CT Imaging of Uncommon Pediatric Abdominal Tumors

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This pictorial presentation, is a *step-by-step manual*, describing the authors approach to performing CT for evaluation of various pediatric abdominal tumors, including clinical indications, patient preparation and CT technique.
Purpose

To review the CT imaging findings of uncommon abdominal tumors in pediatric patients.

Understanding the characteristic CT imaging appearance of various uncommon abdominal tumors in children will allow accurate differentiation among various uncommon abdominal tumors in children and, in turn, lead to optimal pediatric patient management.
CT Technique

Oral and Intravenous Contrast Agents

- Dilute water-soluble, iodine-based contrast agent is the most commonly used oral contrast of choice, which can be administered by mouth or through a nasogastric tube if necessary.
- Amount of oral contrast is based on the age of the patients and shown in Table 1.
- For IV contrast agent, a nonionic IV contrast at a dose of 2 mL/Kg (up to a dose of 125 mL) should be used.
- IV contrast can be administered by mechanical or hand injection, which depends on the size and stability of IV catheter.
- Suggested guideline for IV contrast injection rate is detailed in Table 2.
CT Technique

CT Parameters

Should follow the ALARA principle.

- Acquisition of an optimal CT data set is based on selecting proper CT parameters, including tube current or milliamperage (mAs), kilovoltage peak (kVp), table speed, and detector collimation.

- Suggested guidelines for mAs and kVp based on patient weight are included in Table 3.

- For table speed, fast scan times of 1 second or less, available on most multidetector CT (MDCT) scanners (> 4 rows), should be used.

- Detector collimation varies based on the type of MDCT scanner.

(See each case for specific CT protocol*)
Main menu

1. Liver and biliary tree tumors
2. Pancreatic tumors
3. Renal and adrenal tumors
4. Gastric and Intestinal tumors
5. Mesentery and peritoneal tumors
6. Genitourinary tumors
Liver and biliary tract tumors

- Hepatic masses constitute about 5–6% of all intra-abdominal masses in children. [3]

- The majority of liver tumors in children are malignant.

- Malignant tumors of liver constitute the third most common intraabdominal malignancy in the pediatric age group after Wilms’ tumor and neuroblastoma.

- Only about 1/3 of the liver tumors are benign. [3]
Liver and biliary tract tumors

- Rhabdomyosarcoma (RMS) arising from the biliary tree is rare, accounting for approximately 1% of all RMS in childhood. [4-6]

- A differential diagnosis of liver tumors in children can be obtained based on the age of the child, clinical information (in particular AFP) and imaging characteristics. [3]
Liver and biliary tract tumors

CT PROTOCOL

- **Patient Position:** Supine Feet First.
- **Clinical Indication:** Liver tumors, liver transplant, portal vein/artery thrombus/stenosis
- **Landmark:** Xiphoid
- **Anatomic Coverage:**
  - *Phase 1:* Arterial Phase (Smart Prep off of Left Ventricle of the Heart)
    Diaphragm to Iliac Crest
  - *Phase 2:* Portal Venous Phase (Scan immediately after arterial phase. Symphysis to diaphragm

- **Slice Thickness:** 1.25mm
- **Collimation:** 20mm (16 x 1.25mm)
- **Scan Type/Algorithm:** Helical – Recon
  1) Standard Recon
  2) Soft 1.25mm x 0.5mm
- **Post Processing:** 3 mm coronal and sagittal reformats.
  10mm X 0.7mm Sagittal and Coronal MIPS.
- **Contrast/Timing:** IV Bolus Tracking
- **Dose Reduction Considerations:**
  Reference mAs is double on second phase.
Rhabdomyosarcoma of the biliary tree

- Rhabdomyosarcoma (RMS) arising from the biliary tree is rare, accounting for approximately 1% of all RMS in childhood. [4-6]

- The median age of presentation for biliary RMS is 3 years old. [4, 6, 7]

- Jaundice presents in all cases. Other symptoms are: abdominal pain, hepatomegaly, poor general condition and right hypochondrial tumor. [4,6]

*Commonly the diagnosis is late with massive abdominal tumor and significant local and regional extension.*
No pathognomonic CT imaging features.

CT may show intraductal mass when it is still small in size, with or without associated biliary ductal dilatation. [6]

Biliary RMS typically demonstrates a heterogeneous mass with various degrees of contrast enhancement ranging from none to marked. [8-10]

A large biliary RMS located within the liver is often difficult to be differentiated from other malignant hepatic tumors in children. [4-6, 11]
Fibrolamellar HCC

- Is a subtype of hepatocellular carcinoma. [11-13]
- Seen in older children without associated underlying liver disease or elevated serum alpha-fetoprotein. [11-13]
- Has a better prognosis due to a higher rate of complete surgical resectability and lack of underlying chronic liver disease. [11-13]

On CT:
- Presents as a solitary, relatively well-circumscribed, heterogeneously enhancing mass.
- May contain a central area of low attenuation stellate central scar which results from the coalescent fibrotic lamellae.
- Calcified central scar can be seen in 35% - 55%.
Hepatic angiosarcoma

- Hepatic angiosarcoma is an uncommon malignant hepatic neoplasm arising from endothelial cells and has a poor prognosis. [11, 14, 15]

- Typically occurs in infants and children with a mean age of presentation of 3.7 years. [14, 16, 17]

- The most common clinical presentation is a rapidly enlarging abdominal mass often associated with coagulation disorder such as disseminated intravascular coagulation. [14, 16]

**Serum alpha-fetoprotein level is usually normal in patients with angiosarcoma.**
Hepatic angiosarcoma

On CT, can present as nodules, a large mass, or a combination of both. \[11, 15, 18\]

Unenhanced CT images a majority are hypoattenuating with foci of hyperattenuation representing hemorrhage. \[11-15\]

Enhanced CT images, various contrast enhancement patterns including nodular, central, and peripheral ring-shaped enhancement can be seen.

