastomotic integrity after luminal operations.[3] But it has not been reported in a bilio-enteric anastomosis. Here, we report a method to detect a bile leak from a hepaticojejunostomy after completion of the anastomosis. The method is simple, reproducible, and it does not need any specialized instruments, machines, or technology.

Technique

The apparatus required is described in Table 1 and Figure 1. After completion, the integrity of the hepaticojejunostomy is tested by the air insufflation test (AIT) as follows (Fig. 2):

1. Place a soft intestinal clamp on the Roux limb, 6" distal to the HJ, occluding the lumen of the Roux loop.
2. Fill the syringe with 50 mL of air, connect it to the 3-way cannula, and connect the 25-G hypodermic needle to the 3-way cannula in the long axis with the syringe, keeping the bevel facing toward the ceiling.
3. Insert the needle on the syringe into the closed end of the Roux loop in a trap-door manner (oblique track).
4. Push the plunger of the syringe to insufflate air into the Roux loop, ensuring that the needle is in the lumen and not the jejunal wall, and has not counter punctured the jejunum, and also ensuring that the needle is not trapped in the mucosa to avoid pneumatoides.
5. When 20 mL of air has been injected, instill warm saline into the abdomen to submerge the HJ under saline, and then inject the remaining air into the jejunal lumen. If the jejunal limb does not become turgid with air, inject more air by refilling the syringe using the side limb of the 3-way cannula, and inject just enough air to make the jejunal limb turgid—DO NOT OVERDISTEND.
6. Look for any air leak from the HJ site (Fig. 3).
7. If there is no air leak, the puncture test is negative suck out the air from the jejunum through the needle and remove the intestinal clamp occluding the jejunal loop.
8. In case of an air leak, the defect in the suture line is easily located by the escaping air bubbles. The leaking site is repaired by a figure-of-eight stitch. Steps 4 to 7 (see above) are repeated, and the integrity of the HJ is confirmed again.

Patients with indwelling percutaneous catheters

In patients with indwelling percutaneous catheters, the 50-mL syringe with the attached 3-way cannula, filled with air, is connected to the percutaneous transhepatic biliary drainage (PTBD) catheter instead of inserting the needle into the closed end of the Roux loop, and the test is performed as above.

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Abbreviations and Acronyms
AIT = air insufflation test
HJ = hepaticojejunostomy
PTBD = percutaneous transhepatic biliary drainage
RYHJ = Roux-En-Y hepaticojejunostomy

RESULTS

The AIT was performed in 63 patients undergoing Roux-en-Y HJ for repair of a benign biliary stricture (n = 36) and after choledochal cyst excision (n = 27). Air leaks were documented in 5 patients and were secured by sutures intraoperatively. Postoperative bile leak was found in 2 patients (3%) only. None of the patients testing negative on AIT had any postoperative bile leak.

DISCUSSION

The air leak test is a widely used method to look for a minute hole, puncture, or defect in hollow structure in day-to-day life. American gynecologist Sidor Clinton Rubin developed the air insufflation test to check the patency of fallopian tubes, popularly known as Rubin's test.[4] Surgeons have also used the same principle to look for integrity of suture lines after luminal procedures, where air is insufflated through Ryle's tube in upper gastrointestinal surgery or through per anal-placed Foley's catheter or sigmoidoscope after rectal surgery.[3] Studies have proven the usefulness of the air leak test done through Ryle's tube after sleeve gastrectomy to check for a defect in the staple line.[5,6]

The same principle has been used for low anterior resection or restorative proctocolectomy. The test has not been used in biliary anastomosis, perhaps due to the lack of natural access to the biliary tree for air insufflation. The technique presented here can be used in a bilio-enteric anastomosis, as mentioned previously. It can detect an anastomotic defect during surgery only, and potentially prevent bile leak and its consequences. The AIT, as described above, has no adverse consequences and does not take more than 3 to 5 minutes. The PTBD tube, when available, will obviate the need for a needle puncture, as air can be pushed from the PTBD tube.

