CASE REPORT

Duodenum Inversum: Case Report with an Updated Review of the Literature

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ABSTRACT

In Duodenum Inversum (DI), the third part of the duodenum follows a superior, posterior course before crossing over the midline above the pancreas. A 35-year-old female presented with right upper quadrant (RUQ) pain for the last 2 months. The patient did not have any other medical conditions and had visited multiple hospitals for treatment of the RUQ pain. Upon abdominal examination, tenderness was noted in RUQ, leading to initial suspicions of costochondritis and cutaneous nerve inflammation. Symptoms were resolved with neuromodulator drug, Pregablin. A CT scan was then carried out, revealing incidental findings consistent with the Duodenum Inversum. This case report describes an incidental finding of Duodenum Inversum and an updated literature review, including 17 articles covering diagnostic procedures, treatment modalities, and associated complications.

Keywords: *Duodenum inversum, duodenum abnormalities, medical management, Ladd's procedure.*

INTRODUCTION

Duodenum Inversum is a rare congenital malformation characterized by an abnormal course of the third part of duodenum (D3). In duodenum inversum (DI), the third part of the duodenum follows a superior, posterior course before crossing over the midline above the pancreas [1]. This is in contrast to the typical anatomy, where the third part of the duodenum runs horizontally across the midline before the fourth part ascends to create the duodenojejunal flexure [2]. The first case of duodenum inversum was reported in 1940, and since then, only 22 cases of this rare disorder have been documented. The disorder has an incidence of 0.07% based on 14 cases out of 20,000 GI x-ray examinations [3]. Another study reported an incidence of 0.2% for duodenum inversum, while Anderson *et al*. found a higher incidence of 1% [4, 5]. In a study of 100 consecutive autopsies, Anderson *et al*. identified one case of duodenum inversum [6]. The exact cause of this condition is unknown, but it is thought to be related to a persistent dorsal mesentery that can result in a mobile duodenum [7]. Reporting cases of duodenum inversum is important to highlight its diagnostic challenges. Symptoms can mimic other common conditions, so understanding its unique features can help diagnose accurately.

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CASE PRESENTATION

A 35-year-old female presented with right upper quadrant (RUQ) pain for the last 2 months. The patient did not have any other medical conditions and had visited multiple hospitals for treatment of the RUQ pain. Upon abdominal examination, tenderness was noted in RUQ, leading to initial suspicions of costochondritis and cutaneous nerve inflammation. Previous ultrasound results showed mild fatty liver, with normal liver function tests (LFTs). An endoscopy was performed to rule out peptic ulcer disease, which was also normal. The patient was also treated for Irritable Bowel Syndrome due to suspected psychological stress as an underlying cause, but the pain persisted.

Symptoms were resolved with neuromodulator drug, Pregablin. A CT scan was then conducted, revealing incidental findings consistent with duodenum Inversum. The management of duodenal inversum was not required as the persistent RUQ pain was due to costochondritis and finding of duodenal inversum was incidental.

Diagnostic Procedure

The coronal contrast-enhanced venous phase image from the CT scan shows an abnormal course of the third part of the duodenum (**Fig. 1**). Instead of crossing horizontally at the expected level, it is taking a more vertical path and crossing the midline at a higher level. This deviation from the typical anatomy is known as duodenum inversum, a rare congenital anomaly. Despite this unusual positioning, there is no evidence of stomach enlargement or blockages in the digestive tract. This finding suggests a unique anatomical variation in the duodenum's structure.