The degree of contrast enhancement within the areas of angiosarcoma has been reportedly less than that of the aorta*. \[11-15\]

* Helpful CT imaging hint supporting the diagnosis of angiosarcoma.
Liver hemangioma

- Hepatic hemangiomas are the most common vascular hepatic tumors in the first year of life (50% of the benign tumors). [3]
- Up to 85% of these tumors present by 6 months of age, the male:female ratio being 1:2.
- These tumors may grow rapidly in the perinatal period and may involute eventually.
- In the proliferative phase, there is characteristic hypercellularity, endothelial proliferation and dilatation of vascular spaces, leading to a characteristic ‘cavernous appearance’. [3]
- Infantile hemangiomas may produce type-3 iodothyronine deiodinase leading to hypothyroidism. [3]
Liver hemangioma

- On unenhanced CT, hemangiomas have a lower attenuation than the liver parenchyma with occasional hemorrhage. [3]
- On contrast-enhanced CT there is a characteristic intense, nodular peripheral rim enhancement with central progression.
- Central filling defects may occur in larger lesions due to central thrombosis or fibrosis. [3]
- On delayed enhanced images, infantile hemangiomas show a characteristic persistent enhancement.
- Calcifications may be seen in up to 40% of cases. [3]

**Hemangioma typically show a degree of contrast enhancement similar to that of the aorta.**
Malignant rhabdoid tumor of the liver is a rare and highly aggressive hepatic neoplasm. [19-21]

Malignant rhabdoid tumor of the liver is primarily seen in infants less than 1 year of age.

Children typically present with an abdominal mass. [19-21]
Rhabdoid tumor of liver

Due to its rarity, CT imaging characteristics of rhabdoid tumor of the liver have not been clearly characterized.
Pancreatic tumors

- Pancreatic neoplasms are rare in children and have a different prognosis, with a better clinical outcome than those in adults. [24]
- In general, they are well demarcated with expansile growth patterns, may be quite large at diagnosis, and central cystic necrosis is common.
- They infrequently cause biliary duct obstruction. [24]
- All pancreatic neoplasms in children are capable of producing metastases, usually to the liver and lymph nodes.
Pancreatic tumors

CT PROTOCOL

- **Patient Position:** Supine, Feet First
- **Clinical Indication:** Mass diagnosis or follow up.
- **Landmark:** Xyphoid.
- **Anatomic Coverage:** Xyphoid to Pubic Symphysis
- **Slice Thickness:** 5mm
- **Collimation:** 20mm
- **Scan Type/Algorithm:** Helical/Standard
- **Post Processing / Reformats:** Recon to 1.25 mm thickness by a 0.5 mm interval in standard algorithm for the abdomen. Reconstruct coronal and sagittal reformats.
- **Contrast/Timing:** IV/End of Injection
Pancreatoblastoma

- Also known as pancreaticoblastoma or infantile-type carcinoma of the pancreas.

- Is rare but the most common type of pancreatic neoplasm of young children. [22-24]

- Typically occurring under the age of 7 years.

- The common clinical presentations include a palpable abdominal mass with anorexia and vomiting. [22-25]

- Serum alpha-fetoprotein level is elevated in approximately 1/3 of cases. [24, 25]
Pancreatoblastoma

- On CT, pancreatoblastoma is typically a large heterogeneous, multiloculated cystic mass with internal enhancing septa. [20-22]
- Commonly located within the head of the pancreas.
- Variable imaging appearances of the margins ranging from well-defined to infiltrative have been reported. [20-22]
- Associated small punctate, clustered, or curvilinear calcifications may also be present. [26-28]
Solid-pseudopapillary tumor

- Solid-pseudopapillary tumor is a primary pancreatic neoplasm with low malignancy potential. \[22-24, 29\]
- Usually affects adolescent girls and young women.
- Higher incidence in the Asian population.
- Common clinical presentations in children include a palpable abdominal mass or pain.
Solid-pseudopapillary tumor

- On CT, usually present as a large, well-circumscribed, and heterogeneous mass with fibrous capsule. [22-24, 26, 29]

- The tumor has a mixture of solid and cystic components.

- The cystic component is due to underlying hemorrhagic and necrotic change.

- Small tumors tend to be solid on CT.

- Internal septations and peripherally located calcifications may be also seen.
Mucinous Cystadenoma

- Cystic pancreatic neoplasm, which account for less than 1% of pancreatic neoplasm in adults, and are rare in children. [26]

- There are two different types of cystic pancreatic neoplasms: microcystic serous adenomas and mucinous cystic neoplasm.

- While microcystic serous adenomas are benign, mucinous cystic neoplasm represent a continuum of benign to malignant disease.
On CT, microcystic serous adenomas are typically less than 2 cm in size and contain innumerable small internal cysts.

In contrast, mucinous cystic neoplasm are commonly large multilocular, near water-attenuation, cystic masses. [26]
Islet cell tumors of the pancreas are epithelial tumors of endocrine origin, which typically occur in middle age but may be discovered in older children. [22-24, 29]

Can be classified as either functioning or nonfunctioning depending on their endocrine hormonal activity.

In children, the most common types of functioning islet cell tumor are the insulinoma (47%) and gastrinoma (30%).

Unlike in adults, the remaining other types of functioning and non-functioning tumors have been known to be exceedingly rare in children.

