Case Report

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^{68}Ga-FAPI Avidity in Fat Necrosis and Adrenal Adenoma: Expanding the Spectrum of Benign Pitfalls in Oncologic Imaging

Yağ Nekrozu ve Adrenal Adenomda ^{68}Ga-FAPI Tutulumu: Onkolojik Görüntülemede Benign Tuzakların Spektrumunu Genişletmek

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Abstract

Fat necrosis, a benign postoperative process related to tissue injury and repair, may demonstrate variable findings on functional imaging. We report a case of postoperative fat necrosis following pancreaticoduodenectomy showing intense ^{68}Ga-FAPI uptake in the absence of significant ^{18}F-fluorodeoxyglucose (^{18}F-FDG) avidity. Surveillance ^{18}F-FDG positron emission tomography/computed tomography (^{18}F-FDG PET/CT) demonstrated only mild activity within the surgical bed maximum standard uptake value (SUV_{max} 2.4), while subsequent ^{68}Ga-FAPI PET/CT revealed marked uptake corresponding to fat necrosis SUV_{max} 9.9, consistent with pronounced fibroblast activation during postoperative healing. Additionally, a benign left adrenal adenoma showed low ^{18}F-FDG uptake and only minimal ^{68}Ga-FAPI avidity (SUV_{max} 2.3), reflecting minimal stromal activation. This case highlights the tracer discordance between ^{18}F-FDG and ^{68}Ga-FAPI in fat necrosis and underscores the importance of correlating ^{68}Ga-FAPI findings with surgical history and anatomic imaging to ensure accurate interpretation.

Keywords: ^{68}Ga-FAPI, ^{18}F-FDG, fibroblast activation protein, fat necrosis, adrenal adenoma, pitfalls

Öz

Yağ nekrozu, doku hasarı ve onarımıyla ilgili iyi huylu bir postoperatif süreçtir ve fonksiyonel görüntülemede değişken bulgular gösterebilir. Pankreatikoduodenektomi sonrası postoperatif yağ nekrozunda belirgin ^{18}F-florodeoksiglukoz (^{18}F-FDG) tutulumu olmaksızın yoğun ^{68}Ga-FAPI tutulumu gözlenen bir olgu sunulmuştur. Takip amaçlı yapılan ^{18}F-FDG pozitron emisyon tomografisi/bilgisayarlı tomografi (^{18}F-FDG PET/BT), cerrahi alanda yalnızca hafif aktivite maksimum standart tutulum değeri (SUV_{max} 2,4) gösterirken, daha sonraki ^{68}Ga-FAPI PET/BT, postoperatif iyileşme sırasında belirgin fibroblast aktivasyonuna uygun olarak yağ nekrozuna karşılık gelen belirgin bir tutulum (SUV_{max} 9,9) ortaya koymuştur. Ek olarak, benign sol adrenal adenom düşük ^{18}F-FDG tutulumu ve yalnızca minimal ^{68}Ga-FAPI tutulumu (SUV_{max} 2,3) göstermiş olup, bu da minimal stromal aktivasyonu yansıtmaktadır. Bu olgu, yağ nekrozunda ^{18}F-FDG ve ^{68}Ga-FAPI arasındaki tracer uyumsuzluğunu vurgulamakta ve doğru yorumlama sağlamak için ^{68}Ga-FAPI bulgularının cerrahi öykü ve anatomik görüntüleme ile ilişkilendirilmesinin öneminin altını çizmektedir.

Anahtar kelimeler: ^{68}Ga-FAPI, ^{18}F-FDG, fibroblast aktivasyon proteini, yağ nekrozu, adrenal adenom, tuzaklar

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Introduction

Fat necrosis is a benign pathological process resulting from injury to adipose tissue, most commonly caused by trauma, surgery, ischemia, infection, or exposure to digestive enzymes (1). Histopathologically, fat necrosis is characterized by necrotic adipocytes, release of free fatty acids, infiltration by lipid-laden macrophages and chronic inflammatory cells, and varying degrees of fibrosis and calcification. Over time, this reparative process may evolve into fibrotic or mass-like lesions (2). Fat necrosis is frequently encountered in postoperative settings, particularly after abdominal and pancreatic surgery, where surgical manipulation, vascular compromise, or pancreatic enzyme leakage can damage surrounding fat. Although its exact incidence is variable and likely underreported, fat necrosis is considered a relatively common benign postoperative finding in oncologic patients undergoing imaging surveillance (1).

