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Uncommon Causes of Pyloric and Duodenal Obstruction in Pediatric Population: Radiological and Surgical Correlation

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Abstract

Background: Duodenal and pyloric obstruction in neonates and young children have diverse causes such as atresia, volvulus, and foreign body or may be extra-luminal obstruction.

Aim of Study: To assess causes of pyloric and duodenal obstruction in pediatric population (other than CHPS) and determine the causes of obstruction radiologically and compare them with surgical data.

Patients and Methods: Our study included 22 patients (12 boys and 10 girls), age range from 1 day to 6 years. This study was done on cases of pyloric and duodenal obstruction in newborns, infants and young children less than 6 years in the period from 2017 through 2019. Cases of Congenital Hypertrophic Pyloric Stenosis (CHPS) were excluded from the study. The clinical, radiological data were gathered and compared to each other.

Results: The spectrum of causes of pyloric and duodenal obstruction was as follow: 4 cases of pyloric atresia, 5 cases with duodenal atresia, 3 cases with duodenal stenosis by incomplete web, one case with annular pancreas, 4 cases with midgut volvulus, one case with duodenal duplication cyst, 3 cases with foreign body obstruction and one case with trichobezoar. All cases were treated surgically to alleviate the obstruction. The radiological data were well correlated with surgical findings.

Conclusion: Pyloric and duodenal obstruction in pediatric population has different causes. Radiological imaging could determine the cause of obstruction with good correlation with surgery.

Key Words: *Neonatal and duodenal obstruction – Duodenal atresia – Foreign body ingestion.*

Introduction

GASTRO-INTESTINAL obstruction in pediatric age group is crucial; especially in neonates and infants. Pyloric and duodenal obstruction has special concern in this age group **[1,2]**. Commonly; neonates, infants and young children presented with vomiting have immediate diagnosis of Congenital Hypertrophic Pyloric Stenosis (CHPS) **[3,4]**. However; there are many other causes that obstruct the pylorus and duodenum other than CHPS in this age group. The etiology of pyloric obstruction may be atresia, antral diaphragm or Foreign Body (FB) obstruction **[5-7]**. Obstructed duodenum may be due to atresia, incomplete web or midgut volvulus obstructing the distal duodenum. Extra-luminal obstruction of the duodenum in this age group is mostly due to congenital band, annulus pancreas or compression from congenital cystic or solid masses **[8]**.

Radiological imaging has a major role in the differential diagnosis of the causes of obstruction. Plain X-ray, color Doppler sonography (US), contrast examination and Computed Tomography (CT) may be involved in the radiological diagnosis of such cases **[9,10]**. Surgery is the gold standard to confirm the diagnosis and relieve of obstruction.

The aim of our study is to evaluate cases with pyloric and duodenal obstruction in neonates, infants and young children up to 6 years and determine the radiological spectrum of causes of obstruction and correlate these findings by surgical data.

Patients and Methods

Our study included 22 cases; 12 boys and 10 girls with age range from 1 day to 6 years and age

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Abbreviations:

US : Ultrasonography.
CHPS : Congenital Hypertrophic Pyloric Stenosis.
CT : Computed Tomography.
FB : Foreign Body.

mean is 1 month. This study was done from 2017 through 2019 cases of pyloric and duodenal obstruction (included cases) treated in our university hospitals. The cases referred from Pediatric Surgery Unit and Pediatric Department to the Department of Radiology. The cases were presented by vomiting (bilious or non-bilious). Cases of CHPS were excluded from the study. Cases without surgical interventions were also excluded from the study. The clinical, radiological and surgical data of these cases were analyzed.

Written consent was taken from the parents in accordance with the University Ethical Committee.

Standards and suitable radiological imaging were done to these patients including CT. Erect plain X-ray is the first one to be started with. The distribution of air is very important in these films. We searched also in these films about radio-opaque foreign bodies and pneumo-peritoneium.

Color Doppler sonography was done to all patients. Toshiba Aplio was used with high resolution transducers suitable for the age of the patient. Routine abdominal sonography examination was done to assess the general condition of the abdomen as regards the main organs and collection. Then; we concentrated upon stomach capacity and pylorus and duodenum dimensions. Doppler sonography signs of midgut volvulus must be searched for such as: Whirlpool (wrapping of mesenteric vein and mesentery around the superior mesenteric artery), dilated duodenum and dilated superior mesenteric vein. Other abdominal pathologies causing external compression on the duodenum such masses or cysts should be scanned for.

Contrast examination was used in the form of upper gastrointestinal series. It was done via Ryle tube with injection of 6-15mm contrast material (Ultravist) according to the age of the patient. Then; we followed it from the stomach down to the small intestine. We must report on about the size of the stomach, gastric emptying time, pyloric size, duodenal dimensions; duodenal narrowing, and evidence of mid gut volvulus distal to the duodenum.

Pre-operative preparation was done on a very good standard to improve the general condition of the patients in the form of fluid and electrolyte balance and thermo-regulations. Then suitable operative maneuver was done by one senior surgeon. All clinical, radiological data were collected and analyzed.

Results

Table (1): Causes of pyloric and duodenal obstruction with clinical, radiological and surgical data.

Cause of obstruction	Number of patients (22)	Age	Clinical data	Radiological data	Operative data	Treatment
• Pyloric atresia	4	• 1-2 days	• Non-bilious vomiting	• Single bubble sign on plain X-ray and completely obstructed pylorus on contrast.	• Pyloric atresia	• Surgical repair
• Duodenal atresia	5	• 2-4 days	• Bilious and non-bilious vomiting	• Double bubble sign on plain X-ray and completely obstructed duodenum on contrast.	• Duodenal atresia	• Surgical repair
• Duodenal stenosis	3	• 1-2 months	• Bilious vomiting	• Partial duodenal obstruction on contrast examination.	• Incomplete duodenal web	• Surgical repair
• Annular pancreas	1	• 1 month	• Non-bilious vomiting	• Partial duodenal obstruction on contrast examination.	• Annular pancreas	• Surgical repair
• Midgut volvulus	4	• 7-45 days	• Bilious vomiting	• Whirlpool sign at color Doppler Sonography.	• Midgut volvulus	• Untwisting at surgery
• Duodenal duplication cyst	1	• 2 years	• Bilious vomiting	• US revealed cyst related to the duodenum. Partial duodenal obstruction on contrast examination.	• Duodenal duplication cyst	• Surgical excision
• Coin FB	1	• 2 years	• Non bilious vomiting	• X-ray abdomen revealed a coin at the pyloric region.	• A coin obstructing the pylorus	• Removal
• Magnets FB	1	• 3 years	• Non bilious vomiting	• X-ray abdomen revealed multiple metallic FB at the pyloric region.	• Multiple magnets obstructing the pylorus	• Removal
• Nail FB	1	• 2.5 years	• Non bilious vomiting	• X-ray abdomen revealed a nail at the duodenal region.	• A nail at the duodenum	• Removal
• Trichobezoar	1	• 6 years	• Non bilious vomiting	• CT abdomen revealed a big heterogonous lesion within the lumen of the stomach and extending to the duodenum.	• Trichobezoar filling the stomach and duodenum	• Removal

The causes of pyloric and duodenal obstruction were as follow (Table 1): 4 cases with pyloric atresia, 5 cases with duodenal atresia, 3 cases with duodenal web, one case with annular pancreas, 4 cases with midgut volvulus, one case with duodenal duplication cyst, 3 cases with pyloric and duodenal foreign body obstruction and one case with trichobezoar.