Clinical presentation of children with functioning islet tumors depends on the types of the hormonal product and associated hormone-related syndrome. [22-24, 29]
On CT, functioning islet cell tumors are typically round or oval-shaped, well-defined enhancing mass typically less than 3 cm in size. [25-28]
Renal and adrenal tumors

- Wilms tumor is the most common pediatric solid renal tumor. Recently, several other renal masses have been recognized as separate pathologic entities. [30-32, 34, 36]

- Knowledge of the distinct clinical and imaging features of these lesions may help suggest a particular diagnosis, which in turn has implications for preoperative planning and prognosis.

- The diagnosis of these newly described lesions can be suggested by their unique clinical history, such as age at presentation and distinctive imaging features. [30-32, 34, 36]

- However, be aware of that some renal neoplasms cannot always be diagnosed with preoperative imaging.

CT PROTOCOL
Renal and adrenal tumors

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Clear cell sarcoma

- Clear cell sarcoma of the kidney (bone metastasizing renal tumor of childhood), once thought to be a variant of Wilms tumor. [30-32]
- Accounts for 4%–5% of primary renal tumors in childhood.
- The peak incidence is at 1–4 years of age, and a male predominance has been reported. [30-32]
- Clear cell sarcoma has a nonspecific presentation, most often manifesting as an abdominal mass.
Clear cell sarcoma

- CT imaging shows a sharply demarcated, solid, intrarenal mass, without intravascular extension. [30-32]

- The tumor is characterized by its aggressive behavior and is associated with a higher rate of relapse and mortality.

- It may metastasize to the bones, lymph nodes, brain, liver, and lungs, in some cases even long after nephrectomy.
Atypical congenital mesoblastic nephroma

- Mesoblastic nephroma is the most common solid renal tumor in the neonate. [32]
- Originally thought to represent congenital Wilms tumor, now recognized as a distinct entity, identified within the first 3 months of life, with 90% of cases discovered within the 1st year of life. [32]
- There is a slight male predominance.
- The most common clinical presentation is a palpable abdominal mass, with hematuria less frequent. [32]
Desmoplastic small round cell tumor

- DSRCT is an extremely rare, aggressive and malignant neoplasm. [32-34]

- Typically occurs in children, adolescents and young adults in the abdominal serosal surfaces.

- On CT images, appears as a hypovascular, heterogeneous and well-circumscribed mass containing several foci of internal punctate calcifications. [32-34]
Nephroblastomatosis is characterized by persistent nephrogenic rests. [32, 34-36, 39]

It is considered a precursor to Wilms tumor.

Can be classified as perilobar or intralobar, each form is associated with certain syndrome.

The perilobar form is associated with Beckwith-Wiedemann syndrome, hemihypertrophy and Perlman syndrome.

The intralobar form is associated with Drash syndrome, sporadic aniridia and WAGR syndrome. [32, 34-36]
On CT images, nephroblastomatosis can present as homogeneous low attenuated nodules or masses that enhance less than normal renal tissue and are located at the periphery of the kidney or can present as diffuse nephromegaly retaining the reniform shape. [32, 34-36, 39]
Renal cell carcinoma

- Renal cell carcinoma is rare in children, accounting for less than 7% of all primary renal tumors manifesting in the first 2 decades of life. [32, 34, 37]

- Is associated with von Hippel–Lindau syndrome, in which the tumors tend to be multiple, bilateral and manifest at a younger age. [32, 34, 37]

- Gross painless hematuria, flank pain, and a palpable mass are the most common presenting symptoms. [38]

- The prognosis is influenced by the stage at presentation. [38]
Renal cell carcinoma

- On CT is identified as a nonspecific infiltrative, solid, intrarenal mass, with variable necrosis, hemorrhage, and cystic degeneration with little enhancement with formation of a pseudocapsule. [39]

- Calcifications seen in 25%.

- Metastases to adjacent lymph nodes, bones, lungs, liver or brain are found in 20% of patients at diagnosis. [34, 39]

- Renal cell carcinoma is more likely to manifest bilaterally.
Rhabdoid tumor is a rare, highly aggressive malignancy of early childhood. [30-32, 34, 40]

Approximately 80% occur in patients less than 2 years of age. Comprising 2% of pediatric renal malignancies. [30-32, 34]

There is male predominance by a ratio of 1.5:1. [30-32, 34, 40]

May manifest as hematuria or symptoms referable to metastatic disease. Also may develop hypercalcemia secondary to elevated PTH levels. It is highly aggressive. [31, 40]

The association of rhabdoid tumor with synchronous or metachronous primary intracranial masses or brain metastases has been established as a distinctive feature. The brain lesion is usually near the midline and often in the posterior fossa. [40]

Survival is poor, with an 18-month survival rate of only 20%. [30, 32, 41]
Rhabdoid tumor of kidney

- Metastasizes early in an 80% of cases, to the lungs and less often to the liver, abdomen, brain, lymph nodes, or skeleton. [30-32]

- CT imaging demonstrates a large, centrally located, heterogeneous, soft-tissue mass involving the renal hilum with indistinct margins. Appearance may closely resemble that of Wilms tumor. [31, 40, 41]

- Several features can suggest the diagnosis: subcapsular fluid collections, tumor lobules separated by dark areas of necrosis or hemorrhage, and linear calcifications outlining tumor lobules. Vascular and local invasion is common. [31, 40, 41]
Adrenocortical carcinoma

- Are extremely rare aggressive tumors. [46, 47]
- Can develop at any age.
- Peaks < 5 and 4\textsuperscript{th} to 5\textsuperscript{th} decades of life. [46]
- Female > Men. [42, 43]
- Have been described as a component of several hereditary cancer syndromes like:

  - Li-Fraumeni syndrome
  - Beckwith-Wiedemann syndrome
  - Multiple Endocrine Neoplasia type I

- Unilateral or bilateral adrenal tumors can be found in 20 to 40% patients with MEN1 and the SBLA syndrome. [42, 43]
- Metastatic disease to the liver, lungs, lymph nodes, and bone. [45, 46]
- Prognosis is better in children than in adults. [44, 45]
In an enhanced CT they have a significantly greater attenuation value.