On computed tomography (CT), fat necrosis exhibits a wide range of appearances depending on its stage, including fat stranding, ill-defined inflammatory changes, and mass-like soft-tissue lesions with fibrotic components. These features can closely mimic tumor recurrence or metastatic disease, especially in oncologic patients undergoing surveillance imaging, often necessitating further evaluation with functional imaging modalities (3).

^{18}F-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography (PET)/CT is commonly used to characterize indeterminate postoperative findings; however, ^{18}F-FDG uptake in fat necrosis is variable and may be minimal or absent, particularly in chronic or fibrosis-dominant lesions (2). More recently, fibroblast activation protein inhibitor (^{68}Ga-FAPI) PET/CT has emerged as a novel imaging modality, targeting activated fibroblasts involved in tissue repair and fibrosis, and has shown uptake in both malignant and benign conditions (4).

We report a case of postoperative fat necrosis following pancreaticoduodenectomy demonstrating intense ^{68}Ga-FAPI uptake in the absence of ^{18}F-FDG avidity, highlighting a potential diagnostic pitfall in postoperative oncologic imaging.

Case Report

A 53-year-old male presented in July 2025 with a 3-week history of severe, progressively worsening abdominal pain. The pain was predominantly epigastric and in the right upper quadrant, described as constant, dull, and pressure-like, with intermittent exacerbations following meals. It was associated with abdominal bloating, early satiety, nausea, and dark-colored urine, but without hematemesis or melena. The patient also reported pale stools over the preceding days. On physical examination, the patient appeared ill and visibly jaundiced. Vital signs were stable. Scleral icterus and generalized jaundice were evident. Abdominal examination revealed distension with right upper quadrant tenderness; however, Murphy's sign was negative. Laboratory investigations demonstrated a cholestatic pattern of liver dysfunction, with markedly elevated total and direct bilirubin levels (10 mg/dL and 4 mg/dL, respectively), consistent with obstructive jaundice. Carbohydrate antigen 19-9 (CA 19-9) was elevated to 152 U/mL, suggesting a malignant biliary or periampullary process.

Given the clinical presentation of obstructive jaundice, a transabdominal ultrasound was performed as the first-line imaging modality. Ultrasound examination revealed marked intrahepatic and extrahepatic biliary dilatation, with the common bile duct measuring approximately 10 mm. The gallbladder was distended without wall thickening or gallstones; no acoustic-shadowing calculi were identified. The pancreatic head region appeared mildly heterogeneous, though visualization was limited by overlying bowel gas. These findings suggested a distal biliary obstruction and prompted further cross-sectional imaging. A contrast-enhanced CT scan demonstrated an ill-defined, enhancing, soft-tissue lesion measuring approximately 11×3.5 mm in the periampullary region and involving the distal common bile duct. This lesion was associated with significant upstream biliary dilatation, including the common bile duct, cystic duct, common hepatic duct, and right and left hepatic ducts. No definite evidence of liver metastases, ascites, or distant lymphadenopathy was identified. However, it showed a left adrenal lesion (3.3 cm), consistent with a benign adenoma.

The patient subsequently underwent endoscopic retrograde cholangiopancreatography with biliary decompression and tissue sampling on July 15, 2025. Endoscopic biopsy revealed a poorly differentiated adenocarcinoma. Following discussion at the multidisciplinary tumor board, the patient underwent definitive surgical management.

On July 29, 2025, the patient underwent a pancreaticoduodenectomy (Whipple procedure). Histopathological analysis confirmed a poorly differentiated signet-ring cell adenocarcinoma (poorly cohesive carcinoma) of the ampulla of Vater, staged as pT3bN0M0. The surgical resection margins were free of tumor, indicating an R0 resection.

As part of routine postoperative surveillance, a contrast-enhanced CT scan performed in November 2025 demonstrated no evidence of local recurrence or distant metastatic disease. The examination identified a small left paracolic lymph node measuring up to 0.7 cm, an area

within the surgical bed suggestive of fat necrosis, and a stable left adrenal lesion with imaging features consistent with an adenoma (Figure 1). However, these findings were considered indeterminate in the postoperative setting.

