Agenesis of the dorsal pancreas: a rare cause of insulin-dependent diabetes without abdominal pain

Case report

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Abstract

Rationale: Agenesis of the dorsal pancreas is a very rare condition with an unknown pathology and etiology, although it may be associated with autosomal dominant or X-linked dominant inheritance or retinoic acid and hedgehog signaling pathway alterations. This condition usually manifests with abdominal pain or pancreatitis, although some cases are asymptomatic. Approximately 50% of affected patients with this disorder present with hyperglycemia or various other anomalies.

Patient concerns: We report the case of a 23-year-old Chinese woman who visited the Department of Endocrinology and Metabolism with insulin-dependent diabetes but no specific symptoms, signs, or other deformities. Severe diabetic retinopathy indicated a long period of hyperglycemia.

Diagnosis: Agenesis of the dorsal pancreas was observed incidentally during the common diagnosis of diabetes, and the diagnosis was established using magnetic resonance imaging, diffusion-weighted imaging, and magnetic resonance cholangiopancreatography.

Interventions: Following the diagnosis of diabetes, insulin replacement therapy was initiated at a dosage of up to 45 U per day. The patient’s blood glucose level was monitored, and the insulin dosage was adjusted accordingly.

Outcomes: The patient’s blood glucose levels gradually normalized after insulin treatment and were subsequently maintained with intensive insulin therapy. Treatment for diabetic retinopathy was provided by the Ophthalmology Department.

Lessons: Agenesis of the dorsal pancreas should be considered in a young patient diagnosed with diabetes who presents with obvious diabetes-related complications (e.g., renal, retinal, or neurological) inconsistent with the course of the disease or a history of other congenital anomalies. We recommend the routine use of computed tomography or magnetic resonance imaging when examining young patients with diabetes.

Abbreviations: CT = computed tomography, DWI = diffusion-weighted imaging, ERCP = endoscopic retrograde pancreatography, MR = magnetic resonance, MRA = magnetic resonance angiography, MRCP = magnetic resonance cholangiopancreatography.

Keywords: agenesis of the dorsal pancreas, diabetes, diabetic retinopathy

1. Introduction

Agenesis of the dorsal pancreas is a very rare condition involving a congenital malformation wherein either part or the whole of the dorsal pancreas fails to develop. Affected cases are usually asymptomatic or present with a range of conditions, including hyperglycemia, polypsplenia, congenital heart defects, tetralogy of Fallot, or pulmonary artery stenosis. Although advances in imaging technologies have increased the frequency of diagnosis of agenesis of the dorsal pancreas in recent decades, the disease remains rare and reports of such cases remain sporadic. Despite the importance of this diagnosis, affected cases are often confirmed incidentally, often in patients who present with abdominal pain, pancreatitis, other gastrointestinal diseases, or complications involving physical or visceral malformation.[1] The existing diabetes literature has not given special attention to this malformation, despite the frequency of hyperglycemia in affected patients. Here, we describe our experience with a case of agenesis of the dorsal pancreas in a young woman.

2. Case presentation

A 23-year-old Chinese woman visited our department because of hyperglycemia that had been detected during a routine school blood test 3 days earlier. The patient denied any history of abdominal pain, chronic diarrhea, dry mouth, polydipsia, polyuria, overeating, and/or emaciation, and had no evidence of gastrointestinal disease, trauma, or history relevant to
hyperglycemia. Neither her parents nor her 2 brothers had a significant medical history (including diabetes). The patient provided consent for the publication of this case report and related figures.

Upon physical examination, the patient was found to have a body mass index of 20.8 kg/m², with regular menstrual cycles and no congenital defects. No abnormal signs were observed. The following results were obtained from a laboratory analysis: fasting plasma glucose: 12.29 mmol/L; postprandial 2-hours plasma glucose: 22.3 mmol/L without ketosis; fasting C peptide release test at 0, 0.5, 1, 2, 3 hours: 0.621, 0.878, 0.615, 0.353, and 0.128 ng/mL, respectively (normal range: 1.1 – 4.4 ng/mL); fructose: 598.13 μmol/L; glycated hemoglobin/HbA1c: 13.4%; random urinary microfilming: 25.4 mg/L; uric acid: 517 μmol/L; triglycerides: 24.27 mmol/L; cholesterol: 15.47 mmol/L. Anti-insulin, anti-islet cell, and antiglutamic acid decarboxylase antibodies were negative, and amylase and lipase levels were normal. Accordingly, the patient was diagnosed with fatty liver, hyperlipidemia, and hyperuricemia.

Magnetic resonance imaging (MRI) revealed the absence of most of the neck, body, and tail of the pancreas (Figs. 1 and 2), and these findings were further confirmed by magnetic resonance angiography (MRA) and diffusion-weighted imaging (DWI). However, the pancreatic head was not enlarged (Figs. 3 and 4). Magnetic resonance cholangiopancreatography (MRCP) revealed the absence of the dorsal pancreatic duct (Fig. 5). There was no evidence of chronic pancreatitis or other visceral malformations. Based on these findings, the patient was diagnosed with agenesis of the dorsal pancreas.