Pyloric atresia was encountered in 4 cases in our series Figs. (1-3). The patients presented very early in the first few days in their life by non bilious vomiting. Single bubble sign was seen on X-ray. Sonography revealed dilated stomach with no evidence of intestinal gases beyond this level. The contrast material could not pass beyond the stomach. Surgical exploration confirmed the diagnosis with repair of the atresia.

Duodenal atresia was frequently found in our work. It was reported in 5 cases Fig. (4). Patients presented early (within days after birth) by bilious and non bilious vomiting. Erect abdominal X-ray demonstrated the classical double bubble sign. Contrast examination well demonstrated the disease with no contrast spill beyond the duodenum. Three of the cases were proximal duodenal atresia and the other two cases were distal atresia. On surgery the radiological data were correlated well with the operative findings and surgical repair was done.

Four cases of duodenal narrowing were encountered in this work Fig. (5). The patients came with vomiting within two months of their life. Abdominal X-ray and sonography were not diagnostic. Contrast examination revealed duodenal stenosis but could not reach the actual cause of partial obstruction. Surgical exploration could diagnose incomplete duodenal web in three cases and annular pancreas in the other baby. Surgical repair were done to the patients.

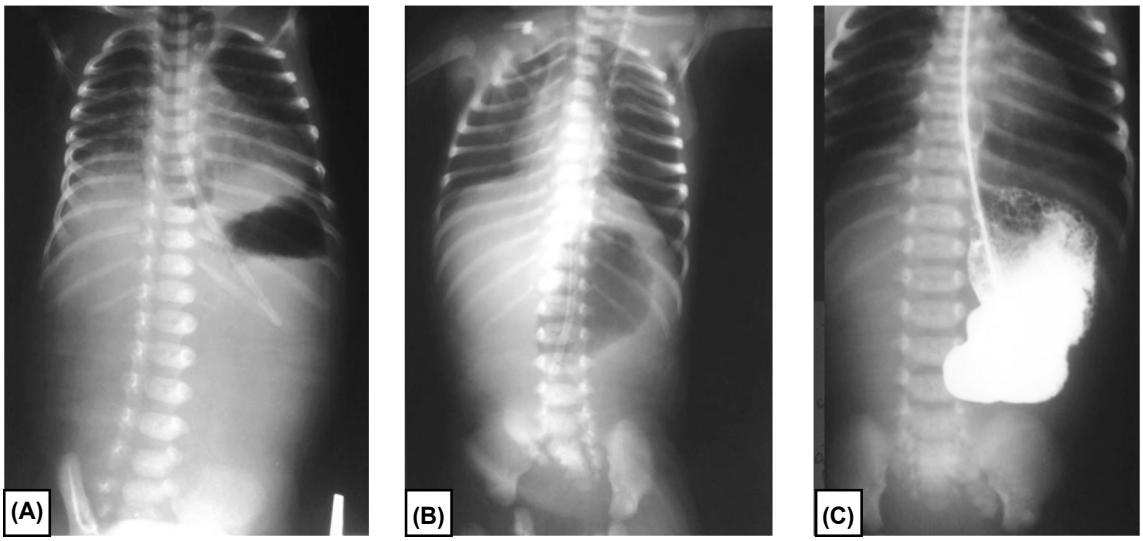

Fig. (1): A neonate with pyloric atresia. (A, B) An erect and supine X-ray showing single bubble sign. (C) Contrast meal showing dilated stomach without passage of contrast through the pylorus.

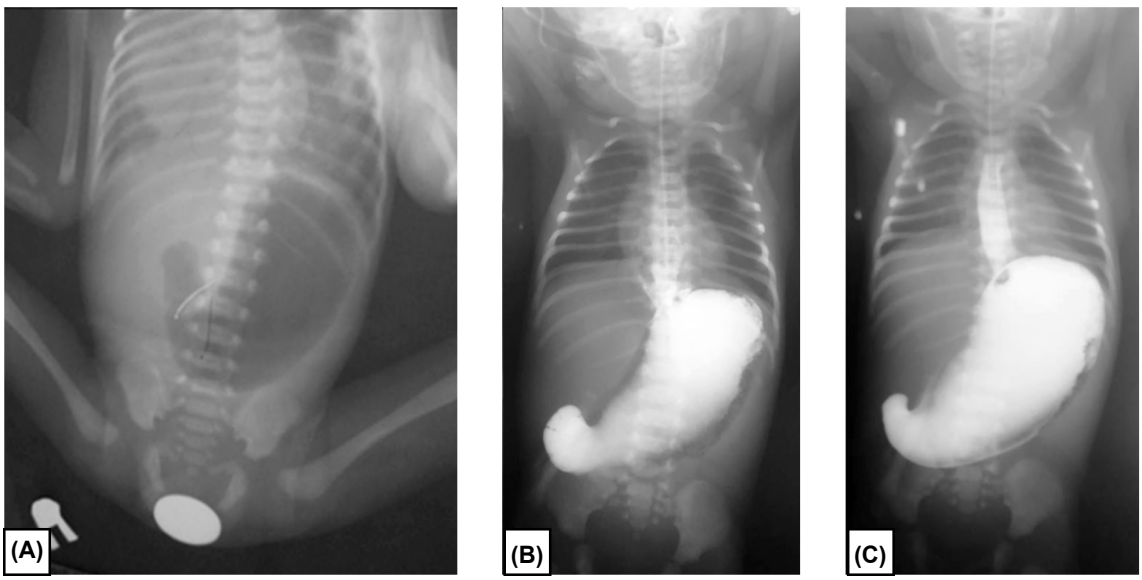

Fig. (2): A neonate with pyloric atresia. A X-ray showing distended stomach with gases, no gases beyond the stomach. (B, C) Contrast meal showing markedly dilated stomach without passage of contrast through the pylorus.