For further characterization of the paracolic lymph node, an ^{18}F-FDG PET/CT was performed in December 2025. The paracolic lymph node showed no ^{18}F-FDG uptake, favoring a benign or reactive etiology. A focal area within the surgical bed demonstrated mild metabolic activity maximum standard uptake value (SUV_{max} 2.4), suggestive of postoperative inflammatory changes. The left adrenal mass measured 3.3 cm, remained hypodense, and exhibited no significant ^{18}F-FDG uptake, findings consistent with a benign adrenal adenoma (Figure 2). Nevertheless, given the known limitations of ^{18}F-FDG in differentiating low-grade malignancy from postoperative or inflammatory changes, diagnostic uncertainty persisted.

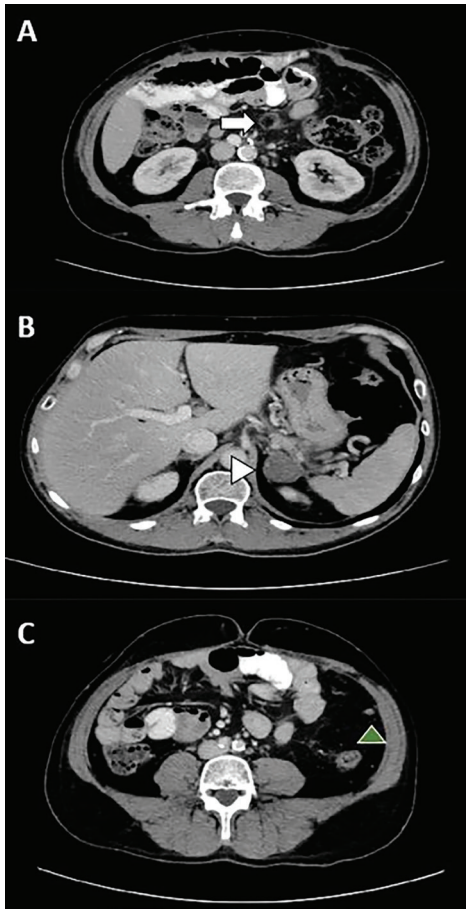

Figure 1. Contrast-enhanced CT scan (November 2025). (A) axial image demonstrating a focal area of fat necrosis within the surgical bed (white arrow) (B) axial image demonstrating a left adrenal adenoma (white arrowhead) (C) axial image demonstrating a small paracolic lymph node (green arrowhead)
CT: Computed tomography

Therefore, ^{68}Ga-FAPI PET/CT was subsequently performed for additional assessment. This study revealed diffuse ^{68}Ga-FAPI uptake within the pancreatic remnant, most consistent with postoperative fibro-inflammatory or reparative changes, while the previously identified paracolic lymph node remained non-avid. Notably, the focal fat necrosis in the surgical bed demonstrated markedly increased ^{68}Ga-FAPI uptake compared to ^{18}F-FDG uptake, with an SUV_{max} of 9.9, significantly higher than on the ^{18}F-FDG study. The left adrenal lesion exhibited minimal ^{68}Ga-FAPI avidity (SUV_{max} 2.3), a finding interpreted in the context of its benign imaging characteristics (Figure 3).

Overall, the absence of focal ^{68}Ga-FAPI-avid lesions suggestive of local recurrence or metastatic disease, particularly within the surgical bed and paracolic lymph nodes, supported a conservative management strategy with continued imaging surveillance. Written informed consent for publication of the clinical information and accompanying images was obtained from the patient.

Discussion

In this case, postoperative fat necrosis following pancreaticoduodenectomy demonstrated intense ^{68}Ga-FAPI PET/CT uptake but only mild ^{18}F-FDG avidity, indicating clear tracer discordance. The lesion was located within the surgical bed and showed imaging features suggestive of fat necrosis, with no clinical or biochemical evidence of disease recurrence. The low-level ^{18}F-FDG uptake likely reflects limited inflammatory activity, whereas the marked ^{68}Ga-FAPI avidity is more consistent with fibroblast activation related to postoperative tissue repair and fibrosis (4).

