The Usefulness of Super-Selective Computed Tomography Angiography (CTA) for Diagnosing and Localizing a Small Insulinoma

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Abstract

Localization of insulinomas by preoperative imaging is critical for successful surgical resection. However, the visualization and localization of small insulinomas by recent imaging modalities still remains a challenge. Here, we report a 77-year-old woman with a small insulinoma successfully localized by performing arterial stimulation and venous sampling (ASVS), and subsequent super-selective CTA (SSCTA). It was not visualized by routine non-invasive imaging tests such as digital subtraction angiography (DSA). The small size (1.0 cm) of the surgically removed tumor supports the usefulness of SSCTA for localizing very small insulinomas.

Key words: insulinoma, computed tomography angiography (CTA), imaging diagnosis, localization

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Introduction

Insulinomas are the most common functioning neoplasm of the pancreatic β cells which provoke hyperinsulinemic hypoglycemia. Although they are associated with clinically specific symptoms, the preoperative diagnosis and localization is challenging because approximately 80-90% of the tumors are smaller than 2 cm in diameter (1, 2). Recent technical advances in imaging including contrast-enhanced ultrasonography (US), endoscopic US, multidetector CT, magnetic resonance imaging (MRI) with better gradients and coils, and DSA have improved considerably both in quality and sensitivity for the detection of insulinomas, however, we still confront difficulties in localizing small insulinomas (1-3). In this report, we present a case with a very small insulinoma, in which we successfully localized and surgically removed it by employing SSCTA.

Case Report

A 77-year-old woman was admitted to our hospital, since she had been suffered from repeated attacks of unconsciousness for 3 years. On admission, her height was 144 cm, body weight 46 kg (BMI 22.1 kg/m²) and waist circumference 88 cm. During past 3 years, she gained about 5 kg. All laboratory data were within normal range, except for very low fasting plasma glucose level (FPG), 32 mg/dL. The concurrent insulin level was not suppressed, 5.7 μ U/mL, under the condition of hypoglycemia. Despite hypoglycemia, glucagon, adrenaline and cortisol were within normal range, 124 pg/mL, 18 pg/mL, and 15.5 μ g/dL, respectively. It suggested that the presence of hyporesponsiveness of counter-regulatory hormones due to repeated hypoglycemic attacks. Although insulinoma was easily suspected from her symptoms and laboratory data, imaging techniques including US, contrast-enhanced helical CT and MRI did not show any ab-

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Figure 1. (A) Dynamic helical CT, which fails to show the tumor in the pancreas. (B) SSCTA demonstrating a well-enhanced round lesion in the pancreatic head (arrow).

Figure 2. Graphs of insulin levels ($\mu\text{U/mL}$) after injection of calcium gluconate (0.025 mEq/kg). Four- to five-fold elevation of insulin is observed in GDA and CA. Abbreviations; SA: splenic artery, GDA: gastroduodenal artery, CA: celiac artery, SMA: superior mesenteric artery

normalities in her pancreas (Fig. 1A). DSA also failed to demonstrate abnormal tumor stains. After angiography, ASVS was subsequently performed and it showed a marked increase in insulin secretion after calcium stimulation into celiac artery (CA) and proximal gastroduodenal artery (GDA), indicating that the insulin secreting tumor located in the head of pancreas (Fig. 2). To further demonstrate the exact localization of the tumor, SSCTA was performed. Briefly, the catheter was super-selectively placed in the proximal GDA and 20 mL of contrast medium was injected through the catheter at an estimated 1.0 mL/sec during sequential helical scanning of the pancreas. It showed a distinct round shape tumor measuring 1.0 cm in diameter (Fig. 1B). She was operated on and a $10 \times 9 \times 9 \text{ mm}$ well bounded tumor was removed from the pancreas head by

performing pancreatoduodenectomy (Fig. 3A). Acini of exocrine pancreas were seen surround the round tumor (Fig. 3B) and the strong immunoreactivities for insulin were visualized in the insulinoma cells (Fig. 3C). Two weeks after the operation, she was discharged with normal blood glucose profiles and the patient is still free of symptoms 4 years after the operation.

Discussion

The majority of insulinomas is single and benign (1, 4), which promises a hope for cure by successful surgical resection. Despite the availability of sophisticated modalities, localizing small insulinomas still remains a technical challenge (5). In a previous report, the positive rates for US, enhanced CT and angiography have been reported 48.9%, 80% and 69.3%, respectively (6). ASVS has been developed as sensitive strategy for localization of insulinomas (6-9). It is invasive but powerful tool not only for rough localization of the tumors but for ascertaining the presence of functional tumor with high sensitivity (82%) and specificity (91%) (10). Preoperative examination of the further precise anatomical relationship between the tumor and the pancreatic duct is valuable and leads to a better surgical approach (2, 11, 12). If insulinomas locate near the surface of the gland, simple enucleation may be performed to preserve the pancreatic parenchyma as much as possible. To minimize invasion, laparoscopic enucleations have been used for relatively small tumors ($<2 \text{ cm}$ in diameter) and for tumors located on the surface of pancreas away from the pancreatic duct (13). In the present case, typical clinical symptoms and the result of ASVS indicating the tumor localization in the head of pancreas, prompted us to pinpoint its localization by performing SSCTA. It visualized well-defined 1.0 cm enhancing mass deep in the parenchyma of the pancreatic head. SSCTA possesses a clear advantage over conventional dynamic CT and

Figure 3. (A) Gross appearance of pancreas head. Well-bounded tumor, 10×9×9 mm, is seen (arrow) (Bar=10 mm). (B) Insulinoma and surrounding normal acini of exocrine pancreas. Hematoxylin and Eosin staining. (C) Immunostaining for insulin. The strong immunoreactivities are seen. (Bar=2 mm)

it can provide greater enhancement of pancreatic tumors by the administration of contrast material directly into the proper artery. In the present case, super-selective injection of contrast material into the GDA is a key for success. An additional advantage in SSCTA is that it demonstrates the detailed relationship between the tumor and pancreatic parenchyma by 2D reconstructions such as horizontal, coronal and sagittal section. We suggest that SSCTA should be performed in ASVS-positive insulinoma in cases of failure in visualizing tumors by various imaging modalities. The major advantages of SSCTA over ASVS are its ability to reveal exact localization and detecting multiple tumors. The only disadvantage of SSCTA is that it requires an invasive and complicated procedure. Future studies are required to demonstrate the detection limit of size, sensitivity and specificity of SSCTA.

In conclusion, it is essential to visualize and localize insulinomas preoperatively to define the optimal surgical approach. We would like to postulate that SSCTA may be a high sensitive and invaluable imaging technique for visualizing small insulinomas when other sophisticated imaging approaches fail to detect.

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