


Indirect percutaneous core needle biopsy of solid pancreatic or peripancreatic lesions

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Abstract

Solid pancreatic or peripancreatic lesions comprise a heterogeneous group of diseases that rely on a multi-modality imaging approach for subsequent tissue procurement. Endoscopic ultrasound (EUS)-guided fine needle aspiration (FNA)/biopsy is an effective and safe method for tissue diagnosis in this region. The failure to obtain adequate tissue for diagnosis under EUS guidance is still a rare but important issue. Percutaneous core needle biopsy (CNB) provides an alternative pathway for adequate specimen acquisition. Because of the deep retroperitoneal location, the percutaneous biopsy of pancreatic or peripancreatic lesions may inevitably pass through visceral organs. The procedure is relatively risky and difficult for general radiologists, particularly beginners, and an adequate knowledge of the abdominal anatomy and biopsy technique is indispensable. In this review, various aspects of percutaneous CNB for solid pancreatic or peripancreatic lesions using different trans-organ approaches are reviewed to increase the chance of successful biopsy.

Key words: Biopsy—Pancreas—Indirect access—Computed tomography—Ultrasonography

Solid pancreatic or peripancreatic lesions can be broadly divided into neoplastic and non-neoplastic lesions. Accurate diagnosis can be challenging in some patients

and biopsy is often required. Common imaging techniques include EUS-guided FNA and percutaneous CNB. EUS-guided FNA is an effective method to confirm malignancy (Fig. 1), but tumor typing is sometimes limited by the small amount of procured tissue [1].

Percutaneous CNB provides a larger tissue sample compared with EUS-guided FNA, resulting in a better diagnostic yield for solid pancreatic or peripancreatic lesions [2]. Percutaneous CNB can be performed using either computed tomography (CT)- or sonographic-guidance. Because of the deep location of the pancreas, biopsy usually requires an experienced operator. Determining a safe route can be challenging, and the trans-organ approach can provide an alternative option for specimen acquisition [3]. The procedure is relatively risky, however, and a good knowledge of the abdominal anatomy and biopsy techniques is indispensable.

In this article, we review various aspects of percutaneous CNB for solid pancreatic or peripancreatic lesions using the trans-organ approach.

Indication and contraindications

The decision to perform pancreatic or peripancreatic lesion biopsy is predicated on how the result will affect patient management. The risk of peritoneal seeding is potentially higher in percutaneous biopsy than EUS-

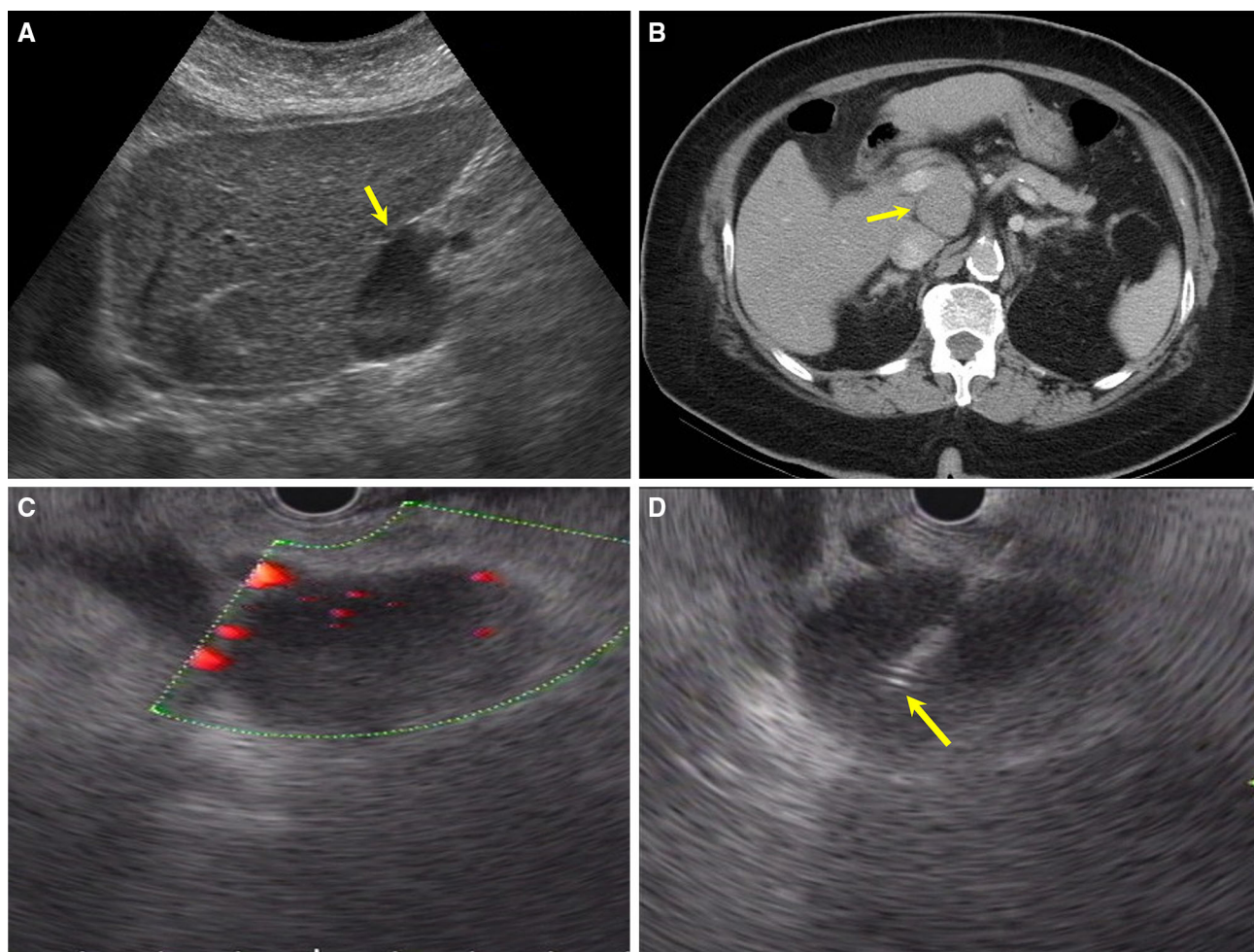


Fig. 1. A 73-year-old woman with a homogeneous mass lesion between the liver and pancreas on ultrasound (**A**) and CT scan (**B**). EUS evaluation of the mass (**C**) and EUS-guided biopsy with FNA is smoothly performed via the

vascular-sparing route (arrow, **D**). B-cell lymphoma is confirmed.

guided FNA of malignant lesions [4]. Therefore, percutaneous biopsy is usually reserved for cases that fail EUS-guided tissue sampling or when it is difficult to detect the lesion under EUS.