And have a slower washout of the contrast material. [48]
Gastric and intestinal tumors

- Primary malignant gastric neoplasm such as lymphoma, leiomyosarcoma, rhabdomyosarcoma, and adenocarcinoma are rare in children. [51-56]

- CT imaging appearances of primary malignant gastric neoplasm varies widely in their size, attenuation, and contrast enhancement.

- The benign gastric neoplasm such as gastrointestinal stromal tumor can also appear similar to malignant gastric neoplasm when it becomes large, heterogeneous, and associated with ill-defined borders. The definite diagnosis requires tissue sampling. [51-56]
Gastric and intestinal tumors

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Gastrointestinal Stromal Tumor

- Are the most common mesenchymal tumors of the gastrointestinal tract.

- The most common site of involvement is the stomach followed by the small intestine. [57]

- Clinically, gastrointestinal bleeding due to mucosal ulceration is usually the presenting sign.

- On CT they typically manifest as an eccentric well circumscribed mass occasionally with a hypoattenuating center representing cystic degeneration or necrosis. [57]
Intestinal lymphoma

- The most common malignant neoplasm involving the mesentery and peritoneal cavity is lymphoma in children. [58-59]

- The GI tract is the most common site of manifestation of NHLs in children, most frequently of B-cell origin. The stomach and duodenum are very rarely involved, whereas the distal ileum, cecum, appendix, and ascending colon are the most frequently involved sites. [60]

- In children, the most common subtypes are Burkitt lymphoma, Burkitt-like lymphomas and large B-cell lymphomas, lymphoblastic lymphoma, anaplastic large cell lymphoma, and other peripheral T-cell lymphomas. [57-61]

- Secondary bowel involvement from generalized lymphomas is more common than primary lymphoma.

- Male children are twice as frequent as females.
Intestinal lymphoma

- CT scan shows marked thickening of the intestinal wall in a focal or diffuse distribution, loss of stratification, showing soft-tissue attenuation with minimal enhancement. [57-61]

- Usually spreads circumferentially throughout the intestinal submucosa, progressively infiltrating the bowel wall. [57-61]
Intestinal lymphoma

- The lumen may be narrowed or dilated with an aneurismal aspect due to replacement of the muscular layers by tumor spread. [57-61]

- Mesenteric lymphadenopathies are seen.

- Intussusception may be a complication of lymphoma. [57-61]

- Acute abdomen with symptoms mimicking those of acute appendicitis is a relatively frequent presentation in children. [57-61]
Colonic hematoma

- *A tumor mimicker.*

- A localized submucosal colonic hematoma may act as a lead point for intussusception and can be confused by an abdominal mass when the medical history is not accurate. [62-64]

- Bowel injuries are detected in 5% of blunt abdominal trauma and are the third most common type of injury from blunt trauma to abdominal organs.

- The most common mechanism of traumatic bowel injury in children is a motor vehicle accident, bicycle handlebar injury and child abuse.

- The main goal of imaging these patients is to distinguish significant bowel injuries that require surgical intervention from those that can be managed nonsurgically. [62-64]
Enhanced CT images can help depict indirect signs of bowel injuries like: Bowel wall defects; intraperitoneal, mesenteric, or retroperitoneal free air; intraperitoneal presence of bowel contrast material; extravasation of contrast material from mesenteric vessels; and evidence of bowel infarct. [62-64]

Delayed diagnosis of bowel injuries results in increased morbidity and mortality, usually because of hemorrhage or peritonitis that leads to sepsis.
Mesentery and peritoneal tumors

- Primary neoplasms of peritoneal and subperitoneal origin occur much less frequently than metastatic peritoneal involvement from a known or occult primary tumor. [61]

- These rare primary lesions, see Table 4 [61] are often first detected at computed tomography (CT) and should be considered in the absence of a known or suspected organ-based malignancy.

- Distinguishing a benign from a malignant process and a primary from a metastatic process is also challenging.

- CT features combined with the patient’s relevant clinical and demographic data can help narrow the differential diagnosis for a peritoneum-based neoplasm in many cases. [61]
Mesentery and peritoneal tumors

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Desmoplastic small round cell tumor of mesentery

- Desmoplastic small round cell tumor is a highly aggressive malignancy recently described. [61]
- The peritoneal cavity is the most common site of involvement.
- Most often affects adolescents and young adults.
- The most typical CT appearance is that of multiple rounded peritoneal masses with or without ascites.
- Heterogeneous enhancement with central low-attenuation areas is common. [61]
- The omentum and paravesical regions are often involved. An infiltrative appearance with diffuse peritoneal thickening is a less common manifestation. [61]
Pelvic metastasis of gastrointestinal stromal tumor

- GIST are the most common mesenchymal tumors of the gastrointestinal tract. [51-57, 61]

- Peritoneal involvement by GIST is most often due to metastatic spread from a primary gastrointestinal site, but primary tumors do occur. [51-57, 61]

- Image characteristics are similar to the primary tumor.
Most pineal region masses are malignant germ cell neoplasms that occur in young male patients. The most common is a germinoma. [80, 81]

Other pineal region masses include choriocarcinoma, endodermal sinus tumor, and embryonal carcinoma.

When embryonal carcinoma is part of a mixed germ cell tumor, it can be the most aggressive and produce systemic metastases. [80, 81]

Mitoses, hemorrhage, and necrosis are frequently occurring histologic features.