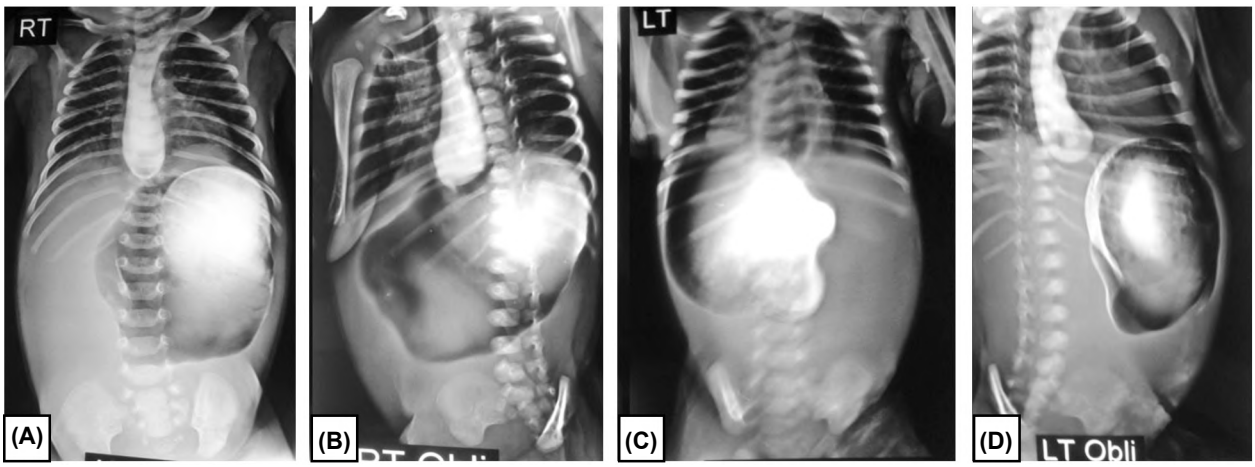

Fig. (3): A neonate with pyloric atresia. (A, B, C, D) Serial upper contrast images showing dilated stomach and esophagus. No contrast could be seen beyond the stomach.

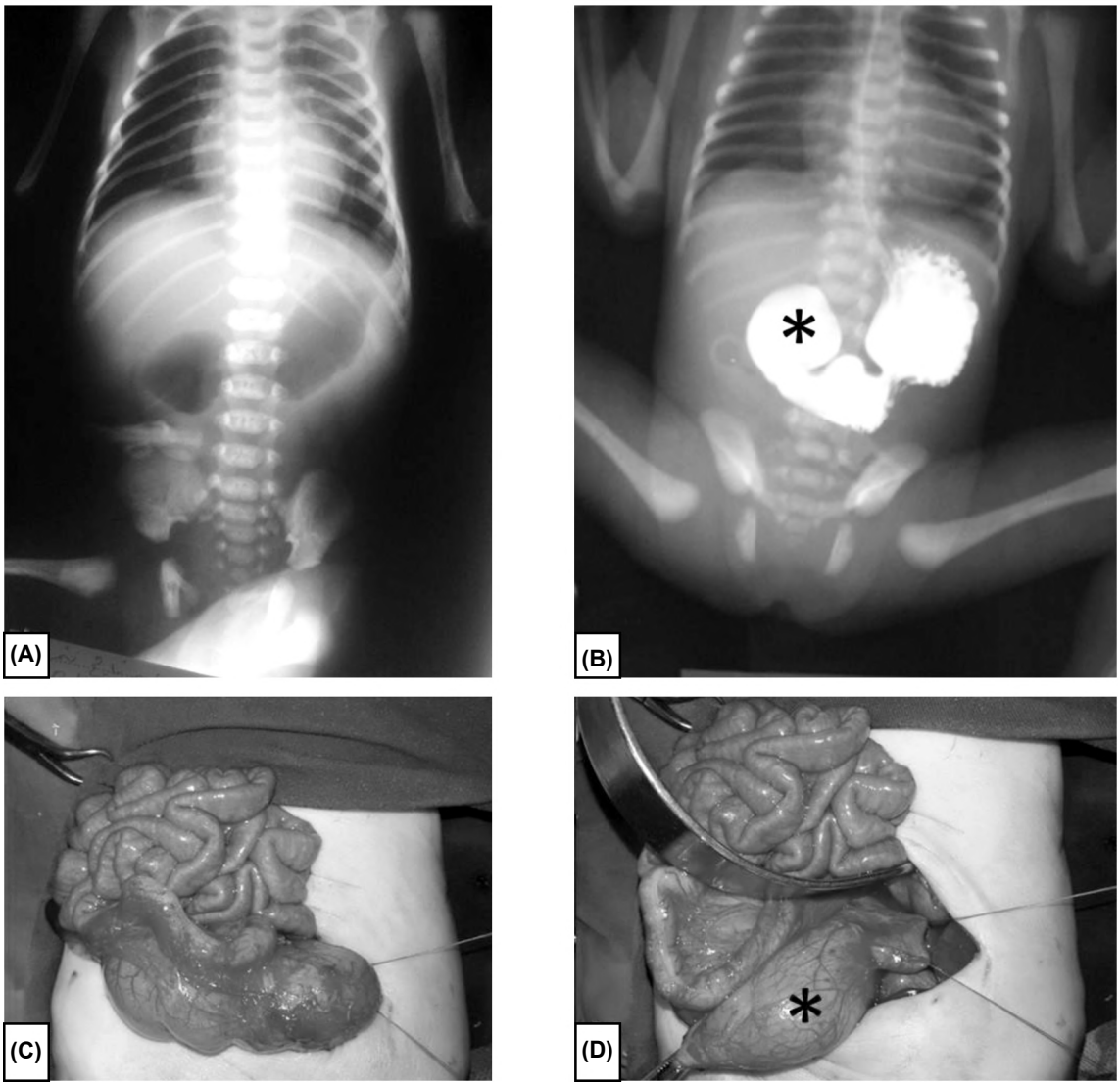

Fig. (4): A neonate with duodenal atresia. (A) X-ray showing double bubble sign. (B) Contrast meal showing demonstrating duodenum (*) without passage of contrast beyond the duodenum. (C, D) Surgical photos showing dilated duodenum (*).

