Case Report

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# A case report on agenesis of dorsal pancreas with insulin-dependent diabetes mellitus: a rare entity

Himal Bikram Bhattarai, MBBS[a], Saral Lamichhane, MBBS[a], Madhur Bhattarai, MBBS[b,*], Prativa Subedi, MBBS[c], Suryakiran Acharya, MBBS[d], Prabesh Bikram Singh, MBBS[b], Rohit Pandit, MBBS[d], Sajeev Joshi, MBBS[e], Ayusha Subedi, BPT[f], Manish KC, MBBS[c]

**Introduction:** Agenesis of the dorsal pancreas (ADP) is a clinically rare entity that occasionally presents with abdominal pain. It is also association with various disorders of glucose metabolism.

**Case presentation:** A 23-year-old male presented with continuous epigastric pain for 4 h and intermittent vomiting. He has a history of experiencing recurrent abdominal pain and diarrhoea for the past 5 years. Additionally, he has been diagnosed with type 1 diabetes mellitus for 15 years. Contrast-enhanced computed tomography of the abdomen showed the absence of body and tail of the pancreas.

**Discussion:** ADP is caused by unknown factors, but may be linked to genetic mutations or changes in signalling pathways related to retinoic acid and hedgehog. Symptoms can be absent, but may include abdominal pain, pancreatitis, and hyperglycaemia due to beta-cell dysfunction and insulin deficiency. Imaging modalities, such as contrast tomography or magnetic resonance cholangiopancreatography, or endoscopic retrograde cholangiopancreatography, are crucial in the diagnosis of ADP.

**Conclusion:** It is important to consider ADP as a differential diagnosis in patients with glucose metabolism disorders and associated symptoms such as abdominal pain, pancreatitis, or steatorrhea. It requires the combined use of imaging modalities such as ultrasound, contrast tomography, magnetic resonance cholangiopancreatography, or endoscopic retrograde cholangiopancreatography, as ultrasound alone may not provide a complete diagnosis.

**Keywords:** agenesis of dorsal pancreas, diabetes mellitus, diabetic ketoacidosis, endocrine dysfunction

## Introduction

The agenesis of the dorsal pancreas (ADP) is an exceedingly rare anomaly that is caused by a defective formation of the pancreas[1]. The dorsal pancreatic bud fails to develop properly during embryonic development. As a consequence, the body and tail of the pancreas are absent, leaving only a small, round pancreatic head adjacent to the duodenum[2]. The size of the remaining pancreas varies, and there is a small duodenal papilla and a remnant of the duct of Santorini[3]. Most of the cases are asymptomatic; otherwise key presenting symptoms are abdominal pain and co-existing hyperglycaemia due to beta-cell dysfunction and insulin deficiency[4]. Although there is a huge improvement in technology in recent years for the detection of dorsal pancreatic agenesis, it remains a rare condition, with only sporadic reports of cases. There are very few cases that report the correlation between diabetic ketoacidosis (DKA) and ADP[5–7]. We present a case of a 23-year-old male with ADP with insulin-dependent diabetes mellites who presented with DKA. The following article is presented in accordance with CARE guidelines for case reports[8].

### HIGHLIGHTS

- Agenesis of dorsal pancreas is rare entity and rare cause of diabetes mellitus.
- Patients may present with abdominal pain, pancreatitis, and hyperglycaemia.
- Agenesis of the dorsal pancreas needs to be ruled out in a young patient with diabetes mellitus using imaging modalities like computed tomography or magnetic resonance cholangiopancreatography.
- Ultrasound have limitation in visualizing the pancreatic body and tail due to bowel gas interference.

## Case presentation

A 23-year-old male presented to the emergency department with continuous epigastric pain for four hours and intermittent vomiting. He also complained of recurrent abdominal pain and episodic diarrhoea for the last 5 years. He had a history of

[a]Gandaki Medical College, Teaching Hospital and Research Center, Pokhara, [b]Tribhuvan University, Institute of Medicine, Maharajgunj, [c]Kist Medical College and Teaching Hospital, Lalitpur, [d]Om Saibaba Memorial Hospital, Kathmandu, [e]Scheer Memorial Hospital, Banepa and [f]Manmohan Memorial Community Hospital, Jhapa, Nepal

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*Corresponding author. Address: Tribhuvan University, Institute of Medicine Maharajgunj, 44600, Nepal. Tel:. +9779861678146. E-mail address: madhurbhattarai180@gmail.com (M. Bhattarai).