From an imaging perspective, fat necrosis typically appears on CT as a fat-density lesion with surrounding inflammatory stranding or soft tissue components, which may simulate tumor recurrence in the postoperative setting (5). On ^{18}F-FDG PET/CT, uptake is usually mild to moderate and reflects inflammatory activity (5), whereas ^{68}Ga-FAPI PET/CT may demonstrate intense uptake due to fibroblast activation associated with tissue repair and fibrosis, as presented in this case. In contrast, adrenal adenomas characteristically demonstrate low attenuation on CT (often <10 Hounsfield units) and are stable over time, and typically show absent or minimal uptake on both ^{18}F-FDG and ^{68}Ga-FAPI PET imaging (6). The differential diagnosis of postoperative fat-containing lesions includes local tumor recurrence, peritoneal metastasis, and postoperative inflammatory or fibrotic changes (7). Similarly, adrenal lesions may raise concern for adrenal metastasis, pheochromocytoma, or primary adrenal malignancy, particularly when imaging findings are atypical or equivocal (8). Therefore, careful integration of morphologic CT findings, functional PET imaging, and clinical context is essential for accurate interpretation.

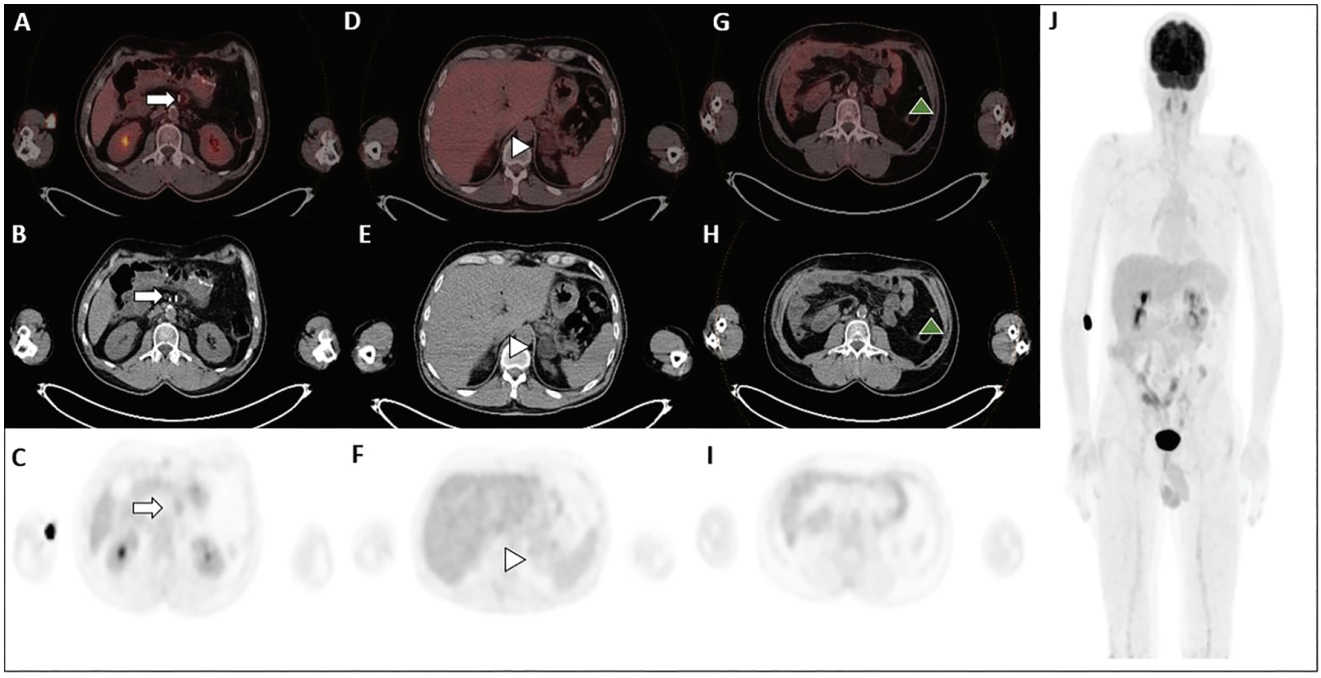

Figure 2. ^{18}F-FDG PET/CT scan (A-C) axial fused PET/CT, CT, and PET images demonstrate a focal area of fat necrosis within the surgical bed, showing mild ^{18}F-FDG uptake (SUV_{max} 2.4) (white arrow) (D-F) corresponding images demonstrate a left adrenal adenoma without ^{18}F-FDG uptake (white arrowhead) (G-I) images demonstrate a small paracolic lymph node without ^{18}F-FDG uptake, favoring a benign or reactive etiology (green arrowhead) (J) the maximum intensity projection image shows no abnormal hypermetabolic uptake
^{18}F-FDG PET/CT: ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography, SUV_{max}: Maximum standard uptake value