There are no particular imaging characteristics that suggest embryonal carcinoma.

These tumors are capable of producing elevated levels of both α-fetoprotein and human chorionic gonadotropin, serum or CSF assays may be helpful in differential diagnosis. [80, 81]
Metastatic melanoma

- 80% of cases of melanoma metastasize to the gastrointestinal tract and its mesentery. The lesions are more common in the distal jejunum or ileum. [58, 61, 65]

- Metastases from melanoma can spread to the mesenteric lymph nodes or through embolic hematogenous spread.

- Tumor deposits can act as a lead point for intussusception.

- Carcinomatosis may occur due to rupture of tumor into the peritoneal cavity. [58, 61, 65]
Metastatic melanoma

- On CT classically manifests as enhancing mural nodules protruding into the intestinal lumen or as focal thickening of the intestinal wall. [58, 61, 65]

- Deposits in the submucosal layer result in an intraluminal mass.

- Deposits in the serosa result in implants that can compress the adjacent bowel loops as the implants grow; and

- Deposits in the mesentery result in masses that do not compress bowel loops until very large.

- Necrosis and ulceration may occur in large masses. [58, 61, 65]
Metastatic melanoma

- Lymphatic spread is less common, but when it occurs may be marked.

- Embolic metastases from melanoma reach the antimesenteric border of the small intestine through small arterial branches. [58, 61, 65]

- The site of deposition of hematogenously seeded cells influences the eventual radiologic appearance.
Mesenteric Plexiform Neurofibromatosis

- Neurofibromatosis type I (NF-1) is a systemic AD neurocutaneous syndrome. [58, 66, 67]

- Nerve sheath tumors arising from the subperitoneal space are uncommon.

- Plexiform neurofibroma (PN) is considered pathognomonic of NF-1, and are very rare in children less than 10 years old [1, 3].

- When it occurs below the diaphragm, PN is usually retroperitoneal or paraspinal in location, are bilateral, symmetric masses in a paraspsoas or presacral location. [58, 66, 67]

- Gastrointestinal involvement occurs in 10-25% of patients with NF-1.
Mesenteric Plexiform Neurofibroma

- On CT images PN can be seen as an interdigitating network of finger-like fronds of tumor extending in a serpentine fashion along a nerve and its branches with extensive infiltration of the mesentery by a homogeneous and low-attenuation mass. [58, 66, 67]

- Encasing the retroperitoneal and mesenteric vasculature is an unusual manifestation of NF-1.

- Visceral involvement is uncommon but intrahepatic and periportal extension has been described like our case. [67]
Abdominal lymphoma

- The most common malignant neoplasm involving the mesentery and peritoneal cavity is lymphoma in children. [57-61]

- Mesenteric and peritoneal lymphoma are more common in non-Hodgkin lymphoma than in Hodgkin disease.

- The common presenting symptoms in children with lymphoma in the epigastric region include abdominal pain, abdominal distention, and nausea.

- On CT, lymphoma commonly presents as relatively well-circumscribed round or oval shaped masses, or a large conglomerate masses with mass effect on adjacent structures. [57-61]
Synovial cell sarcoma

- Synovial cell sarcomas are rare and aggressive tumors preferentially occurring in children and young adults, accounting for approximately 5 to 10% of soft tissue sarcomas. [68-69]

- The common location of synovial cell sarcoma is the para-articular regions of the lower extremities. Mesenteric / peritoneal synovial cell sarcomas in the epigastric region are very rare. [68-69]
Synovial cell sarcoma

Due to its rarity, characteristic CT imaging appearance of mesenteric / peritoneal synovial cell sarcomas is currently not clearly known.

This case shows a large heterogeneously enhancing soft tissue mass with relatively well-circumscribed margins.

A substantial portion of low attenuation areas without contrast enhancement within the tumor likely represents areas of tumor necrosis.
Paraganglioma

- Paraganglioma is a rare neoplasm arising from the neuroendocrine cells located in various anatomic locations. [70-72]

- The patients with hormonally active paraganglioma typically present with symptoms including palpitations, headache, sweating, and hypertension due to excess secretion of catecholamine. [70-72]

- In contrast, patients with non-functioning paraganglioma commonly present with an enlarging epigastic mass and pain. [70-72]
Paraganglioma

On CT, paragangliomas are typically hypervascular soft tissue mass. Internal low attenuation, non-vascular area representing cystic degeneration can be often seen particularly in large non-functioning tumors. [70-72]

CT is also helpful for evaluating metastatic diseases from paraganglioma which occur in the regional lymph nodes, bone, liver, and lungs. [70-72]
The differential diagnosis for pelvic masses is extensive, and it can be difficult to assess their origin.

In the female pelvis they can arise from the reproductive organs (eg, uterus, cervix, ovaries, fallopian tubes).

Or they can arise from the gastrointestinal system, urinary system, adjacent soft tissues, peritoneum, or retroperitoneum or from metastases.

In this part of the presentation we will focus our attention in large genitourinary masses.

The site of origin, CT imaging characteristics, and clinical history may all help narrow the differential diagnosis.

Although with large tumors it may not always be possible to determine the site of origin or distinguish between various tumors at radiology.
Genitourinary tumors

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Juvenile Granulosa Cell Tumor

Granulosa cell tumor (GCT) is the most common ovarian tumor with estrogenic manifestations. Two main pathologic subtypes exist: adult and juvenile (JGCT). [73-75, 78]

JGCT typically occurs during the newborn period (50%), with a mean age of diagnosis of 1 month. [73-75, 78]

Represents approximately 8% of ovarian neoplasms. Ovarian tumors composed of these cell types are called sex cord–stromal tumors.