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**Table 1**

**Laboratory result of this patient.**

| Investigation | Result | Reference range |
|---|---|---|
| Haemoglobin | 11.3 gm/dl | 12–18 |
| Leucocyte count | 7000 | 4000–11 000 |
| Platelet count | 218 000/cumm | 150 000–400 000 |
| HbA1c | 9.3% | < 5.7% |
| Serum creatinine | 0.87 mg/dl | 0.6–1.3 |
| Serum uric acid | 5.5 mg/dl | 2.4–6.0 |
| Serum vitamin D3 | 9.3 ng/dl | 30–100 |
| Total cholesterol | 175 mg/dl | < 200 |
| Serum triglyceride | 78 mg/dl | < 150 |
| HDL | 35 mg/dl | > 40 |
| C peptide | 0.35 nmol/ltr | 0.5–3.0 |
| Pancreatic amylase | 50 U/l | 25–125 |
| Pancreatic lipase | 35 U/l | 10–140 |
| Faecal pancreatic elastase | 110 ug/g | > 200 |
| Carcinoembryonic antigen | 0.7 U/ml | < 2.5 |
| Ca19.9 | 7 U/ml | < 37 |
| Glutamic acid decarboxylase antibody | Negative | |
| Islet cell antibody | Negative | |
| Urine routine microscopy | Moderate glycosuria without proteinuria | |
| Stool routine microscopy | 2–4 pus cells without ova and parasite | |

HDL, High-density lipoproteins.

smoking two packs of cigarettes daily. He had no known allergy to the drug or any substances. On further inquiry, he had a history of Type 1 Diabetes Mellitus for the last 15 years treated with insulin injections twice daily. He was non-compliant with treatment due to financial constraints for the last few years. Family history was insignificant.

At the time of presentation, he was drowsy with a pulse rate of 120 beats/min, respiratory rate of 26/min, blood pressure of 106/74 mmHg, and oxygen saturation of 96% on room air. Physical Examinations were unremarkable. Electrocardiogram revealed sinus tachycardia. Ultrasound was normal without any evidence of cholecystitis and cholangitis. Pancreas was not clearly visualized. With ongoing resuscitation, blood glucose, arterial blood gas, and urine dipstick tests were sent. Laboratory tests revealed metabolic acidosis with $HCO_3$ of 12 mg/dl. The random blood glucose level was 325 mg/dl and urinalysis revealed glycosuria and ketonuria. The glycated haemoglobin (HbA1c) was 9.1%. The patient was negative for glutamic acid decarboxylase antibody and islet cell antibody. Levels of carcinoembryonic antigen and cancer antigen CA19.9 were within normal ranges (Table 1). The patient was admitted to the ICU and treated with intravenous fluids, insulin, and potassium replacement in line with diabetic ketoacidosis.

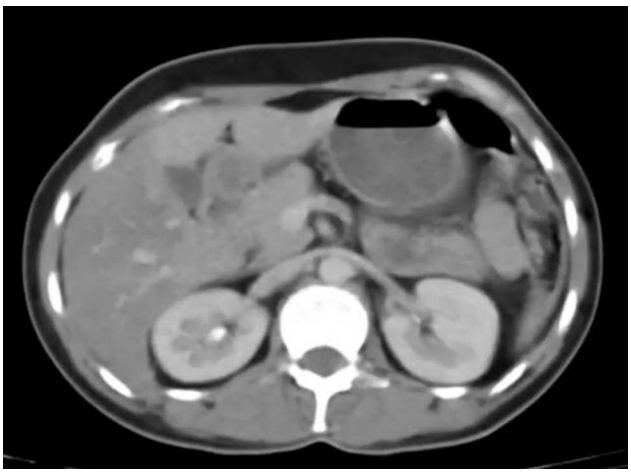

**Figure 1.** CT abdomen showing absence of pancreatic parenchyma except thin strips of tissue at the level of the head and uncinate process. CT, computed tomography.

Additionally, computed tomography (CT) of the abdomen was performed where the body and tail of the pancreas were not visualized. A thin strip of tissue at the level of the head and uncinate process were appreciated. Diagnosis of ADP was thus made (Figure 1).