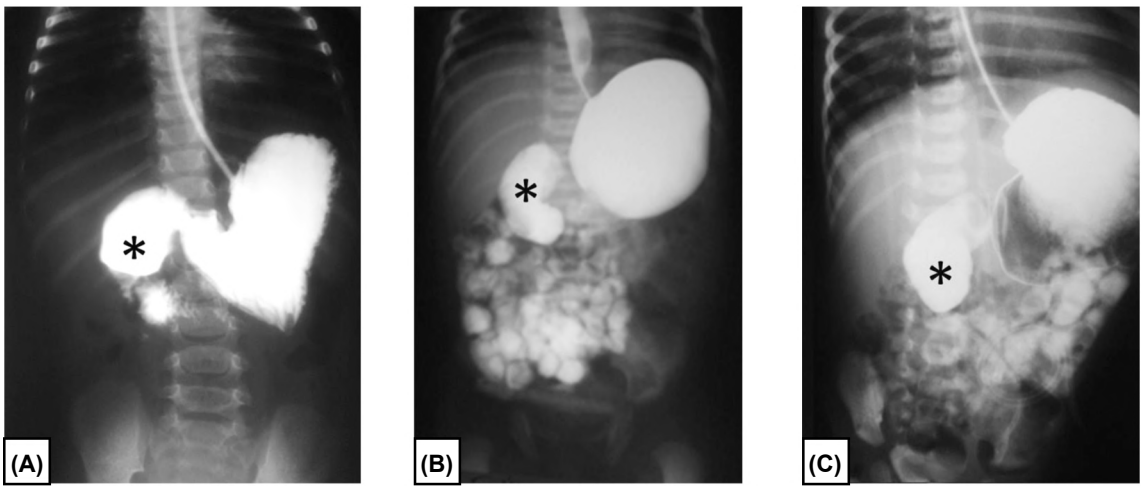

Fig. (5): Three different infants with duodenal stenosis. (A, B, C) Contrast images showing dilated stomach and duodenum (*) with duodenal stenosis.

Midgut volvulus was seen in 4 cases in our research work Figs. (6,7). The patients presented in neonatal period with bilious vomiting. Erect abdomen X-ray was irrelevant in the distribution of GIT air. Normal pylorus was found at sonography. Color Doppler sonography was the main stay in the diagnosis. Whirlpool sign was the gold stand in the diagnosis. Duodenal dilatation was seen in all cases in sonography and upper contrast series. Surgery was done to all cases. Untwisting of the volvulus parts were accomplished in theses babies.

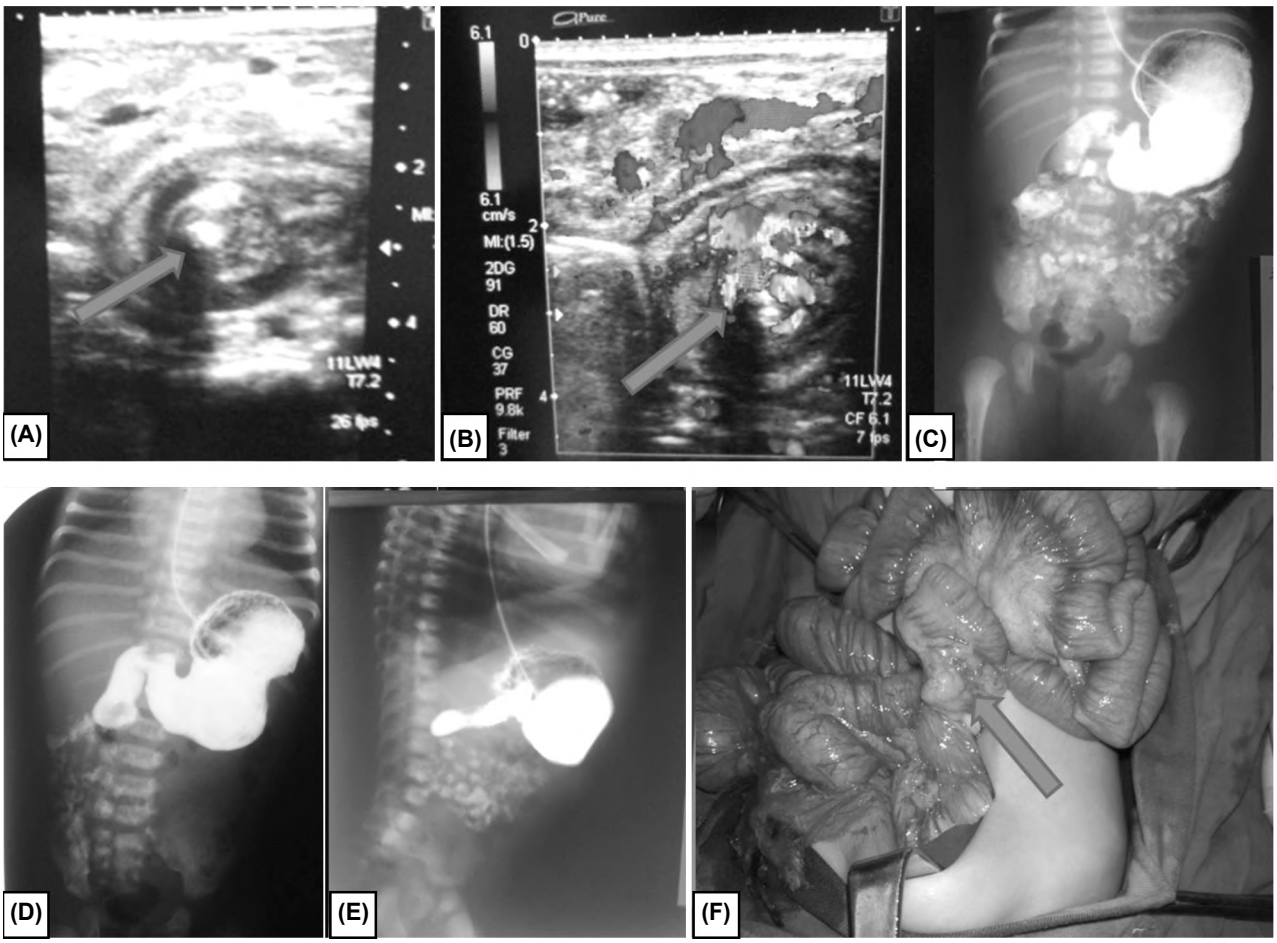

Fig. (6): A neonate with midgut volvulus. (A) Sonography and color Doppler images showing whirlpool sign (arrow). (C, D, E) Contrast meal illustrating dilated duodenum with partial duodenal obstruction. (F) Surgical photo showing midgut volvulus (arrow).