Although the patient had no symptoms of diabetes or neurological changes, she exhibited obvious and severe diabetes-related retinal changes (Fig. 6). Therefore, insulin replacement therapy at a daily dosage up to 45 U was administered for diabetes treatment. The patient refused a 24-hours urinary protein analysis. Her blood glucose levels improved after insulin therapy and were maintained with intensive insulin therapy (Novolin R with meals and Novolin N at bedtime). She was subsequently referred to the Ophthalmology Department for the treatment of diabetic retinopathy.
3. Discussion

As noted above, agenesis of the dorsal pancreas, or congenital short pancreas, is a very rare condition. Similarly, reports of this condition are very rare, with fewer than 100 cases described in the literature since the initial report in 1911.[2,3]

The exact etiology of agenesis of the dorsal pancreas remains unknown. During gastrulation, epiblast stem cells differentiate into the ectoderm, endoderm, and mesoderm. The pancreas develops etymologically from the endoderm into dorsal and ventral buds on opposite sides of the foregut. The ventral bud differentiates into the posterior part of the pancreatic head, while the dorsal bud forms the pancreatic tail and body. Fusion of the 2 buds occurs during the seventh week of gestation, followed by growth of the pancreatic ductal system.[4] Autosomal dominant or X-linked dominant inheritance may contribute to this condition, and Rittenhouse and colleagues suggest the involvement of alterations in some retinoic acid and hedgehog signaling pathways.[4]

Agenesis of the dorsal pancreas may be asymptomatic, although abdominal pain. In such cases, recurrent pain may be attributable to a lack of papillary muscles or to simultaneous acute or chronic pancreatitis,[5] which may itself be caused by sphincter of Oddi dysfunction, compensatory enzyme hypersecretion, remaining ventral gland hypertrophy, and elevated pancreatic intra-ductal pressure.[6] However, the patient in the present case did not report abdominal pain.

Agenesis of the dorsal pancreas is often reported in combination with other anomalies such as polysplenia syndrome, congenital heart defects (e.g., septal defects), tetralogy of Fallot, or pulmonary artery stenosis,[7] although no such deformity was observed in the present case. Additionally, approximately 50% of patients with this disorder present with hyperglycemia consequent to the lack of islets and beta-cells, which are located in the dorsal pancreas and
respond positively to glucose stimulation.\[1\] Although the patient in this case presented with hyperglycemia, the circumstances were unusual. Notably, the severity of diabetic retinopathy observed at the time of diagnosis suggested a long course of diabetes. However, the patient did not exhibit obvious symptoms and signs. Additionally, although the patient’s poor level of beta-cell function would suggest type 1 diabetes, tests for diabetes-related autoantibodies were all negative and no history of a DKA attack was reported. Accordingly, these data do not support autoimmune diabetes. Furthermore, the high insulin dosage required to control her glucose level is consistent with an insulin shortage caused by a loss of pancreatic tissue. We further note that the patient preferred a highly caloric diet, which may have led to the conditions of fatty liver, a high uric acid level, and hyperlipidemia, eventual insulin resistance, and accelerated diabetes development. Insulin treatment reduced her uric acid and lipid levels to within normal ranges.

Imaging modalities are useful for the diagnosis of agenesis of the dorsal pancreas. Both MR and CT imaging can facilitate diagnosis and differentiate this condition from other disorders such as carcinoma of the pancreatic head with secondary atrophy of the distal body and tail, pancreatic lipomatosis (i.e., fat replacement of the pancreatic parenchyma), autodigestion secondary to chronic pancreatitis, and pancreatic divisum.\[3\] DWI and MRA are particularly useful for clarifying pancreatic deformity. Furthermore, both endoscopic retrograde pancreatography (ERCP) and MRCP can be used to confirm the missing dorsal pancreatic duct.\[3\] However, MRCP, which is noninvasive, should be recommended first because ERCP may induce acute pancreatitis and would thus exacerbate diabetes. In terms of medical costs, however, MR or CT imaging should be sufficient to detect agenesis of the dorsal pancreas. We note that the diagnostic usefulness of ultrasound imaging is limited because interference from bowel gas restricts the ability to visualize the pancreatic body and tail.

4. Conclusion

Most cases of agenesis of the dorsal pancreas involve abdominal pain and/or pancreatitis and are thus detected in Departments of General Surgery and Gastroenterology. By contrast, few cases are detected in the Department of Endocrinology and Metabolism consequent to hyperglycemia. Therefore, we recommend that clinicians consider agenesis of the dorsal pancreas when a young patient is diagnosed with diabetes against a history of other congenital anomalies or in the presence of obvious diabetes-related complications (renal, retinal, or neurological) inconsistent with the course of the disease. We further recommend the inclusion of CT or MR imaging in routine examinations of young patients with diabetes.

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