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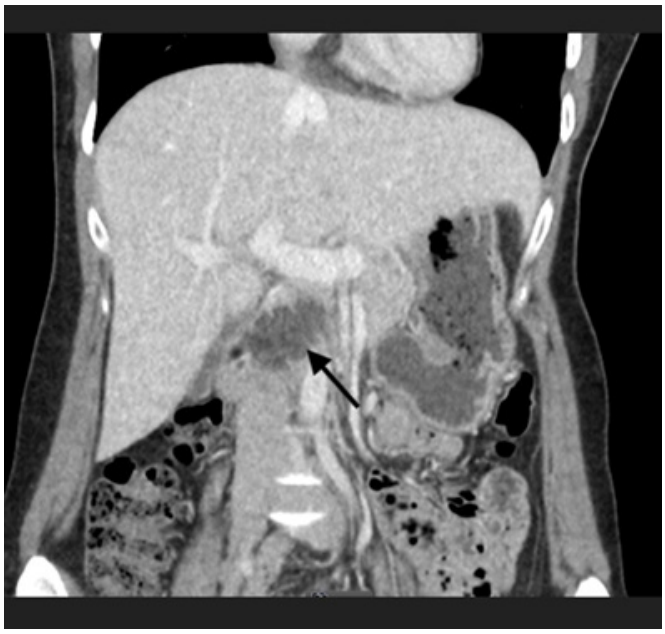

Fig. (1): Coronal contrast-enhanced venous phase image from the CT scan showing an abnormal course of the third part of the duodenum.

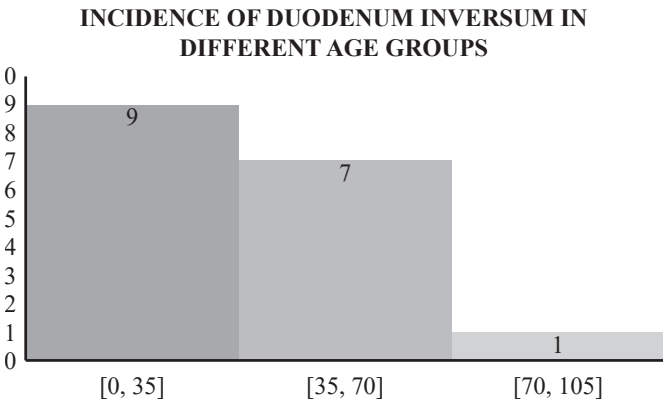

Fig. (2): Incidence of duodenum inversum with respect to age.

DISCUSSION

We reviewed 17 studies with a mean age of 32.66±25.37 years. Previous literature reported an average age of 46 years with a gender distribution of 4:1 in favor of males over females [1]. Fig. **(2)** illustrates that the occurrence of duodenum inversum is more common in younger age groups and decreases with age. This age distribution pattern suggests that duodenum inversum is likely a congenital condition rather than an acquired one. The pathophysiology of duodenum inversum supports its congenital origin.

The case reports we analyzed primarily focused on established diagnostic and treatment methods for duodenum inversum. However, the field is actively evolving, offering promising prospects for improved diagnosis and management.

Traditionally, fluoroscopic upper gastrointestinal (UGI) series with barium contrast has been the mainstay for diagnosing duodenum inversum [8]. This technique involves swallowing a liquid containing barium, a metallic compound that coats the digestive tract and allows for visualization on X-rays. However, advancements in imaging technology are proving valuable in aiding diagnosis. High-resolution CT scans can provide a more detailed picture of the internal anatomy, confirming the abnormal positioning of the duodenum and even assessing the course of the superior mesenteric artery (SMA) which can be crucial for surgical planning, especially in cases of malrotation [8]. Lehman *et al*., diagnosed the case of DI with Enteroclysis and hypotonic duodenography [9].

Treatment for duodenum inversum varies depending on the severity of symptoms. The case reports we reviewed didn't mention treatments in detail, minimally invasive surgical techniques are emerging as a promising advancement in treating complications associated with duodenum inversum. Traditional open surgery may be necessary in severe cases, particularly when obstruction is present. However, laparoscopic or robotic surgery offers a less invasive approach with potential benefits like faster recovery times, reduced scarring, and fewer post-surgical complications.

The cornerstone of treatment for uncomplicated duodenum inversum remains medical management [8-10]. Medications like antacids and antispasmodics can help alleviate symptoms like heartburn and indigestion by reducing stomach acid and relaxing the muscles in the digestive tract [10]. Goyal *et al*. successfully treated a case of duodenum inversum with dietary modifications and prokinetics [11]. In another case report, Menchise *et al*. encountered a case of duodenum inversum with partial duodenal obstruction that was initially managed with enteral food intake but proved ineffective [12]. However, surgery is necessary for individuals with complications like obstruction or those who don't respond to medical therapy [1]. Surgical options for severe fibrotic bands include duodenojejunostomy, and rarely, gastrojejunostomy [1, 13, 14]. Long *et al*. in 1999 successfully managed a 16-year-old patient with medical treatment and a partial Ladd's procedure [15]. The specific surgical approach will depend on the nature and severity of the complication.