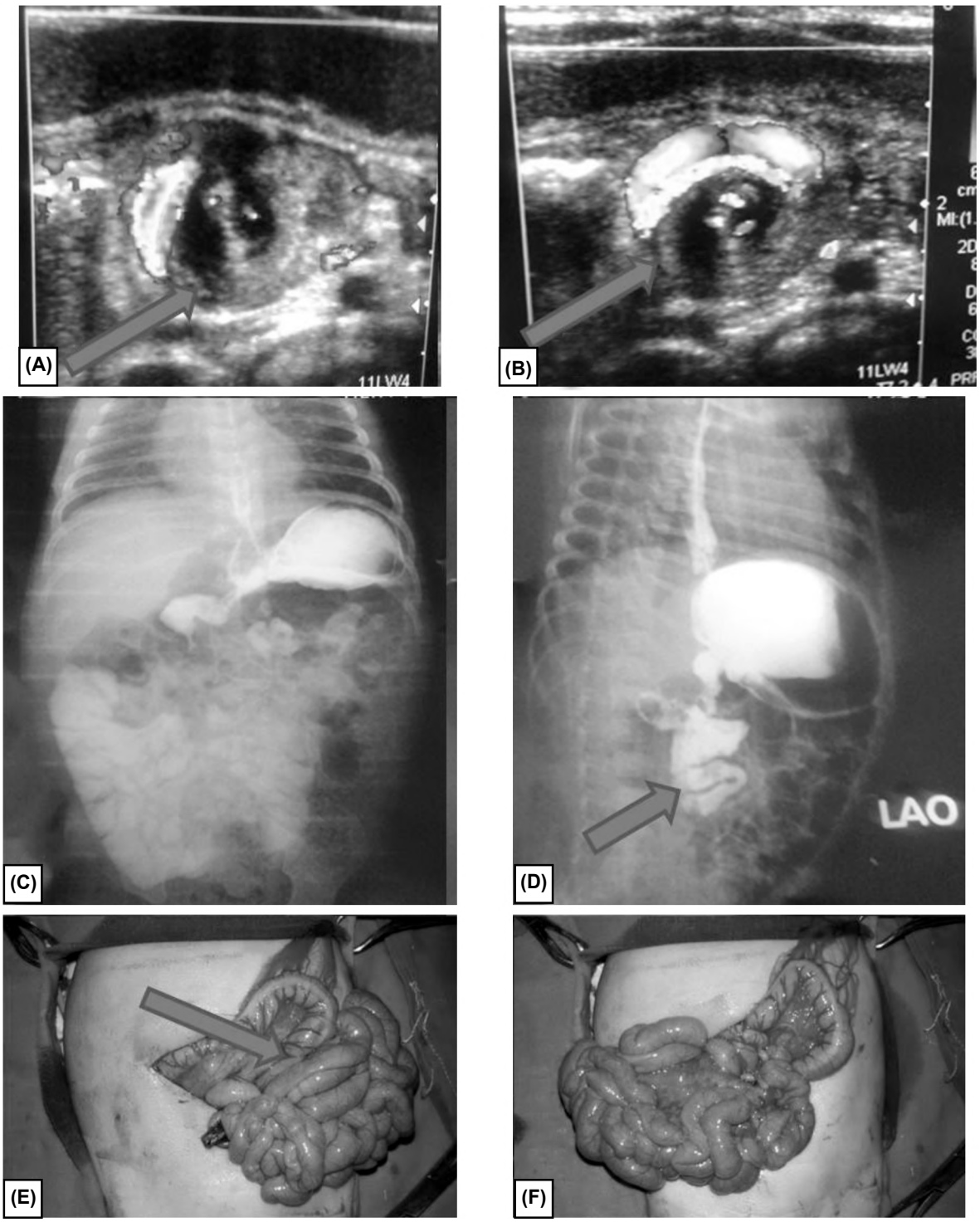

Fig. (7): A neonate with midgut volvulus. (A) Color Doppler images showing whirlpool sign (arrow). (C, D) Contrast meal demonstrating dilated partial duodenal obstruction (arrow). (E, F) Surgical photos showing midgut volvulus (arrow).

Duodenal duplication cyst was found in one case Fig. (8). The infant had the age of 2 years and presented by vomiting. Sonography revealed a relatively big cyst related to the duodenum. Contrast study demonstrated a filling defect compressed the duodenum with partial obstruction. Surgery confirmed the presence of duodenal duplication cyst. Excision of the cyst was archived on surgery.

Three cases with history of foreign body swallow were included in our series. One of them was coin swallow with pyloric obstruction Fig. (9). The coin was evident on X-ray and removed by endoscopy. The other infant was about 3 years old was history of magnets swallow Fig. (10). The patient came with vomiting. Plain X-ray illustrated four and half metallic foreign bodies intimately

related (stuck) to each other in the pyloric region. Surgical exploration found the multiple stuck magnets and removed them. The third patient came with bilious vomiting. X-ray definitely diagnosed the case with evidence of nail at the duodenal region Fig. (11). Surgical removal of the nail was done.

There was a strange case; a 6 years old girl complaining of abdominal pain and vomiting. Examination revealed hard mass at the epigastric region. A big heterogonous lesion filing the stomach and extending to the duodenum and diagnosed as a big trichobezoar at CT. Surgical exploration was done with removal of the lesion Fig. (12).