Although the indications for percutaneous pancreatic or peripancreatic biopsy are not standardized, a biopsy is clearly indicated in cases of inoperable pancreatic cancer, suspicion of lymphoma, metastatic tumors, neuroendocrine tumors, and differentiation of cystic tumors [5].

Contraindications to the procedure include uncooperative patients and patients with uncorrectable bleeding disorders [6]. Intra-abdominal biopsy is a procedure that carries a moderate risk of bleeding, and correction of coagulopathy and thrombocytopenia are recommended before the procedure [7]. Appropriate management includes blood transfusion and withholding of medication in order to reach an international normalized ratio (INR) < 1.5, an activated partial thromboplastin time

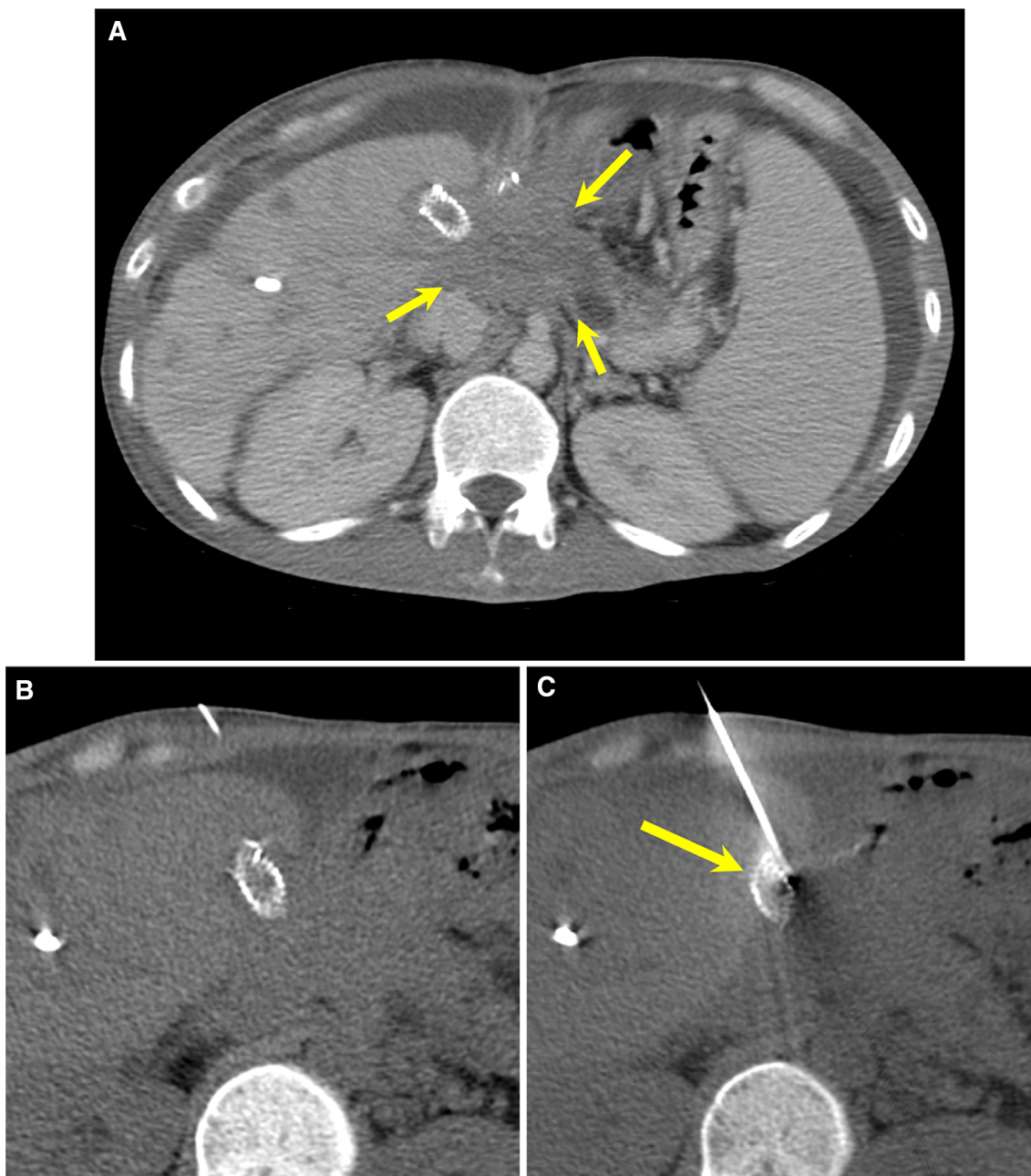


Fig. 2. A 37-year-old man with history of chronic pancreatitis has a heterogeneous, enhancing mass lesion at the pancreatic head (arrows, **A**). A 22- or 23-G needle for local anesthesia is inserted first providing a direction for the

subsequent biopsy needle insertion (**B**). A 17-G coaxial needle with 18-G biopsy gun is used for the biopsy. The metallic stent (arrow) is a landmark for lesion localization. The pathology shows pancreatic adenocarcinoma (**C**).