It's important to acknowledge that there's currently no single gold standard for treatment. The approach is often individualized based on the patient's presentation and the severity of their symptoms.

Future research holds promise for further advancements in both diagnosis and treatment. Advancements

in high-resolution MRI or CT scans hold promise for more precise diagnosis. This would ensure a more targeted treatment plan and potentially avoid unnecessary procedures. Exploring minimally invasive surgical techniques can lead to more precise and improved surgical outcomes. Additionally, a deeper understanding of the underlying genetic factors contributing to Duodenum Inversum could pave the way for earlier detection and potentially preventative measures.

Duodenum Inversum, while a congenital anomaly, can lead to a cascade of complications in some individuals. One of the most common concerns is peptic ulcer disease (PUD). The abnormal positioning of the duodenum can trap digestive juices, creating an acidic environment that irritates the duodenal lining and increases the risk of ulcer formation [16].

Another potential complication is cholecystitis. This association may arise due to a condition called choledochocele, a pouching of the bile duct at its junction with the duodenum, which can disrupt bile flow and contribute to gallstone formation [16].

In some cases, duodenum inversum may present with gastritis [1]. The exact reason for this association is not fully understood, but the altered anatomy may disrupt the normal digestive process.

A more serious complication is gastrointestinal (GI) obstruction, which can occur due to the abnormal positioning and redundancy of the duodenum itself, causing kinking or narrowing of the passage [12]. This can be similar to the obstruction seen in Ladd's syndrome, a condition where bands of tissue abnormally encircle the duodenum [17].

In the literature, duodenum inversum is associated with various medical conditions. Kim *et al*. reported a case of duodenum inversum in a patient with trisomy 21, hypothyroidism, and undescended testes [18]. Other associated conditions include duodenal obstruction, duodenal ulcers, GERD, annular pancreas, partial pancreatic agenesis, pancreatic divisum, duodenitis, duodenal volvulus, and partial rotation [14, 15, 18] (**Table 1**).

The good news for individuals with duodenum inversum is that the long-term outlook appears positive. In the reviewed case reports, most cases responded well to either conservative management or surgical intervention [12, 17, 19, 20]. These studies documented successful outcomes, with patients experiencing resolution of symptoms, significant weight gain, and a general improvement in well-being [6, 16, 21]. Notably, no studies reported an increased risk of long-term complications or mortality specifically associated with duodenum inversum [22]. This suggests that once any initial complications are addressed, patients can expect a good quality of life.

However, it's important to acknowledge that data on long-term follow-up beyond six months was limited in the case reports reviewed. While the positive short-term outcomes are encouraging, additional studies tracking patients for extended periods would provide a more

Table 1: Showing patient age, clinical features, diagnostic and treatment modalities of duodenum inversum case reports.

Study	Patient Age	Clinical Features	Associated Disease	Diagnostic Imaging	Management Plan
Zambito *et al*. 2023	53	abdominal pain, nausea, vomiting, malaise, and fatigue	Duodenal Volvulus	CT Scan	Nasogastric Intubation & Bowel Decompression Initially. Later, Surgical Exploration leading to Duodenojejunostomy
Childress *et al*. 1979	24	abdominal pain, nausea and dizziness	Incomplete rotation	UGI	Laparotomy; followed by LUQ Cecopexy
Yap *et al*. 2022	77	epigastric pain, nausea and hematemesis	Duodenitis	CT Scan	Pre-Endoscopic IV Pantoprazole; followed by oral Pantoprazole (BID for 3M)
Kim *et al*. 2012	1 month	cryptorchidism, and hypothyroidism	Trisomy 21, undescended testes and hypothyroidism	UGI and Laparoscopy	Diagnostic Laparoscopy; followed by Bilateral Orchidopexy
Patel *et al*. 2016	2 months	stiffening of all four extremities, arching of the back, staring eyes and bubbles from the mouth and nose.	GERD	UGI	Initial therapy of Ranitidine (3 Weeks); followed by Nissen Fundoplication
Patel *et al*. 2016	2 months	dyspnea, intermittent stiffening, gasping and spitting up after feeds	GERD	UGI	Lansoprazole