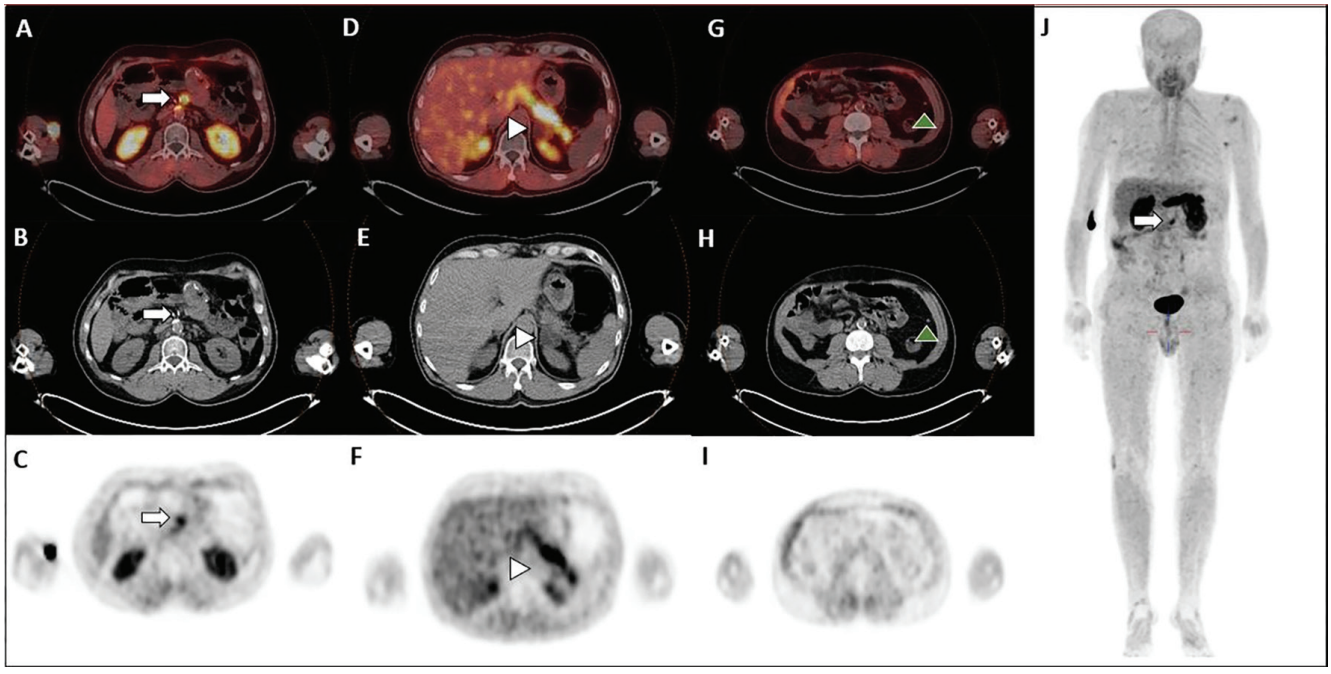

Figure 3. ^{68}Ga-FAPI PET/CT scan (A-C) axial fused PET/CT, CT, and PET images demonstrate a focal area of fat necrosis within the surgical bed that shows intense FAPI uptake (SUV_{max} 9.9) (white arrow) corresponding images (D-F) demonstrate a left adrenal adenoma with minimal FAPI uptake, indicated by the white arrowhead (G-I) images demonstrate a small paracolic lymph node without FAPI uptake, which favors a benign or reactive etiology (green arrowhead) (J) MIP image demonstrates a focal increase in FAPI uptake in the upper mid-abdomen, corresponding to fat necrosis (white arrow)
PET/CT: Positron emission tomography/computed tomography, MIP: Maximum intensity projection, SUV_{max}: Maximum standard uptake value, FAPI: Fibroblast activation protein inhibitor

Several studies have shown that ^{68}Ga-FAPI PET/CT uptake is not specific to malignancy and may be observed in a range of benign conditions characterized by fibroblast activation, including postoperative changes, inflammatory lesions, and fibrotic processes (9). Activated fibroblasts play a central role in wound healing and tissue remodeling after surgery, which can lead to prominent ^{68}Ga-FAPI uptake even in the absence of a viable tumor (9). In contrast, ^{18}F-FDG uptake in such postoperative or fibro-inflammatory settings is frequently mild or variable, as metabolic activity is often limited once acute inflammation subsides and fibrosis predominates (10). This fundamental difference in tracer biology explains why lesions with minimal ^{18}F-FDG avidity may nevertheless appear conspicuous on ^{68}Ga-FAPI PET/CT and underscores the potential for false-positive interpretations when ^{68}Ga-FAPI uptake is assessed without careful correlation to clinical history and anatomic imaging.