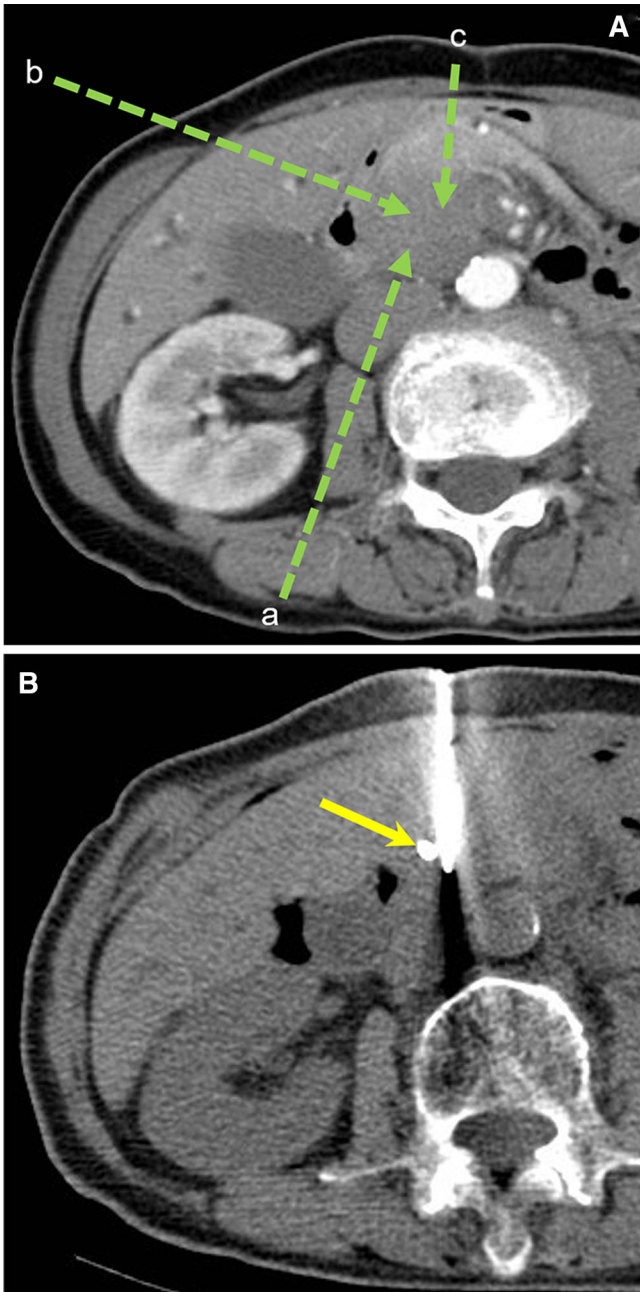


Fig. 3. Biopsy of the pancreatic tumor. **A.** Trans-caval approach is a safe method if a fine needle (21G or 22G) is used (a). Trans-duodenal approach is more risky because the surgery is more difficult and complicated if duodenal perforation occurs (b). Trans-gastric approach is a feasible method (c). **B.** The plastic common bile duct stent (arrow) is used a landmark for the biopsy target.

(aPTT) < 1.5 times the control value, and a platelet count > 50,000/ μ l.

Biopsy techniques

Biopsy is performed using either a 17-G coaxial introducer needle with an 18-G biopsy needle, or a 19-G coaxial introducer needle with a 20-G biopsy needle. The biopsy procedure can be performed under CT-guidance, sonographic-guidance, or both CT- and sonographic-guidance. The choice between the use of CT or sonography is largely dependent on personal preference and familiarity of the operator with each modality.

Most pancreatic or peripancreatic biopsies are performed under CT-guidance because of their deep retroperitoneal locations. The biopsy route is determined during the pre-procedural CT. The intra-abdominal fat planes can serve as the marker for each access: through the peri-renal space for pancreatic tail lesion or through the anterior mesenteric fat between the intestinal loops. The coaxial needle is advanced and manipulated several times to attain a suitable direction for insertion within the targeted lesion. When intervening bony or vascular structures result in a lack of an appropriate route using axial imagery, gantry tilt can be helpful [8]. Coronal and sagittal reconstructions can help in deciding the required angulation and proper choice of skin entry site. When the lesion is off-plane from the skin site even after gantry tilt, a 22-G Chiba needle can be inserted to provide direction. The coaxial needle can then target the lesion accordingly (Figure 2).

A delicate review of the previous contrast-enhanced image study before the procedure is recommended to evaluate the possible access route. However, there is usually no need for contrast injection during the CT-guided biopsy unless there is concern for avoiding critical vascular anatomy. Surgical materials such as clips or a metallic/plastic stent can serve as a marker to confirm the location of the target lesion (Figs. 2, 3). The pancreatic lesion may be difficult to characterize in the non-enhanced CT, and the parenchyma area prior to the dilated pancreatic duct should be used as a target in these cases.

Sonographic-guided biopsy has certain advantages compared with CT-guided biopsy, including lack of ionizing radiation, portability, relatively short procedure time, real-time intraprocedural visualization of the biopsy needle, and relatively lower cost [9]. The technique however is more challenging for the radiologist, especially the inexperienced radiologist.

