

US-Guided Percutaneous Pancreas Biopsy: Practical Strategies for Safe and Effective Biopsy

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Histopathologic confirmation remains a critical component of decision-making in pancreatic tumors, particularly when systemic therapy, radiation therapy, or other non-surgical treatment is planned. In many institutions, endoscopic ultrasound-guided sampling continues to be regarded as the standard first-line route for tissue diagnosis. Nevertheless, ultrasound-guided percutaneous pancreas biopsy remains a highly relevant option in contemporary practice. It is especially valuable when endoscopic sampling is non-diagnostic, not readily available, technically impractical, or when a core specimen is specifically required for histologic architecture, immunohistochemistry, or molecular analysis. The purpose of this lecture is not to promote a simplistic replacement of endoscopic ultrasound, but rather to define the appropriate role of the percutaneous approach and to present a practical framework for performing the procedure safely and effectively.

The available literature supports selective but confident use of percutaneous biopsy for solid pancreatic lesions. Large retrospective series from experienced European centers have shown high diagnostic yield, excellent diagnostic accuracy, and low complication rates in properly selected patients. Comparative data also suggest that percutaneous ultrasound-guided biopsy may achieve diagnostic performance comparable to, and in some situations even higher than, endoscopic ultrasound-guided sampling, although such findings must be interpreted with caution because of case-selection bias. The central message is therefore not that one route is universally superior, but that biopsy strategy should be individualized according to lesion location, lesion conspicuity on transabdominal ultrasound, body habitus, interposed vessels or bowel, and operator expertise.

Among all technical steps, pre-procedural route planning is the single most important determinant of success. Cross-sectional imaging, usually contrast-enhanced CT or MRI, should first be reviewed in detail to determine the exact position of the lesion and its relationship to the stomach, duodenum, liver, spleen, colon, kidney, mesentery, and major vascular structures. A route that appears feasible on CT or MRI must then be reassessed under real-time ultrasound because surrounding organs may shift according to respiration, fasting status, probe compression, and patient position. Color Doppler ultrasound is indispensable for identifying vessels that must be avoided. In general, the safest path is the most controllable one, with the shortest practical skin-to-lesion distance and the fewest critical structures along the expected needle tract.

A practical and clinically useful way to conceptualize safe path selection is to classify pancreatic lesions according to their location. Lesions in the uncinate process are often approached through the omentum when a caudocranial route is available. Lesions in the head or neck may be approached trans-gastric or, in selected circumstances, through an intervening enteric path when the tract is short, stable, and well controlled. Lesions in the body may permit trans-omental or trans-gastric access depending on their depth and surrounding anatomy. Tail lesions frequently require more individualized strategies, including trans-splenic, trans-renal, or other tailored route, depending on the position of the colon, spleen, and regional vessels. Accordingly, there is no single universal pathway for pancreatic biopsy; the operator must select the safest path for the specific lesion in the specific patient at the specific moment of the procedure.

Image fusion may substantially expand the technical feasibility of difficult cases. Real-time fusion of ultrasound with prior CT or MRI can improve target localization, confirm surrounding anatomy, help identify the most viable portion of

a lesion, and maintain the intended puncture angle throughout the procedure. This is particularly helpful for deep lesions, poorly conspicuous lesions, uncinata process masses, and cases in which an important structure is difficult to appreciate on grayscale ultrasound alone. In the same context, adjunctive techniques such as hydrodissection may widen the space between the target and adjacent organs, improve the sonic window, and reduce the risk of collateral injury. These methods should be regarded as extensions of careful planning rather than substitutes for it.

Patient cooperation is another key requirement for procedural safety. Deep inspiration should be avoided during pancreatic biopsy, especially when the planned route traverses or closely abuts the liver or spleen. Cranio-caudal migration of abdominal organs during deep breathing may increase the risk of laceration or loss of needle control. For this reason, shallow breathing should be explained and rehearsed before needle insertion. Compression of the abdominal wall with the probe is also a simple but powerful maneuver. It can reduce skin-to-lesion distance, displace bowel gas, stabilize mobile bowel loops, and improve lesion visualization. In many cases, appropriate compression, together with respiration control and fasting, determines whether a lesion is approachable or not.

Needle selection and needle handling directly influence both diagnostic adequacy and procedural safety. In most abdominal applications, an automated spring-loaded 18-gauge core needle represents a practical balance between visibility, tissue yield, and maneuverability. Needle length and throw should be selected according to target depth and lesion size. When a double-firing system is available, a staged firing technique is particularly useful. The operator may first position the needle tip at the near edge of the lesion, then advance the inner stylet to the desired depth, and finally deploy the outer cutting cannula. This stepwise approach reduces the likelihood of over-penetration into deep vessels or other vulnerable structures.

Continuous and confident visualization of the biopsy needle is a basic requirement for safe pancreas biopsy. Although many experienced operators prefer a free-hand technique, the essential principle is the same regardless of method: the needle shaft must be kept as parallel as possible to the long axis of the transducer. If the needle becomes poorly visible, it should be realigned while maintaining a stable transducer position. Needle conspicuity is also affected by the echogenicity of intervening tissues. The needle is usually more clearly seen in relatively hypoechoic tissue than in hyperechoic abdominal fat or bowel gas. Large-caliber needles are generally easier to visualize than thin needles, and subtle in-and-out or bobbing motion may help the operator recognize the needle track during advancement.

The indications for ultrasound-guided percutaneous pancreas biopsy include confirmation of suspected malignancy, clarification of an indeterminate lesion, and tissue acquisition when a benign diagnosis must be established with confidence. Contraindications include uncorrectable coagulopathy, lack of a safe access route, and poor patient cooperation with uncontrolled motion. Standard preparation includes fasting, coagulation review, medication review including antiplatelet agents, informed consent, and establishment of intravenous access. Sedation is not mandatory in most cases, but local anesthesia, careful observation during the procedure, and structured post-procedural monitoring remain essential components of safe practice.

Complications are uncommon in experienced hands but should always be anticipated. Pain is the most frequent minor event. Bleeding remains the most important major complication, although the overall incidence is low. Injury to intervening organs is a theoretical concern whenever the route traverses the liver, spleen, stomach, bowel, or kidney, yet clinically significant injury appears uncommon when the route is meticulously planned and needle motion is well controlled. Needle-tract tumor seeding is rare but should be minimized by limiting the number of passes to the lowest

number reasonably necessary for diagnosis. Re-biopsy may still be required in small lesions, technically difficult locations, or biologically heterogeneous tumors.

In conclusion, ultrasound-guided percutaneous pancreas biopsy remains technically demanding, but it is a safe, feasible, and clinically valuable procedure when performed with a full understanding of path planning, real-time sonographic anatomy, needle control, and organ motion. The difficulty of the procedure varies considerably according to lesion size, lesion location, body habitus, surrounding anatomy, and operator skill. Therefore, this procedure should be undertaken only when the operator is confident that a safe and controllable route can be created. When those conditions are met, ultrasound-guided percutaneous biopsy can serve as an effective complementary or alternative strategy for tissue diagnosis in selected pancreatic lesions.

Keywords: pancreas biopsy; ultrasound guidance; percutaneous core needle biopsy; image fusion; hydrodissection; procedural safety

Selected References

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