Chandan *et al*. 2018	62	Nausea and chronic intermittent abdominal pain ,occasional nonbloody & nonbilious emesis	None	UGI	Exploratory laparotomy; followed by Duodenojejunostomy
Long *et al*. 1999	16	Nausea, Vomiting, Crampy Abdominal pain, Weight loss	None	UGI	NJ Tube Feedings , Ranitidine & Omeprazole (9 Months); followed by Partial Ladd's Procedure
Menchise *et al*. 2016	10	Intermittent abdominal pain, Abdominal Tenderness, Bilious emesis, preceding diarrheal illness	Partial duodenal obstruction	UGI	Initial Acid Suppression Therapy, NJ Feedings for 6 Days; followed by Oral Liquid Diet. NG Intubation 2 months later with a soft diet for 1 Month. NG removed after 3 Months from Initial Hospitalization
Sharma *et al*. 2023	16	non-bloody, non-bilious vomiting with correspondingly decreased oral intake	None	UGI	Antiemetics, PPIs & Azithromycin Initially; followed by Botox administration in the pylorus. NJ Intubation done but simultaneously expelled. Pt. sent home on Amitriptyline & Cyproheptadine
Komrad *et al*. 1959	55		Duodenal Ulcers		
Azhough *et al*. 2009	38	crampy abdominal pain and fullness after eating, weight loss	Annular Pancreas	EGD and UGI	Medical management trial for 10 months; followed by partial ladd's procedure and gastrojejunostomy
Lehman *et al*. 1987	48	left upper quadrant pain, mild hypertelorism	Partial pancreatic agenesis and pancreatic divisum	Enteroclysis and hypotonic duodenography	Empirical trial of Antacids
Rozek *et al*. 1951	43	upper abdominal pain	None	UGI	Initially Antispasmodics & Antacids with gallbladder diet, bile salts; followed by Ulcer Regime (PPIs)
Rozek *et al*. 1951	69	recurrent upper abdominal pain	None	UGI	Ulcer Regime along with Antispasmodics & Antacids
Dogan *et al*. 2016	12	nausea, vomiting, non-specific epigastric tenderness and weight loss	None	UGI	Oral Omeprazole
Srivatsa *et al*. 2024	13	Right hemi-abdominal pain with bilious vomiting	None	UGI	Bowel Regimen, Diagnostic Laparoscopy; followed by Duodenojejunostomy
Urgel *et al*. 2022	0 months	Bilious vomiting	None	UGI	Observation only

comprehensive picture of the long-term prognosis for individuals with duodenum inversum.

Duodenum inversum, though not a life-threatening condition, remains an enigma wrapped in a mystery. The case reports we reviewed provided valuable clinical insights, but the exact cause (etiology) of duodenum inversum remains elusive. This lack of understanding underscores the need for further research in several key areas.

The future of medicine lies in personalization, and duodenum inversum is no exception. By analyzing individual factors like the severity of presentation and underlying cause, researchers aim to develop tailored treatment approaches. This personalized approach could lead to more effective management strategies and improved long-term outcomes for each patient.

CONCLUSION

In conclusion, Duodenum inversum (DI) is a rare congenital anomaly that poses diagnostic challenges due to its nonspecific symptoms. Advancements in imaging techniques have improved diagnostic accuracy. Most cases are managed conservatively with medications, while surgery is reserved for severe complications. Increased awareness and reporting of DI cases are crucial for better outcomes. Ongoing research offers promise for improved management and understanding of DI.

LIST OF ABBREVIATIONS

CT Scan: Computed Tomography Scan

DI: Duodenum Inversum

LFT: Liver Function Test

MRI: Magnetic Resonance Imaging

PUD: Peptic Ulcer Disease

RUQ: Right Upper Quadrant

UGI: Upper Gastrointestinal

CONSENT FOR PUBLICATION

Informed consent from the guardians of the patient involved in this study.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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