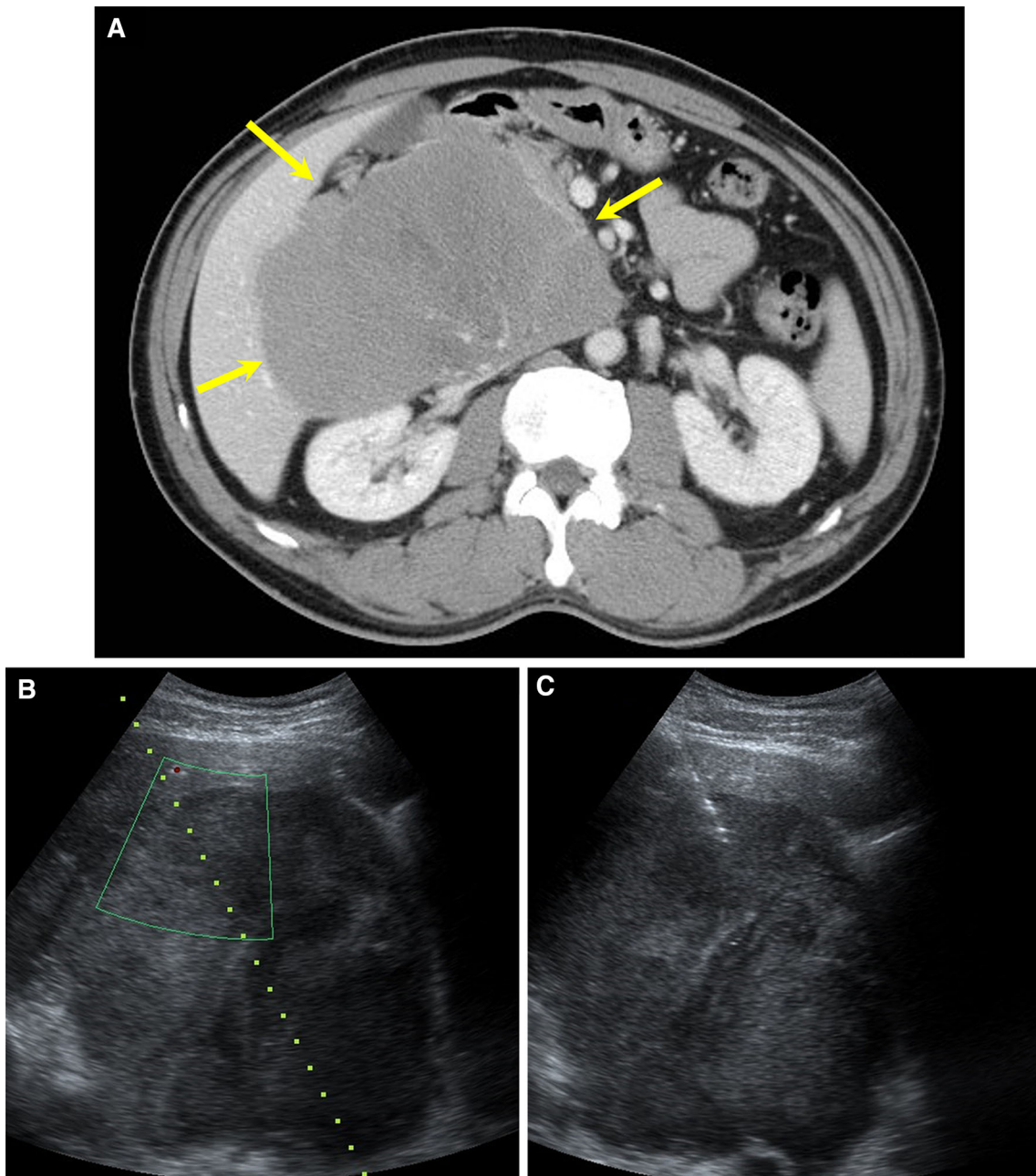
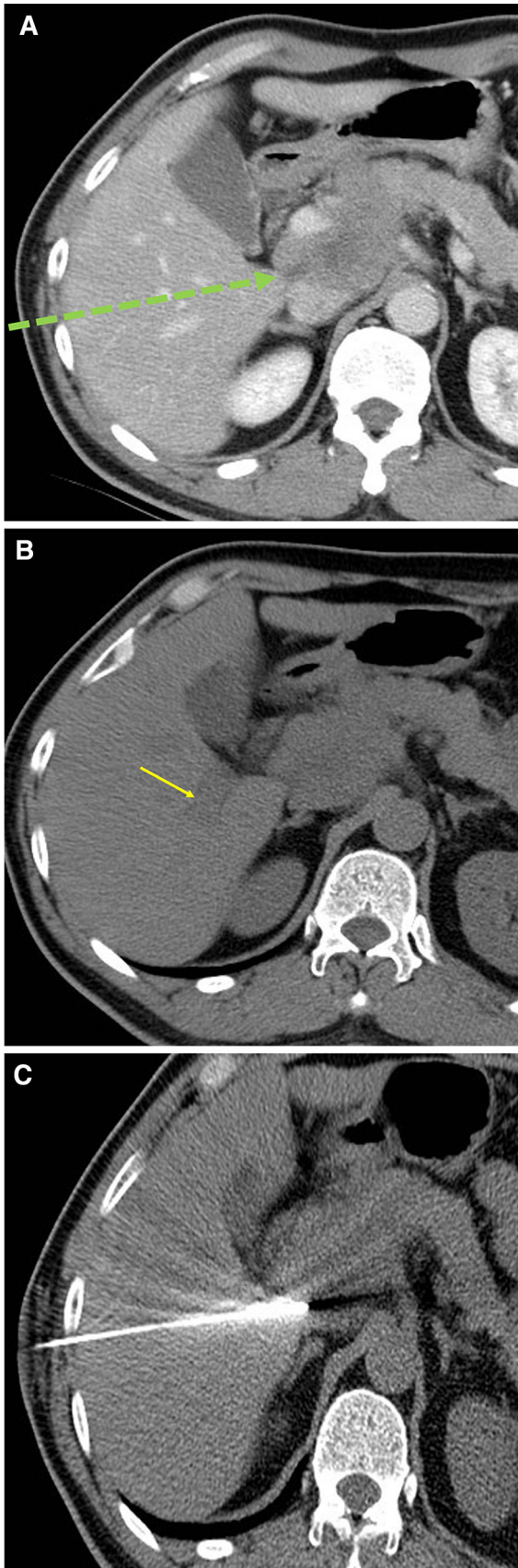


Fig. 4. A suspected large solid retroperitoneal tumor was referred to our hospital for surgery (arrows, **A**). Color Doppler evaluates the biopsy route, avoiding the penetration of vascular structures (**B-C**).



◀**Fig. 5.** A heterogeneous mass lesion is noted at the peripancreatic head region (**A**). Ultrasound guides needle insertion, sparing the vital vessels (arrow, **B**) and CT confirms the needle position (**C**). Pathology revealed diffuse large B-cell lymphoma.