DKA resolved gradually after a few days and the pain gradually subsided. The patient was discharged home with subcutaneous insulin Mixtard 70/30 (20U before lunch and 16U before dinner) and pancreatic enzyme supplementation. A low-fat diet was recommended and regular follow-up was advised.

## Discussion

The pancreas develops from the fusion of the ventral and dorsal buds during the seventh week of gestation. The ventral bud is responsible for the development of the Wirsung duct, the most inferior portion of the head, and the uncinate process. On the other hand, the dorsal bud, which is connected to the minor papilla through the Santorini duct, gives rise to the upper head, body, and tail of the pancreas[9]. Agenesis of the ventral pancreas and complete agenesis of the pancreas are both fatal[2].

The exact cause of dorsal pancreas agenesis is not yet understood. Autosomal dominant or X-linked dominant inheritance may play a role in this condition. Rittenhouse and colleagues suggest that changes in certain signalling pathways related to retinoic acid and hedgehog may also be involved[10]. Monogenic mutations in genes such as insulin promoter factor 1[11], pancreas-associated transcription factor 1[12], and transcription factor-2/hepatocyte nuclear factor-1 homeobox B[13] have been linked to pancreatic agenesis. However, it is likely that multiple genes are involved in this disorder. One limitation of our case is that a DNA sequencing test was not performed for genetic analysis.

Most of the cases are not clinically symptomatic but when symptomatic, they commonly present with abdominal pain, pancreatitis, and hyperglycaemia[14]. Recurrent pain in such cases may be a result of a lack of papillary muscles or concurrent acute or chronic pancreatitis which may be brought on by dysfunction of the sphincter of Oddi, compensatory enzyme hypersecretion, residual ventral gland hypertrophy and increased pancreatic intraductal pressure[15]. Approximately 50% of patients with ADP also have diabetes, often insulin-dependent, as per the comprehensive review of 53 cases by Schnedl *et al*.[16]. The dorsal portion of the pancreas contains the majority of the beta cells that produce insulin. Patients with ADP have a varying degree of beta-cell dysfunction as evidenced by variations in the severity of high fasting blood glucose and insulin-dependent diabetes mellitus reported in earlier studies[16,17]. Our patient also presented with hyperglycaemia and diabetic ketoacidosis. The exocrine

pancreatic dysfunction in cases of dorsal pancreatic agenesis is infrequent because the exocrine function tends to remain intact as long as there is at least 10% of normal pancreatic tissue present. However faecal elastase, as a measure of exocrine function in our case is low.

ADP is frequently reported alongside other conditions such as polysplenia syndrome, retro aortic left renal vein, and congenital heart defects (e.g. septal defects, tetralogy of Fallot) or pulmonary artery stenosis[16]. Our case was not associated with any of these conditions.

Imaging modalities are crucial in the diagnosis of ADP. Ultrasonography is the most popular method for assessing abdominal pain and other abdominal symptoms[18]. The interference from the superimposed gas in the stomach and duodenum limits its effectiveness in detecting pancreatic anomalies[3]. The absence of the pancreas body and tail can be confirmed using either CT or magnetic resonance cholangiopancreatography (MRCP). They can also distinguish ADP 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, periportal lymphadenopathy and anatomic variations[19]. The major and accessory duct systems are revealed through endoscopic retrograde cholangiopancreatography (ERCP) or MRCP. ERCP is an invasive technique while MRCP can aid in the noninvasive, radiation-free diagnosis of ADP. In our case, ultrasonography was unrevealing while CT showed the absence of the body and tail of the pancreas. MRCP/ERCP was not done in our case due to lack of unavailability in our centre and it was not beneficial in terms of further management. Regarding medical expenses, MR or CT imaging is adequate for identifying the absence of the dorsal pancreas.

## Conclusion

Clinicians should take into account the diagnosis of ADP for patients who present with a glucose metabolism disorder along with abdominal pain, pancreatitis, or steatorrhea. The combined use of imaging modalities is required for the diagnosis of dorsal pancreatic agenesis if it is suspected. Clinicians should be aware of the limitations of ultrasound in visualizing the pancreatic body and tail due to bowel gas interference.

## Ethical approval

None.

## Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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## Author contribution

H.B.B., S.L., and M.B. wrote the original manuscript, reviewed, and edited the original manuscript. P.S., S.A., P.B.S., R.P., S.J., A.S., and M.K. reviewed and edited the original manuscript.

## Conflicts of interest disclosure

None.

## Research registration unique identifying number (UIN)

None.

## Guarantor

Madhur Bhattarai.

## Data availability statement

All available data are within the manuscript itself.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

## References

[1] Association AD. 2. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes—2021. Diabetes Care 2021;44 (suppl_1):S15–33.
[2] Voldsgaard P, Kryger-Baggesen N, Lisse I. Agenesis of pancreas. Acta Paediatr 1994;83:791–3.
[3] Liang K, Ou X, Huang X, *et al*. Agenesis of the dorsal pancreas: a rare cause of insulin-dependent diabetes without abdominal pain: Case report. Medicine (Baltimore) 2018;97:e0046.
[4] Buzzetti R, Zampetti S, Maddaloni E. Adult-onset autoimmune diabetes: current knowledge and implications for management. Nat Rev Endocrinol 2017;13:674–86.
[5] Jeong C, Yang YS, Son HS, *et al*. Diabetic ketoacidosis and acute pancreatitis in a patient with agenesis of the dorsal pancreas. Korean J Intern Med 2022;37:484–5.
[6] Devarbhavi P. Dorsal agenesis of pancreas manifesting clinically as diabetic ketoacidosis: a rare case study. Annu Res Rev Biol 2014;4: 2579–86.
[7] Yang T, Yang X, Wang L, *et al*. Agenesis of the dorsal pancreas presenting with diabetic ketoacidosis - A case report and literature review. BMC Endocr Disord 2019;19:3–7.
[8] Riley DS, Barber MS, Kienle GS, *et al*. CARE guidelines for case reports: explanation and elaboration document. J Clin Epidemiol 2017;89: 218–35.
[9] Caetano LA, Santana LS, Costa-Riquetto AD, *et al*. PDX1—MODY and dorsal pancreatic agenesis: New phenotype of a rare disease. Clin Genet 2018;93:382–6.
[10] Rittenhouse DW, Kennedy EP, Mascaro AA, *et al*. The novel triad of dorsal agenesis of the pancreas with concurrent pancreatic ductal adenocarcinoma and nonalcoholic chronic calcific pancreatitis: a case series and review of the literature. J Gastrointest Surg 2011;15: 1643–9.
[11] Stoffers DA, Zinkin NT, Stanojevic V, *et al*. Pancreatic agenesis attributable to a single nucleotide deletion in the human IPF1 gene coding sequence. Nat Genet 1997;15:106–10.
[12] Sellick GS, Barker KT, Stolte-Dijkstra I, *et al*. Mutations in PTF1A cause pancreatic and cerebellar agenesis. Nat Genet 2004 3612 2004;36: 1301–5.

[13] Haumaitre C, Barbacci E, Jenny M, *et al*. Lack of TCF2/vHNF1 in mice leads to pancreas agenesis. Proc Natl Acad Sci USA 2005;102:1490–5.
[14] Sakpal SV, Sexcius L, Babel N, *et al*. Agenesis of the dorsal pancreas and its association with pancreatic tumors. Pancreas 2009;38:367–73.
[15] Uygur-Bayramiçli O, Dabak R, Kiliçoglu G, *et al*. Dorsal pancreatic agenesis. JOP 2007;8:450–2.
[16] Schnedl WJ, Piswanger-Soelkner C, Wallner SJ, *et al*. Agenesis of the dorsal pancreas and associated diseases. Dig Dis Sci 2009;54:481–7.
[17] Erotokritou A, Gerharz CD, Sagir A. Agenesis of dorsal pancreas associated with pancreatic neuroendocrine tumor: a case report and review of the literature. J Med Case Rep 2018;12:185.
[18] Vijayaraghavan SB, Gouru S, Senthil S. Sonographic features of agenesis of dorsal pancreas. Indian J Radiol Imaging 2013;23:179–82.
[19] Cho HS, Woo JY, Hong HS, *et al*. Morphologic classification of congenital short pancreas on multidetector computed tomography. J Comput Assist Tomogr 2013;37:797–804.