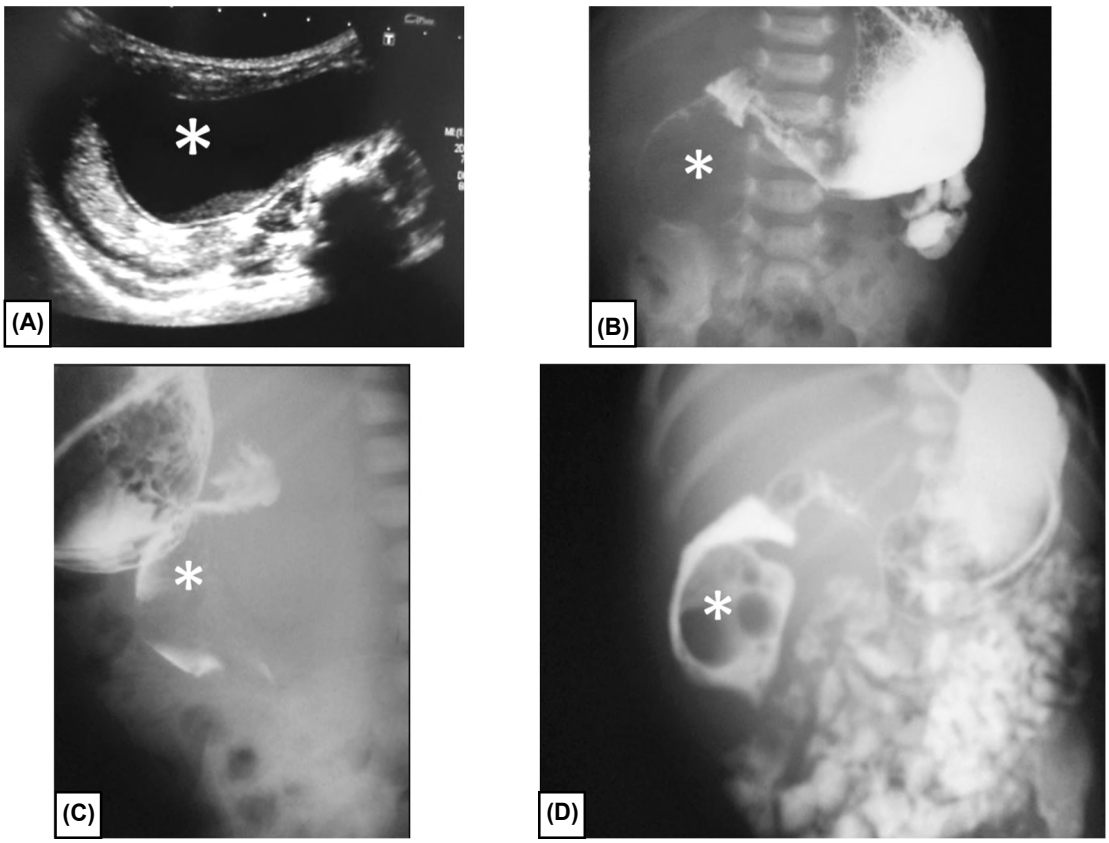

Fig. (8): A neonate with duodenal duplication cyst. (A) Sonography image illustrating big cystic lesion at the duodenal region (*). (B, C, D) Serial contrast images showing a big filling defect (*) splaying the duodenum.

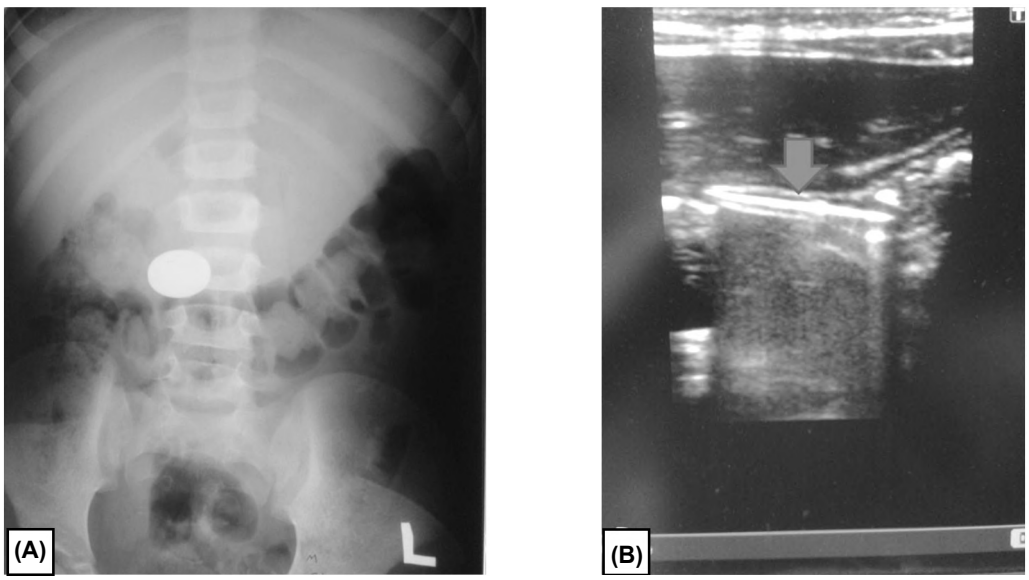

Fig. (9): An infant with coin swallow. (A) X-ray film showing well defined smooth metallic radio-opaque shadow at the pyloric region. (B) Sonography image demonstrating a hyperechoic area (arrow) with marked shadowing is seen at the pylorus.

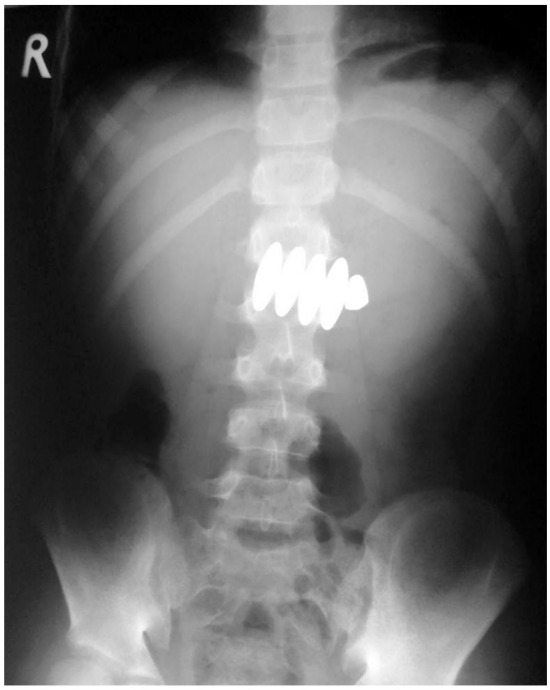

Fig. (10): A young boy with magnets swallow. X-ray film showing multiple oblong dense metallic radio-opaque shadows closely related to each other at the pyloric region.