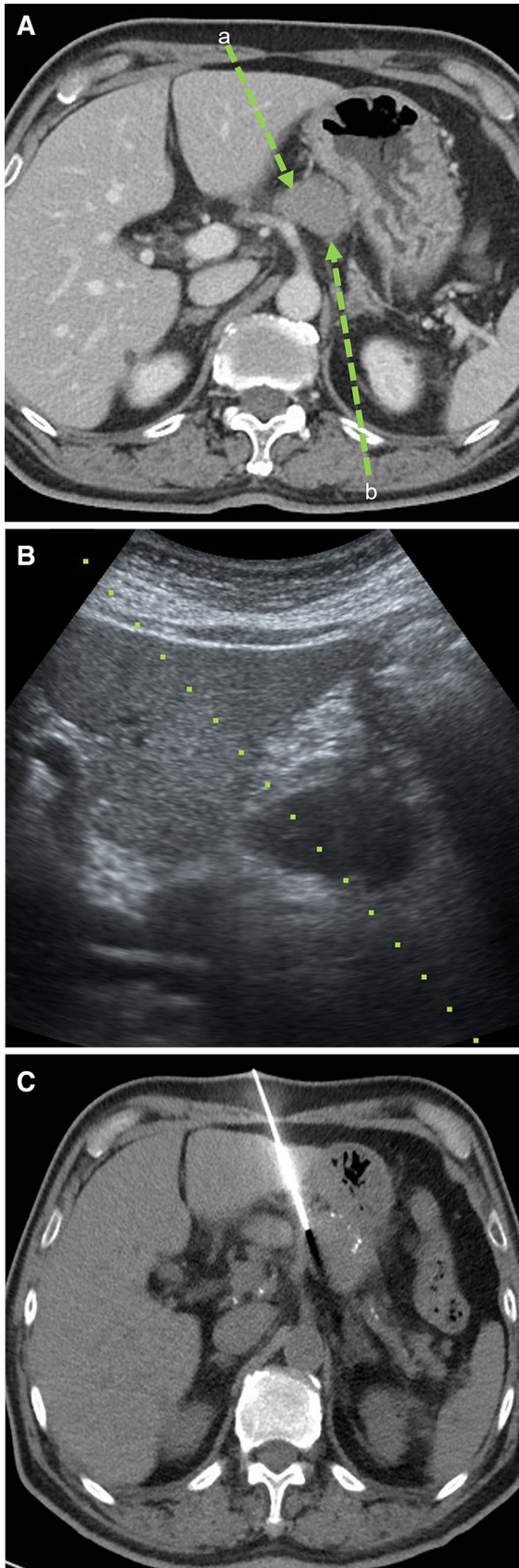
Coaxial cutting needle technique is used more frequently because it can reduce seeding rate and potentially reduce patient discomfort [10]. After penetrating into the peritoneal cavity, the blunt end of the coaxial needle can push aside the intervening bowel loops and target the lesion. A blunt-tip stylet needle can also serve as a pathfinder to navigate in fat and preserve vital structures [11]. The size of the biopsy needle is chosen based on institutional preference. Theoretically, a larger-bore needle will increase the risk of seeding. Complications related to the size of the biopsy needle are also a concern, especially when the trans-organ route is utilized. No significant differences in the complication rates have been reported based on needle caliber [3, 12].

Indirect access

Since the pancreas is a deep retroperitoneal organ, indirect access provides an alternative when abdominal structures prevent direct access to pancreatic or peripancreatic lesions. Possible access routes can be divided into solid organs (such as liver, kidney, and spleen) and hollow organs like the gastrointestinal tract or gallbladder.

Transhepatic

The transhepatic access provides a safe and effective way to perform pancreatic or peripancreatic lesion biopsy, especially when the lesion is located in the pancreatic body and head. Either CT-guided or sonographic-guided biopsy can be performed. The sonographic-guided approach usually saves time and involves no radiation. The lesion can be visualized using the liver as an acoustic window. When there is gastric air interposed between the abdominal wall and the liver, a right subcostal or intercostal approach provides an alternative. Color Doppler US is useful in avoiding vessels during the procedure (Figs. 4, 5, 6, 7).



◀**Fig. 6.** A solitary mass lesion is noted at the lesser omentum (**A**). The available access route is via the transhepatic (*a*) or trans-adrenal approach (*b*). The ultrasound-assisted CT-guided biopsy (**B-C**) reveals a diffuse large B-cell lymphoma.

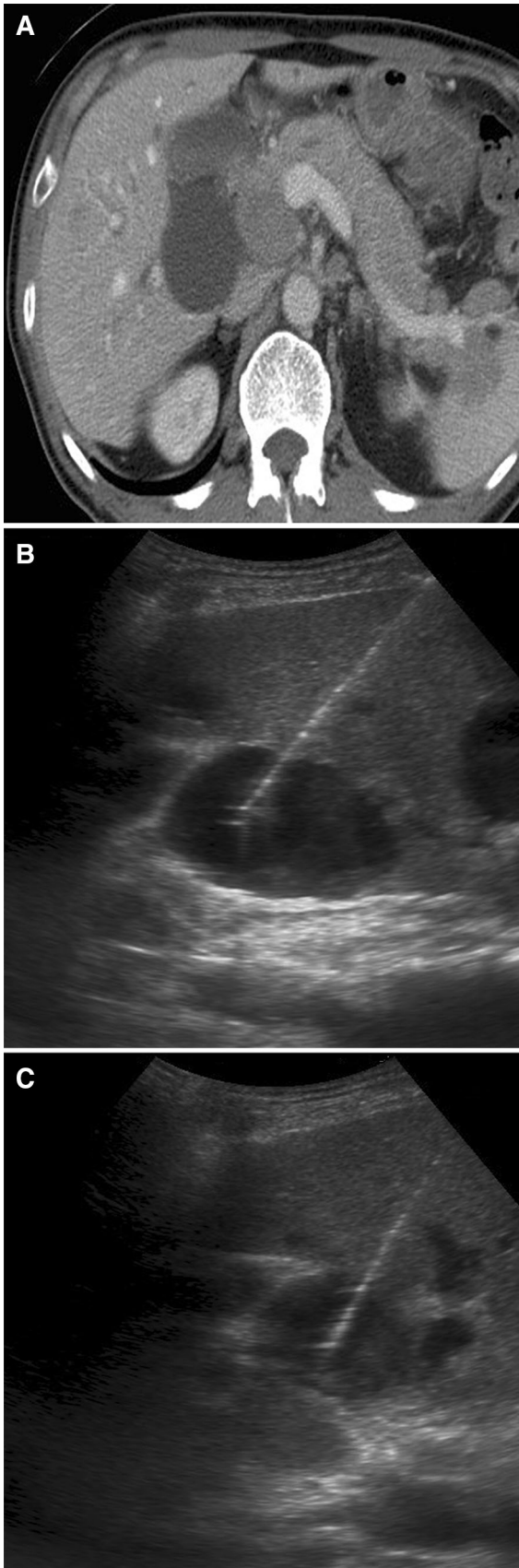
Trans-renal or trans-splenic

When a solid organ is punctured, hemorrhage becomes a major concern. Hydrodissection and/or pneumodissection are reportedly beneficial in some case series [12–14], but indirect access is still occasionally required. If there are no large vessels or vital organs in the access route, it becomes feasible to directly biopsy the lesion (Fig. 8) or biopsy through the solid organ. A lesion within the pancreatic tail can be easily obscured by intervening abdominal structures and can be approached by trans-renal access through the left kidney (Fig. 9). The trans-splenic route is an alternative when dealing with a pancreatic tail lesion. The reported complication rates associated with splenic biopsy are similar to those associated with liver or kidney biopsies using an 18 gauge (or smaller) needle [14]. Trans-splenic access for pancreatic biopsy has been reported in a recent case series [3].