JGCT of the ovaries, which is far more common and which can also occur bilaterally. When affecting the testis it has been associated with ambiguous genitalia and chromosomal abnormalities. [73-75, 78]

JGCT is typically a benign lesion and represent stage I disease, usually managed successfully with surgical resection. [73-75, 78]
Juvenile Granulosa Cell Tumor

- Internal blood flow and vascular supply of the tumor originating from the retroperitoneal vessels may be seen. [73-75, 78]

- Estrogenic effects on the uterus may manifest as uterine enlargement or as endometrial thickening or hemorrhage.
Juvenile Granulosa Cell Tumor

On CT images, JGCT can appear as a large, multicystic mass with heterogeneous enhancement of the solid components, in which the cyst may contain hemorrhagic fluid. [77-79,82]

Or as an entirely solid mass and homogeneous contrast enhancement, associated necrosis is rarely seen. [77-79,82]
Ovarian fibromas are benign mesenchymal tumors. [73, 74, 76]

Rarely occur in the paediatric age group. Is an uncommon neoplasm in prepubertal girls and is rarely found before 3 years of age but there has been a case reported in infancy.

They represent approximately 4% of all ovarian tumors and are often associated with torsion, ascites and pleural effusion. The latter situation is known as Meigs’ syndrome. [73, 74, 76]

A familial predominance has been reported. Young women with basal cell nevus syndrome (Gorlin’s syndrome) often have ovarian fibromas, which are usually calcified, multinodular, and bilateral. [73, 74, 76]

There has been report of ovarian fibromas before menarche most commonly unilateral. There can be a recurrent ovarian tumours after resection.
On CT fibromas often demonstrate a distinctive appearance because of their dense fibrosis and show a heterogeneous predominantly hypodense mass with areas of cystic degeneration. [73, 74, 76]

- Calcifications may be seen.

- AngioCT is useful to depict their vascular supply and plan surgery. [73, 74, 76]
Malignant germ cell tumor

- Malignant germ cell tumors are the most common malignant ovarian neoplasms in girls and young women. [73, 74, 77]
- Account for approximately two-thirds of the ovarian cancers that occur in the first 2 decades of life.
- This group of neoplasms, include dysgerminoma, endodermal sinus tumor, embryonal carcinoma, mature teratoma, immature teratoma, and choriocarcinoma.
- Elevated serum a-fetoprotein and human chorionic gonadotropin levels can help establish the diagnosis. [73, 74, 77]
The appearance of a malignant mixed germ cell tumor varies according to its individual constituents, but it is generally a complex, predominantly solid tumor, as are the other germ cell tumors. [73, 74, 77]
Rhabdomyosarcoma (RMS) is the most common pediatric soft-tissue sarcoma and constitutes 3–5% of all malignancies in childhood. [79]

RMS occurring outside the head and neck region comprise 40%; around 15% are genitourinary (GU) nonbladder prostate tumors (GU-NBP, i.e. paratesticular, vaginal and uterine tumors), 10% are bladder prostate tumors (GU-BP), 15% occur in the limbs, and 20% occur in other sites (i.e. thoracic or abdominal tumors).

The six significant prognostic factors for localized RMS are tumor site, node involvement, tumor size, and patient age.

Survival for localized disease (85% of patients) has improved from 25% in the early 1970s to 75%. [79]
Bladder rhabdomyosarcoma

- Clinical symptoms vary widely and are site-specific. [79]

- CT shows a multilobulated heterogeneously enhancing mass, with areas of necrosis or cystic degeneration. Calcifications can be seen.

- The most common sites of metastatic spread are to the lungs and pleura, bones and lymph nodes. [79]

- RMS has been reported to be associated with neurofibromatosis, fetal alcohol syndrome and basal cell nevus syndrome. [79]
# Table 1: Amount of Oral Contrast versus Patient Age

<table>
<thead>
<tr>
<th>Age</th>
<th>Amount of Oral Contrast During the First 90 Min</th>
<th>Additional Amount of Oral Contrast Given 15 Min Prior to Scanning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1 mon</td>
<td>90 mL</td>
<td>45 mL</td>
</tr>
<tr>
<td>1 mon. – 1 yr.</td>
<td>180 mL</td>
<td>90 mL</td>
</tr>
<tr>
<td>1 yr. – 6 yrs.</td>
<td>240 mL</td>
<td>120 mL</td>
</tr>
<tr>
<td>6 yrs. – 12 yrs.</td>
<td>360 mL</td>
<td>180 mL</td>
</tr>
<tr>
<td>12 yrs. – 16 yrs.</td>
<td>480 mL</td>
<td>240 mL</td>
</tr>
<tr>
<td>16 yrs. – 18 yrs.</td>
<td>600 mL</td>
<td>300 mL</td>
</tr>
<tr>
<td>Catheter Size (gauge)</td>
<td>Injection Rate (cc/sec.)</td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Hand Injection</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>1.5 – 2.5</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>2.0 – 3.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Intravenous Catheter Size versus Intravenous Contrast Injection Rate
### Table 3: Tube current and kilovoltage by patient weight

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Tube Current (mA)</th>
<th>Kilovoltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>10 – 15</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>16 – 25</td>
<td>60</td>
<td>80</td>
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<tr>
<td>26 – 35</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>36 – 45</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>&gt; 45</td>
<td>100</td>
<td>100-120</td>
</tr>
</tbody>
</table>
Primary peritoneal neoplasms