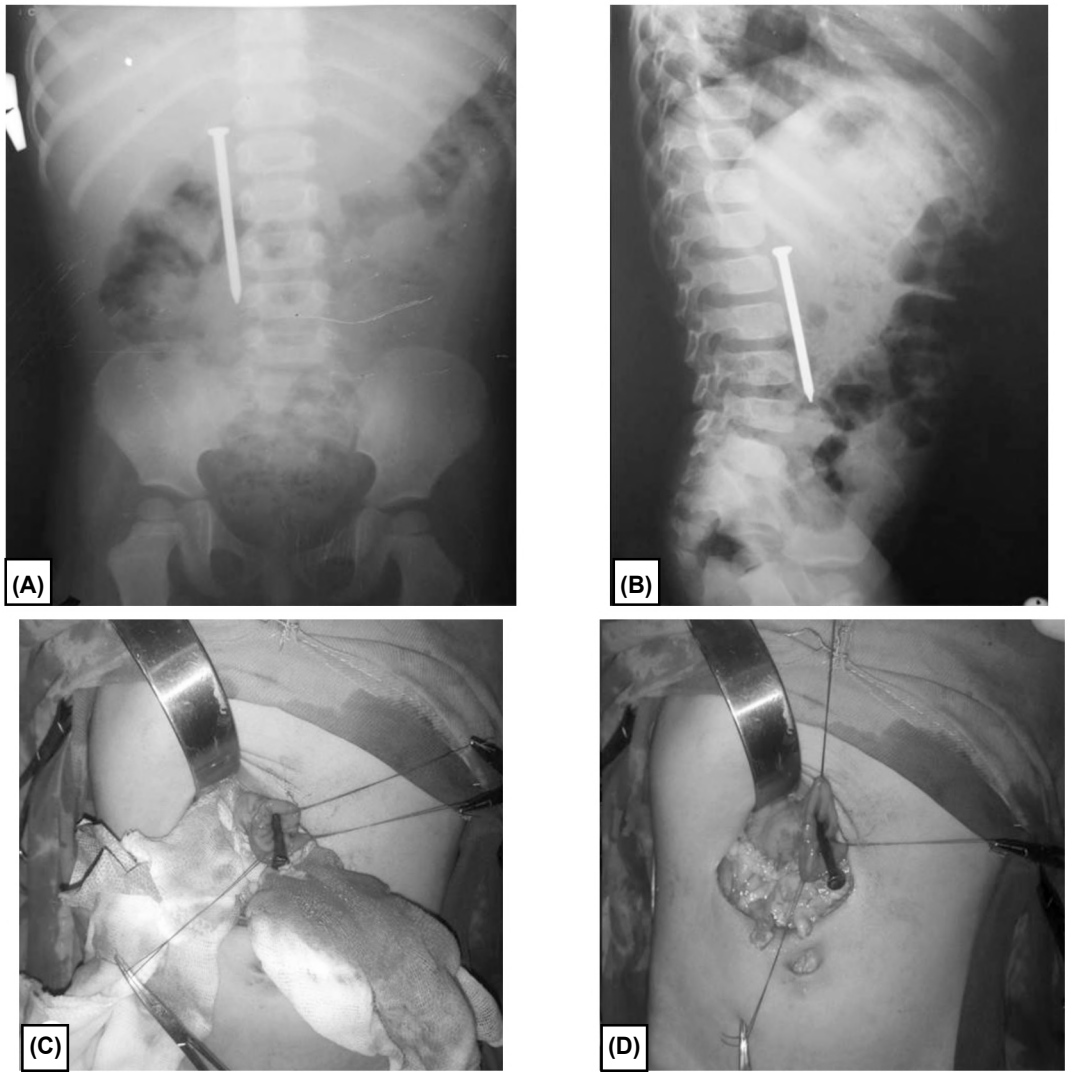

Fig. (11): A child with a nail swallow. (A, B) X-ray images showing the nail at the duodenal region. (C, D) Surgical photos during removal of the nail.

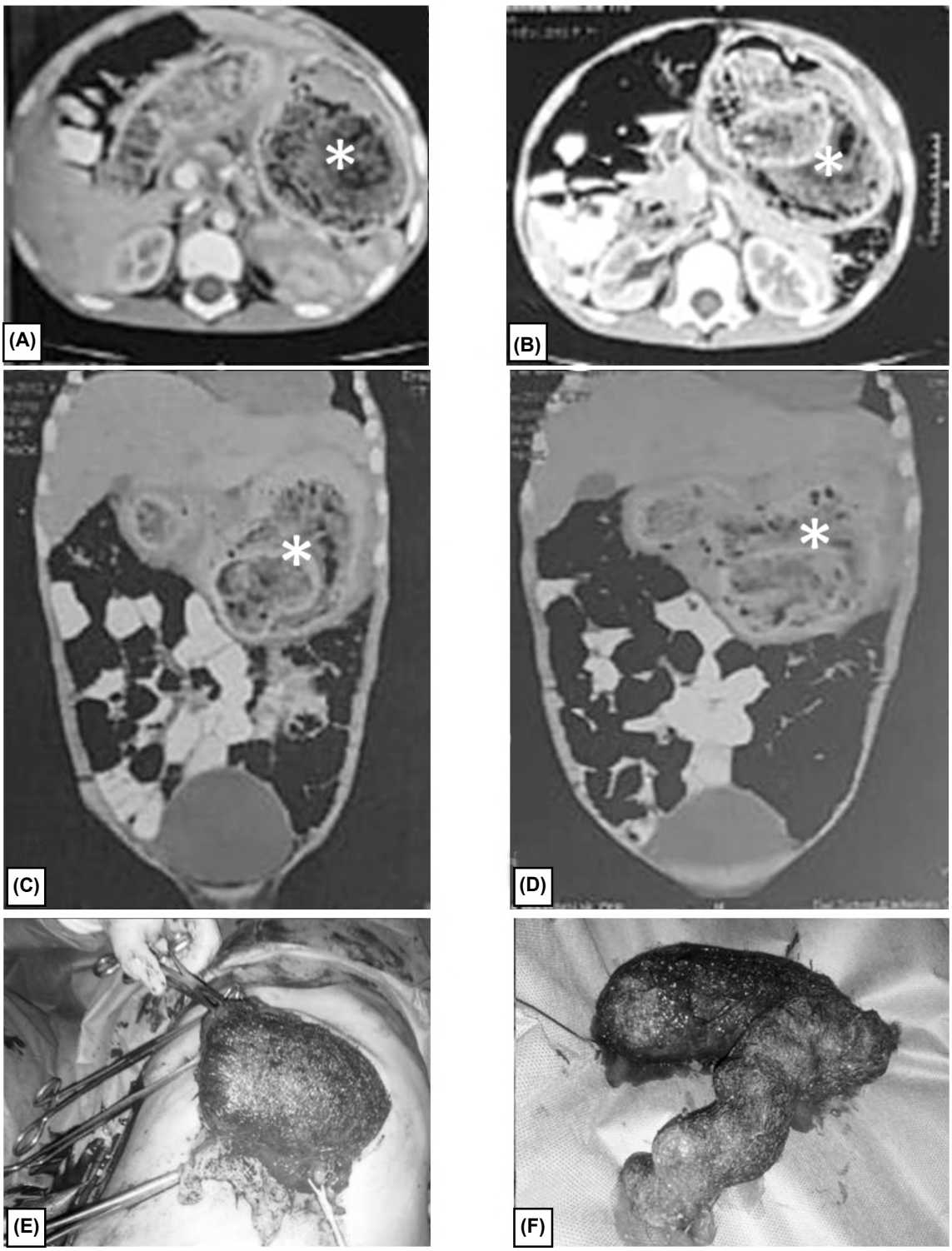

Fig. (12): A girl with trichobezoar. (A, B) Axial CT images and (C, D) Coronal CT images showing the markedly heterogonous very big lesion (*) filling the stomach and extending to the duodenum. (E, F) Surgical photos of the trichobezoar.