Trans-gastric

When the stomach or other hollow organ serves as an access route, it is necessary to keep the biopsy needle as perpendicular to the surface as possible. In order to avoid the needle sliding over, the needle should be advanced forcibly and quickly when penetrating the wall. The coaxial needle puncture is first made through the anterior wall into the hollow space. The stylet is then withdrawn and the outer sheath is held against the posterior internal wall. The stylet is then inserted again and the whole needle is advanced quickly into the target lesion (Fig. 10).

Several studies have demonstrated that trans-gastric CNB is a practical biopsy method with complication rates in the range of 0–15.3% [15, 16]. No premedication or GI preparation is required and overnight fasting is adequate before the procedure [3, 16]. Since gastric air may obscure the pancreatic lesion during sonography, a trans-gastric access is usually performed under CT-guidance (Figs. 3, 10). After the procedure, fasting is unnecessary unless there are abnormal findings on follow-up CT or the patient has complaints.



◀**Fig. 7.** A mass lesion is noted at the portocaval space (arrows, **A**). The liver cyst provides a landmark and an acoustic window. It is easy to adjust the approach of the needle to the adjacent target (**B-C**). The pathology revealed a diffuse large B-cell lymphoma.



Fig. 8. A large advanced pancreatic body cancer with vascular encasement is noted. Failed EUS fine needle aspiration and subsequent direct tumor biopsy via the omentum or mesentery is performed as no large vessels are in front of the tumor. Pathology confirmed pancreatic adenocarcinoma.

Trans-enteric

Infection, peritonitis, and perforation are major concerns when the needle penetrates small bowel or colon (Fig. 11). There have been several reports of percutaneous pancreatic biopsy using core needles through the small bowel or colon [3, 17]. Safety is still of major concern, especially when the biopsy is performed through the colon, as it carries a theoretically higher risk of infection.

Trans-gallbladder

Another possible access route is through the gallbladder, although there is no published report in the literature regarding this technique. A case of a patient with autoimmune pancreatitis who underwent trans-gall-

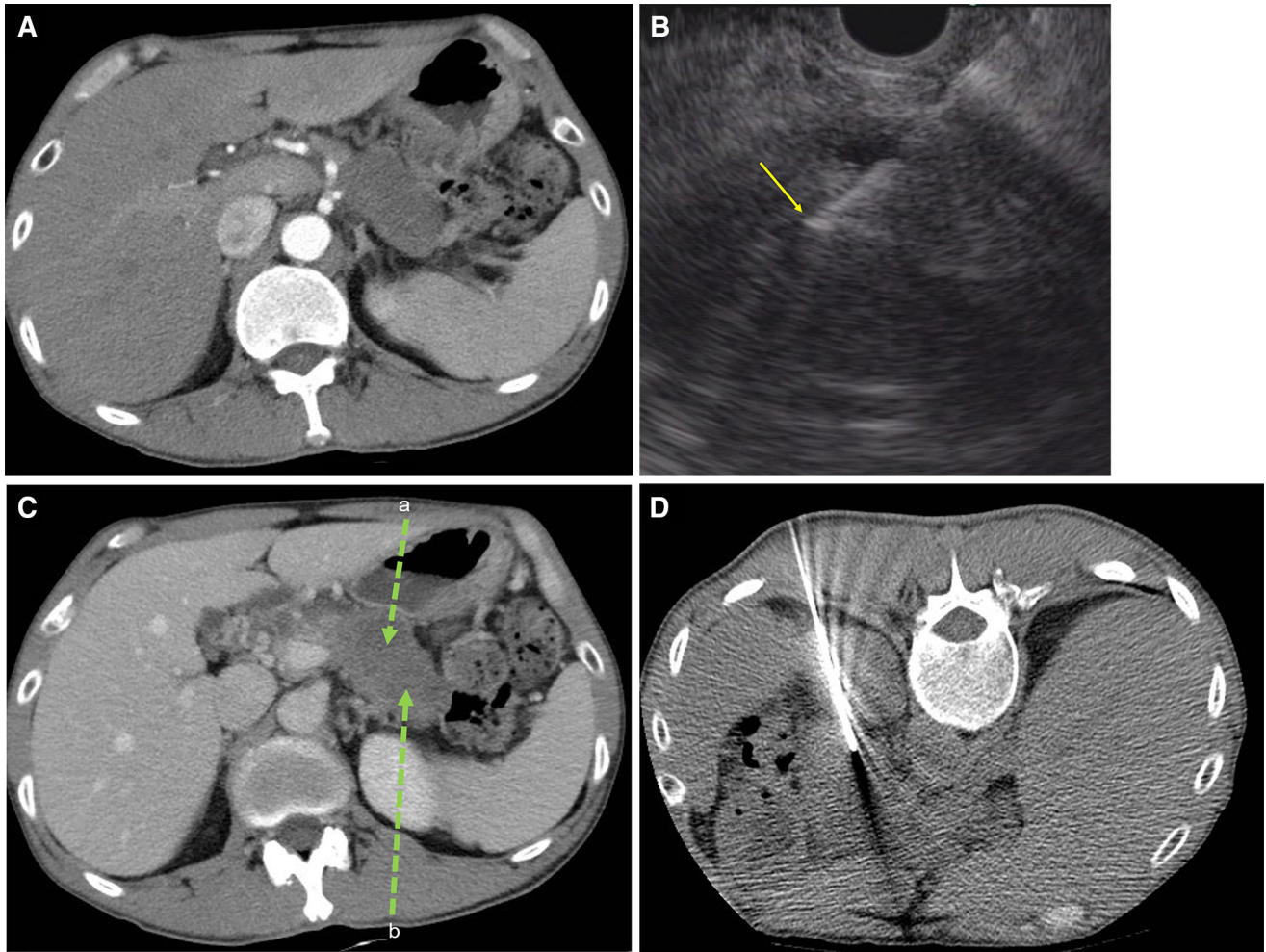


Fig. 9. A large hypovascular pancreatic body and tail cancer with vascular encasement (grade 4, T4) was noted (**A**). EUS biopsy does not reveal definite diagnosis (arrow, **B**). The CT-guided biopsy is performed using an anterior approach via the

liver and stomach (*a*) or using a posterior approach via the upper pole of the left kidney (*b*) (**C**). A trans-renal approach is performed in this patient and the pathology reveals pancreatic mucinous adenocarcinoma (**D**).