- Mesothelioma
- Cystic mesothelioma
- Papillary serous carcinoma
- Desmoplastic small round cell tumor
- Benign mesenchymal tumors
  - Hemangioma
  - Lymphangioma
  - Lipoma
  - Nerve sheath tumor
  - Gastrointestinal stromal tumor (GIST)
  - Leiomyomatosis peritonealis disseminata
- Malignant mesenchymal tumors
  - Liposarcoma
  - Malignant fibrous histiocytoma
  - Leiomyosarcoma
  - GIST
  - Nerve sheath tumor
  - Fibrosarcoma
  - Angiosarcoma
  - Synovial sarcoma
- Lymphoproliferative disorders
  - Peritoneal lymphomatosis
  - Leukemic infiltration
  - Granulocytic sarcoma
  - Extramedullary plasmacytoma

42. Lacroix A, MD et al Clinical presentation and evaluation of adrenocortical tumors. http://www.utdol.com/online/content/topic.do/topicKey/adrenal/17707
43. Diane MF Savarese, MD and Lacroix A, MD Treatment of adrenocortical carcinoma http://www.utdol.com/online/content/topic.do/topicKey/adrenal/17707


Embryonal rhabdomyosarcoma of the biliary tree

- Four-year-old male with abdominal fullness.
- Axial and coronal enhanced CT images in arterial and venous phase demonstrate a large heterogeneous enhancing mass centered midline and is located inferior and to the left of the liver. A discrete cleavage tissue plane separating this mass and the liver is not visualized.
- There is evidence of intrahepatic biliary ductal dilation. The extrahepatic bile ducts are not visualized. This mass demonstrates heterogeneous arterial flow. The common hepatic artery courses within the superior aspect of this mass and feeds a portion of the mass. The main portal vein courses through the superior aspect of this mass and is patent. Periportal edema is identified.

Back to case
19 year old female with a large, well circumscribed, heterogeneous, lobulated enhancing mass, occupying the right hepatic lobe. This mass has linear hypodensities probably related to fibrous septa and on the unenhanced images is possible to see scattered calcifications.
Hepatic angiosarcoma

There is a large round heterogeneous mass that replaces nearly the entire right hepatic lobe. Intratumoral hemorrhage in lobe mass can be seen. The IVC and right renal vein are effaced at the level of the mass. The main and left portal veins are patent. The right portal vein appears patent proximally but is less well seen as it enters the mass. The pancreas is displaced into the left side of the abdomen but appears normal.
Liver hemangioma

There is an irregularly margined mass involving the anterior aspect of the right lobe and the medial segment of the left lobe of the liver. The lesion shows striking dense irregular and nodular marginal enhancement. There are multiple large tubular structures coursing across the lesion, corresponding to the large vascular structures. In addition to the marginal enhancement, there are several uniformly densely enhancing nodules, noted within the inferior most aspect of the lesion. The lesion derives its blood supply from an enlarged celiac axis. Drainage is principally via the middle hepatic vein. The right and left hepatic veins are more normal in caliber. The portal circulation is poorly delineated, presumably related to diminutive size and/or decreased portal flow. Despite substantial flow within this lesion, the aorta diminishes only minimally in caliber above the level of the renal arteries.
Rhabdoid tumor of liver

- Six month old female with an abdominal mass on examination.
- Within the liver there is a large, heterogeneously enhancing mass which occupies part of both lobes of the liver, and extends inferiorly to the level of the iliac bone. There is mass effect on adjacent structures, including the gallbladder, head of pancreas, gastric antrum, proximal duodenum and right kidney. A second, satellite lesion is noted just lateral to the right lobe of the liver, and causes mass effect on the right lobe of the liver. There is associated ascites. The portal veins and the inferior vena cava in its intrahepatic segment appear patent although, there is mild mass effect by the liver mass.
Pancreatoblastoma

There is a large heterogeneous well-defined multiloculated cystic mass with internal enhancing septa commonly located within the head of the pancreas.

No calcifications are seen in this case.
Solid pseudo-papillary tumor

- Large, heterogeneous, lobulated mass that appears arising from the midbody of the pancreas. There is thickening of the adjacent body of the pancreas with central low attenuation. The head and tail of the pancreas appear normal. The mass is taking up much of the LUQ and extending slightly into the RUQ displacing the stomach greater curvature upward and anteriorly. It demonstrates, some heterogeneous enhancement. A feature for a mass is that the fluid component appears to lie at the periphery and the high attenuation material centrally. There is extensive surrounding fat stranding. The adjacent colon (descending and transverse) is thickened and displaced inferiorly. There also appears to be thickening of the adjacent gastric wall. There is trace amount of free fluid within the abdomen and a moderate amount in the pelvis.

- Several sub-cm aorto-caval lymph nodes are seen.
Mucinous cystadenoma

There is a large cystic mass with internal septations arising from the tail of the pancreas. It results in an anterior displacement of the stomach, and posterior displacement of the left kidney. And extends medially to the gastrohepatic ligament. Although the spleen itself appears grossly normal, there are numerous splenic varices and lack of visualization of the splenic vein. These findings are highly suggestive of splenic vein thrombosis. The aorta and its major branches are intact. The stomach and visualized loops of small large bowel are grossly normal. No pathologically enlarged lymph nodes are identified. The aorta and its branches appear widely patent.
Islet cell tumor (Insulinoma)

- There is a mass in the head of the pancreas, densely enhances during the arterial phase. The mass abuts approximately 30 percent of the wall of the SMV. The pancreatic duct and the common bile duct are not adjacent to the mass and are normal in caliber. No other masses in the pancreas are identified. No adenopathy is seen.
Clear cell sarcoma

- There is a primarily solid, heterogeneous, right intrarenal mass involving the mid- to lower pole, that results in obstruction of the upper pole collecting system.
- The mass appears primarily contained within renal cortex with the exception of a single area in the inferolateral aspect where surrounding cortex cannot be definitively demonstrated.
- The delayed images show contrast opacification of the dilated upper pole collecting system, as well as some of the dilated collecting system in the mid-pole region.
Atypical congenital mesoblastic nephroma

- 2-year-old male with hematuria and a solid right renal mass noted on an outside ultrasound.