To date, only a single case report has described ^{68}Ga-FAPI uptake in fat necrosis, to which our case adds both confirmatory and novel observations. In that report, Maliha et al. (11) described CT-diagnosed intra-abdominal fat necrosis demonstrating mild ^{68}Ga-FAPI uptake slightly greater than ^{18}F-FDG uptake (SUV_{max} ~2.9 vs. 2.0) on ^{68}Ga-FAPI PET/CT, supporting the concept that fibroblast activation can persist in benign necrotic adipose tissue even years after surgery. In contrast, our patient's fat necrosis showed marked ^{68}Ga-FAPI avidity (SUV_{max} 9.9) alongside only mild ^{18}F-FDG uptake (SUV_{max} 2.4), indicating a more pronounced fibroblastic reparative process detectable by ^{68}Ga-FAPI imaging but with limited glycolytic activity on ^{18}F-FDG PET. This larger disparity between ^{68}Ga-FAPI and ^{18}F-FDG uptake underscores the heterogeneity of fibro-inflammatory responses in fat necrosis. It suggests that ^{68}Ga-FAPI PET/CT may be more sensitive to activated fibroblasts in certain postoperative lesions than ^{18}F-FDG PET/CT, while also highlighting the risk of overestimating benign postoperative changes as potential malignancy without careful clinical and morphologic correlation.

A similar principle applies to adrenal lesions. Adrenal adenomas are common benign adrenal cortical tumors and, on ^{18}F-FDG PET/CT, typically demonstrate low or only mild ^{18}F-FDG uptake because of their low glycolytic activity, although hormonally active adenomas and lipid-poor lesions may occasionally show moderate uptake, creating diagnostic overlap with malignant adrenal neoplasms and metastases (6). In contrast, ^{68}Ga-FAPI PET imaging targets fibroblast activation protein expressed by cancer-associated fibroblasts and stromal remodeling rather than tumor metabolism, and benign adrenal adenomas are therefore expected to show absent or minimal ^{68}Ga-FAPI uptake (12). To date, only a single published case has specifically documented ^{68}Ga-FAPI findings in an adrenal cortical adenoma, in which a hormonally active adrenal adenoma did not demonstrate significant uptake on ^{68}Ga-FAPI PET/magnetic resonance imaging (SUV_{max} ~1.8), with postoperative histopathology confirming a benign adrenal cortical adenoma (12). The absence of ^{68}Ga-FAPI avidity in adrenal adenoma supports the concept that ^{68}Ga-FAPI PET may help distinguish benign adrenal cortical lesions from adrenal metastases, which are more likely to demonstrate prominent fibroblast-rich tumor stroma and, consequently, higher ^{68}Ga-FAPI uptake (13). However, broader clinical validation remains necessary given the very limited current evidence base.

Conclusion

This case demonstrates that postoperative fat necrosis can show intense ^{68}Ga-FAPI uptake despite minimal or absent ^{18}F-FDG avidity, reflecting fibroblast activation related to tissue repair rather than malignancy. Importantly, the ^{68}Ga-FAPI-avid lesion did not mimic tumor recurrence when interpreted in the context of surgical history, anatomic imaging, and clinical follow-up. Minimal ^{68}Ga-FAPI uptake in a benign adrenal adenoma further illustrates that low-level ^{68}Ga-FAPI avidity may occur in non-malignant adrenal lesions with limited stromal remodeling. This report adds to the growing body of evidence on ^{68}Ga-FAPI PET/CT pitfalls, expanding current knowledge of benign entities that may demonstrate increased tracer uptake and helping refine interpretive awareness in postoperative oncologic imaging.

Ethics

Informed Consent: Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.M., R.M.A-H., B.A., A.A-I., Concept: S.M., A.A-I., Design: S.M., R.M.A-H., A.A-I., Data Collection or Processing: S.M., R.M.A-H., B.A., A.A-I., Analysis or Interpretation: S.M., R.M.A-H., B.A., A.A-I., Literature Search: S.M., R.M.A-H., B.A., A.A-I., Writing: S.M., R.M.A-H., B.A., A.A-I.

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