bladder pancreatic head biopsy is discussed in this report. The use of trans-gallbladder access is quite similar to that of trans-gastric access. The coaxial needle is first advanced into the gallbladder and the stylet is then withdrawn and the outer sheath is pushed against the medial wall of the gallbladder as near as possible to the lesion within the pancreatic head. The stylet is then in-

serted again and the whole needle is quickly advanced into the target lesion. Then the needle is advanced forcibly and quickly when penetrating the gall bladder wall. Biopsy is performed after the coaxial needle is targeted at the lesion. Finally, a 6 Fr pigtail is inserted into the gallbladder to prevent bile leakage and cholecystitis (Fig. 12).

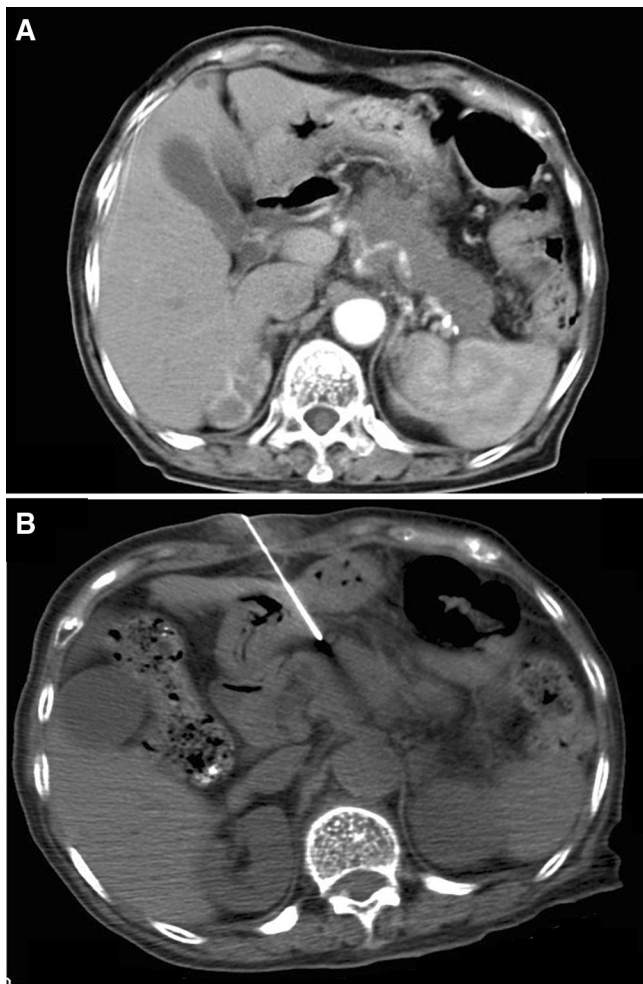


Fig. 10. A large hypovascular pancreatic body and tail cancer with vascular encasement (grade 4, T4) is noted (**A**). The CT-guided biopsy is performed via the trans-gastric approach (**B**). The pathology confirmed pancreatic adenocarcinoma.