Discussion

Intestinal obstruction is commonly encountered in pediatric practice **[11-13]** . The pylorus and duodenum obstructing lesions are a major health problem in these babies. CHIPS is the most common cause of pyloric obstruction in neonatal and early infantile life **[14]** . However; in this work, we concentrated upon the other pyloric and duodenal causes of obstruction.

This work included different causes of pyloric and duodenal obstruction in pediatric population such as pyloric and duodenal atresia, duodenal

stenosis, mid gut volvulus, duodenal duplication cyst, FB swallow that obstructed the pylorus and trichobezoar.

Pyloric atresia is a very rare congenitally anomaly to be encountered. Its incidence is 1:100000 live births. It is less than 1% of all upper gastrointestinal-tract atresia **[15,16]**. Our study included four cases. The neonates came very early by non-bilious vomiting. X-ray and contrast study quickly diagnosed the condition. Surgery confirmed the diagnosis and treated it. Bawazir OA and his colleague **[17]** described series of 20 cases with congenital pyloric atresia. All cases were diagnosed by X-ray as a single bubble sign and by contrast meal. They treated them by surgical repair.

Duodenal atresia is infrequently seen in neonatal clinical practice. Its incidence is 1:7500. It may be associated with gastric diverticulum **[18]**. The neonates presented by vomiting which may be bilious or non bilious according to the level of at the atresia. Our study reported three cases with proximal duodenal atresia and two cases with distal duodenal atresia. These cases were easily diagnosed on plain X-ray by demonstrating the double bubble sign and confirmed at contrast study. Surgery alleviated the obstruction. Kumar et al. **[8]** reported 23 cases with duodenal atresia and its associated anomalies. Singh and his colleague **[19]** found 9 cases of duodenal atresia in examining 53 cases with neonatal intestinal obstruction.

Incomplete duodenal web is one of the causes of partial duodenal obstruction. We encountered such cause in three cases in our series. The patient presented with bilious vomiting and diagnosed as duodenal stenosis on contrast examination. Surgical exploration detected the actual cause of obstruction. Alehossein et al., **[20]** reported two cases with duodenal web in studying 23 cases with bilious vomiting in neonates. Eight cases with duodenal web were reported by Kumar et al., **[8]** on examining 31 patients wits with congenital duodenal obstruction.

Annular panaceas is a rare anomaly to be seen and cause duodenal obstruction. It is due to failure of rotation of the ventral pancreas to connect to the dorsal pancreas in early fetal life **[21]**. We found one case with annular pancreas in this work. Duodenal stenosis is seen on contrast examination and surgery detected the disease. Chen et al., **[22]** reported a big number of cases of annular pancreas (66 cases) in a large series of 287 newborns with congenital duodenal obstruction.

This series included 4 cases with midgut volvulus. This disease entity is not uncommon. It may be associated with jejunal duplication **[23]**. It is frequently seen in practice of neonatal and infantile clinics. It has a characteristic whirlpool sign at color Doppler sonography **[24,25]**. The baby presented with bilious vomiting. Pyloric canal was normal at sonography. Whirlpool sign was found in all cases. Chen et al., **[22]** found 174 cases of intestinal mal-rotation with duodenal obstruction in his series.

GIT duplication cysts have variable presentation in pediatric age group **[26,27]**. Our series reported duodenal duplication cyst with duodenal obstruction. Sonography demonstrated a cyst closely related to the duodenum. Contrast study showed the partial obstruction of the duodenum with a filling defect. Surgery confirmed the diagnosis. Matuszczak et al., **[28]** reported gastric outlet obstruction in 5 month old infant due to duodenal duplication cyst. It was diagnosed by US and CT and confirmed at the surgery.

Infantile swallow of foreign body is an old and new problem commonly seen in daily pediatric practice. Most of foreign bodies can pass all through the GIT. However; few of them may obstruct the pylorus or make serious duodenal complications [29].Imaging modalities can diagnose such cases [30].Three cases were found in our series illustrating this scenario. The first case was coin obstructing the pylorus. The second case was very strange; a 3 years old infant swallowed multiple magnets. We found 4 and half magnets were stuck to each others and obstructed the pylorus at X-ray. This confirmed at surgery with removal of stuck magnets. The third was nail swallow. This case was diagnosed at the X-ray. The nail was removed at surgery.

Trichobezoar or Rapunzel syndrome is a rare disease. It is seen in young girls with psychic problems. It is due to longstanding ingestion of hairs **[31]**. Our study examined a 6 years year old girl with vomiting and abdominal pain. CT could diagnose the case as trichobezoar and surgery confirmed the diagnosis. Chahine et al., **[32]** reported a similar case.

Conclusion:

Pyloric and duodenal obstruction in pediatric population is important medical problem to deal with. The obstructing lesions are diverse. They vary from congenital lesions to foreign bodies and may be trichobezoar. Imaging modalities including US, X-ray, contrast study and may be CT are

important for diagnosis. Surgery is very crucial to relieve the obstruction.

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دور الآشعة فى تشخيص حالات إنسداد فتحة البواب والإثنى عشر فى الآطفال وترابطها بنتائج الجراحة للبواب

ولقد هدفت هذه الدراسة لتقييم آهمية التشخيص حالات إنسداد فتحة البواب والإثنى عشر فى الآطفال وترابطها بنتائج الجراحة.

ولقد إشتملت حالات إنسداد فتحة البواب والإثنى عشر للآطفال آصغر من ٦ سنوات.

ولقد وجد عدد ٢٢ من الآطفال والذين يعانون من إنسداد فتحة البواب والإثنى عشر. وقد تم فحص هؤلاء الآطفال فى قسم الآطفال ووحدة جراحة الآطفال وتم تحويلهم إلى قسم الآشعة حيث آجرى لهم فحص بالآشعة العادية والموجات فوق الصوتية وفحص بالآشعة بالصبغة وآحياناً بالآشعة المقطعية وذلك طبقاً لحالة المريض.

ولقد تم تشخيص كل الحالات ومراجعتها مع الموجودات الجراحية وكانت كالتالى: ٤ حالات رتق فتحة البواب، و٥ حالات رتق الإثنى عشر، و٣ حالات ضيق الإثنى عشر، وحالة واحدة بنكرياس حلقى، و٤ حالات إنفتال المعى المتوسط، وحالة واحدة كيس إزدواجى للإثنى عشر، و٣ حالات إنسداد نتيجة جسم غريب وحالة واحدة بآزهر شعرى (مواد صلبة فى المعدة). ولقد تم عمل الجراحات اللازمة لهؤلاء الآطفال.

ولقد آستنتج من هذه الدراسة الآهمية القصوى للتصوير الطبى فى معرفة آسباب إنسداد فتحة البواب والإثنى عشر فى الآطفال لما فيها من علاج الآطفال بالجراحات المناسبة.