Table 1. Apparatus Required for Operative Technique

Apparatus required	No. of units
Soft intestinal clamp	1
50-mL syringe	1
3-way stop-cock/cannula	1
25-G hypodermic needle	1
Normal saline, mL	500

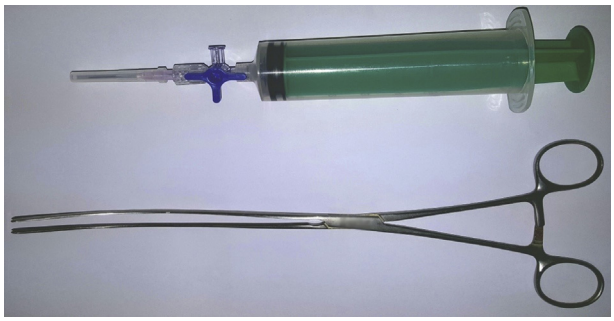

Figure 1. Instruments required for the air leak test.

Although colored dye like methylene blue has also be used to detect leaks in the anastomosis,[7] an air leak is more sensitive because air is 90 times less viscous compared to water. Therefore, the air leak test requires less than one-fifth of the pressure needed for testing as compared with a test done with water-soluble colored dye. In addition, if methylene blue is used, it stains tissues at the leak site and obscures the precise site of the leak, which is very sharply delineated during the AIT, and permits secure closure.

The AIT is simple to use, but it can cause a false negative or false positive result if proper protocol is not followed. If a sufficient amount of air is not pushed in to generate enough pressure, the air leak test can be negative despite a defective anastomosis. All air bubbles should be sucked out from the instilled saline before injecting air to prevent confusion regarding the source of the bubble and to prevent a false positive test. It should be kept in mind that this test is complementary to meticulous anastomotic technique to prevent bile leak and can never substitute for a less than accurate technique.

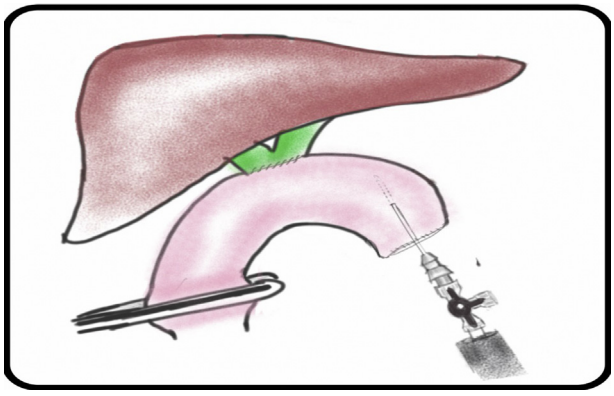

Figure 2. Schematic representation of the technique of air leak test. (Reprinted courtesy of the artist, Dr Saxena.)

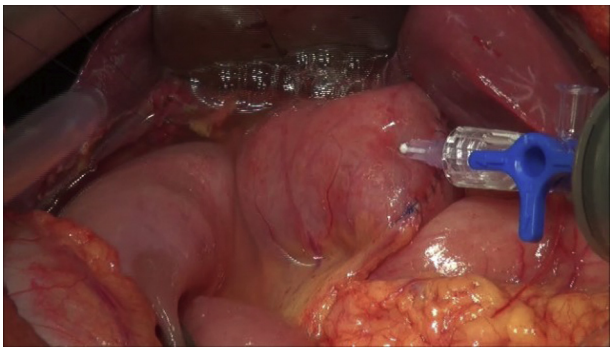

Figure 3. Positive air leak test showing air bubbles coming from the anterior layer of the anastomosis.

CONCLUSIONS

The AIT is simple, inexpensive, and reproducible, requiring no special instruments and only 3 to 5 minutes of operating time, with no demonstrable adverse effects or complications, and it ensures against technical bile leaks.

Author Contributions

Study conception and design: Saxena
Acquisition of data: Saxena, Reddy
Analysis and interpretation of data: Saxena
Drafting of manuscript: Saxena, Reddy
Critical revision: Saxena, Reddy

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