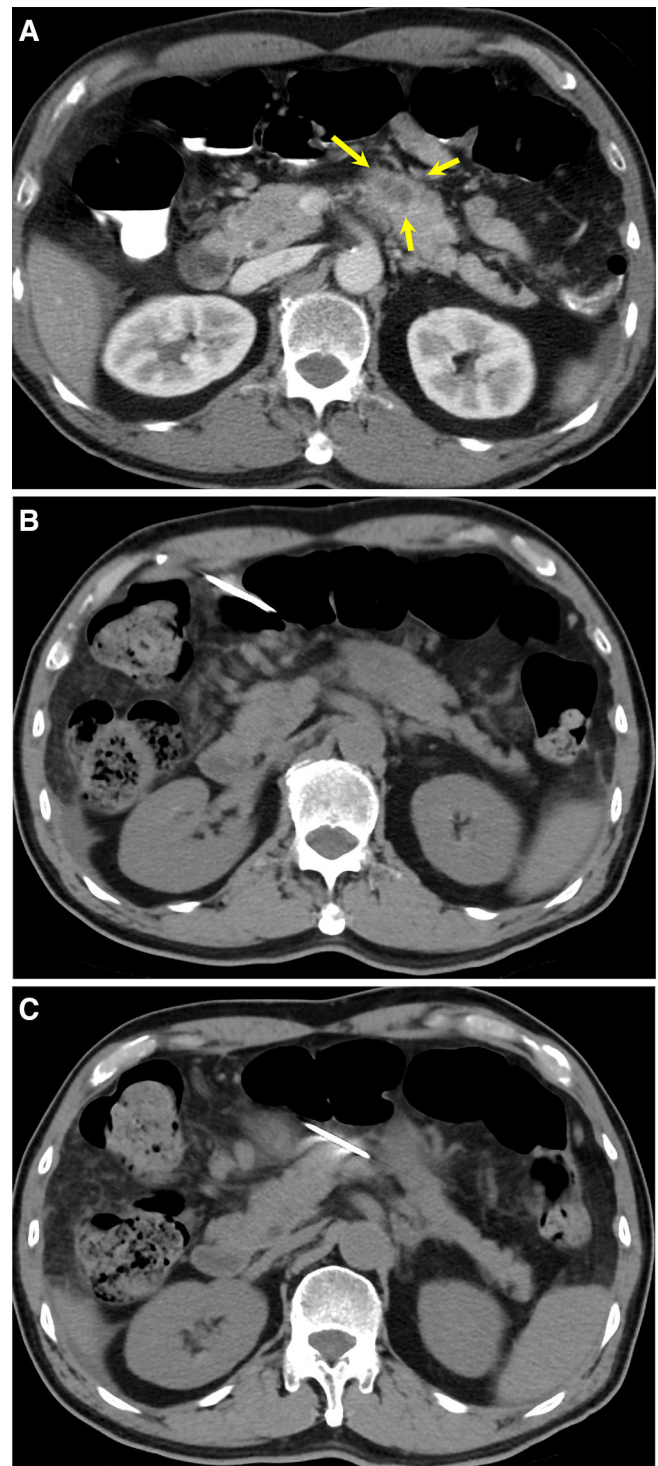
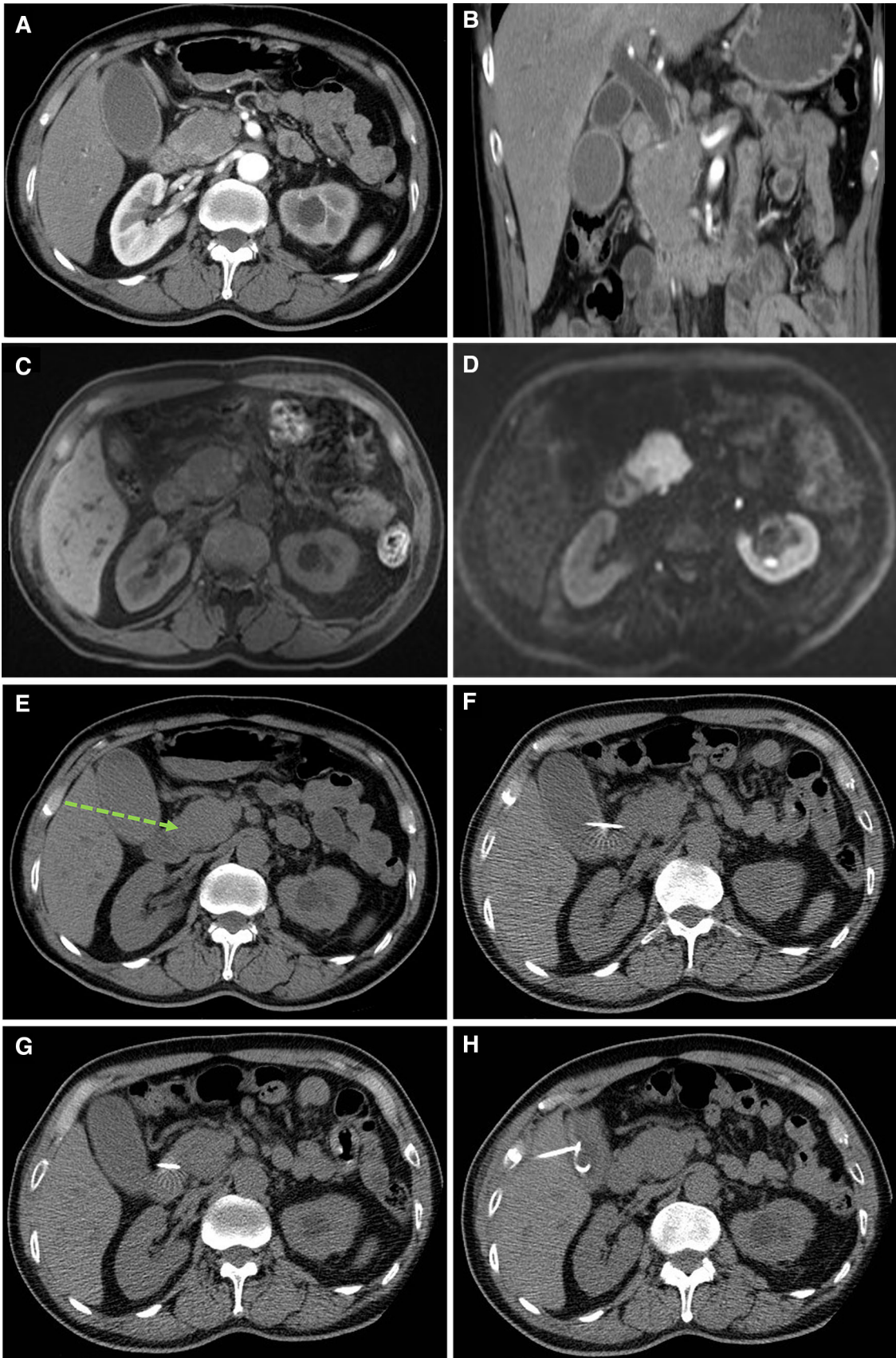


Fig. 11. An irregular unresectable pancreatic body cancer (arrow) with liver metastasis is noted (**A**). The CT-guided biopsy is performed via the trans-colon approach (**B-C**). The pathology confirmed pancreatic adenocarcinoma.



◀**Fig. 12.** A focal mass lesion is noted at the pancreatic head with obstructive jaundice. The mass is heterogeneous and shows progressive enhancement on axial CT images (**A**) and coronal images (**B**) with a dilated common bile duct. The mass is also hypointense on the T1-weighted image (**C**), and hyperintense on the diffusion weighted image with $b = 1000$ (**D**). The CT-guided biopsy of the pancreatic head mass is performed via the trans-gallbladder approach (**E--G**). After biopsy, a 6-Fr pigtail is inserted for biliary drainage to avoid bile leak (**H**). The pathology confirmed autoimmune pancreatitis.

Conclusion

Indirect percutaneous CNB of solid pancreatic or peripancreatic lesions allows procurement of adequate tissue for pathological diagnosis when EUS-guided FNA has failed. Sonographic-guided CNB may be the ideal biopsy method for the experienced operator as it is time-saving, cost-effective, and avoids radiation exposure. Nevertheless, the sonographic-guided approach to the pancreas may be limited by poor visualization due to bowel gas masking and reduced confidence of the performer due to the deep retroperitoneal location of the pancreas. CT-guidance, as an alternative, provides a clear access route and precise needle tip localization with reasonable radiation exposure. The hybrid method using both CT- and sonographic-guidance is a more flexible approach to a pancreatic lesion at a critical location. Knowledge of the abdominal anatomy, adequate patient preparation, and proper biopsy technique are critical factors in the success of the procedure. The suggested steps outlined in this paper can aid in the performance of a percutaneous CNB in a safe and effective manner.

Compliance with ethical standards

Financial support None.

Conflict of interest All authors declared that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual

participants included in the study.

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