- There is a large cystic and solid enhancing mass within the right kidney. The mass measures 4.9 cm anterior-posterior by 5.3 cm transverse by 5.7 cm superior-inferior and displaces normal enhancing renal tissue superoposteriorly. No calcification is seen within the mass. The right renal vein and the inferior vena cava enhance normally.

- This case represented a challenge for the pathologists because of its atypical features, clinically and pathologically, but finally was diagnosed CMN.
Within the posteromedial aspect of the left kidney, there is an ovoid, well-defined mass, containing several calcifications. The mass is relatively hypovascular, does not clearly contain any fat, and does not enhance considerably more on the delayed images. There is mass effect on adjacent kidney and collecting system. The mass extends to the peripheral, posterior aspect of the left kidney, but there is no clear extension into the perinephric space. Margins are well defined. There is no clear extension into the left renal vein. No lesions are identified in the contralateral right kidney.
Nephroblastomatosis

The left kidney is enlarged but preserves its reniform shape and it shows multiple hypodense, hypoenhancing, predominantly peripheral masses. There are larger dominant lesions in the upper and lower poles. The largest is in the lower pole. A few smaller hypoenhancing lesions are also present in the mid and upper pole of the right kidney.
Renal cell carcinoma

There is a large heterogeneously enhancing mass within mid to lower lateral aspect of the left kidney. There is significant perirenal and retro-peritoneal inflammatory changes and hemorrhage surrounding the mass and extending inferiorly to the lateroconal fascia bilaterally as well as to Morison's pouch. There is mass effect on celiac axis and the body of the pancreas, displacing them anteromedially. The left renal artery and vein are visualized and are free of abnormalities. An oval-shaped low density lesion seen superior to the left kidney may represent a necrotic lymph node.
Rhabdoid tumor of kidney

- 12-month-old female with history of anemia and lethargy.
- There is a heterogenously enhancing mass involving the upper pole of the left kidney, with extension into the renal hilum. Additionally, there is a very large subcapsular hematoma associated with this mass. No free fluid is seen. The hematoma compresses and distorts the kidney and renal vessels, making assessment for renal vascular tumor invasion difficult. The spleen and stomach are displaced superiorly and the aorta is displaced medially.
6 month old female with Cushing’s syndrome.

Axial unenhanced CT images at the level of the adrenal glands show bilateral, rounded, well circumscribed soft tissue densities. relatively well-circumscribed, heterogeneously enhancing masses.

Pathology reported bilateral adrenocortical carcinoma.
Gastrointestinal Stromal Tumor

- The patient is 8-year-old girl with history of gastrointestinal bleeding.
- There is a heterogenous mass located just posterior to the lesser curvature of the stomach and anterior to the pancreas. Some portion of this mass demonstrates low attenuation, which may represent necrosis. Mild contrast enhancement is noted in the remaining mass. This large mass abuts the pancreatic body and displaces posteriorly.
Intestinal lymphoma

12-year-old boy with prior history of gastrointestinal lymphoma. The patient is now presenting with abdominal pain and bloody stools.

Intussusception involving a several centimeter segment of the distal most ileum is noted. Both intussusceptum and intussuscipiens appears to be mildly thickened. In addition, there may be a small soft tissue mass measuring 1.5 cm located between the intussusceptum and intussuscipiens. There is an ill-defined low density filling defect within the contrast filled ascending colon adjacent to the radiopaque surgical sutures at the site of the ileocolic anastomosis. There is no evidence of bowel obstruction as oral contrast is identified within the distal portions of the colon. No surrounding inflammatory changes are present. There are several subcentimeter lymph nodes in the right lower quadrant near the intussusception without evidence of lymphadenopathy. Trace amount of free fluid seen within the right lower abdomen.
16-year-old boy with history of abdominal pain and vomiting, now being worked up for possible abdominal mass.

Large intraluminal/intramural mass within the ascending colon. The mass appears encapsulated and either submucosal or intramural in location, with disruption of the capsule seen at the lateral aspect of the colon with associated hemoperitoneum. There was minimal enhancement of this mass after the administration of intravenous contrast. The terminal ileum is distended from partial obstruction. There is a 7 mm hypodensity at the tail of the pancreas likely small cyst. There is no evidence of significant lymphadenopathy. There is large amount of the hyperdense fluid in the pelvis likely hemoperitoneum. The rectum is filled with contrast and air and appears unremarkable.
There is a well-defined, soft tissue density in the region of the antrum of the stomach, with areas of high density within it, and some degree of peripheral enhancement. This does not appear to arise from the liver parenchyma. This may be gastric or mesenteric in origin. There are also areas of low attenuation within this. There are other areas of high density located within the region of the splenic hilum. There is also significant soft tissue component to this. This likely represents a second site of involvement.
Pelvic metastasis of gastrointestinal stromal tumor

- Immediately inferior to the stomach, there is a multilobulated soft tissue density which probably represents decompressed bowel loops. The opacified loops of bowel are within normal limits. There is no free air or ascites. There is no retroperitoneal or mesenteric lymphadenopathy.

- There is an irregular, multilobulated tumor mass interposed between the left side of the uterus and the anterior rectum. In addition, there are two other nodules present within this region and the ovaries are not clearly identified.

- A fluid density lesion is present adjacent to the left side of the uterus and may represent a left ovarian cyst.
There are multiple soft tissue nodules located anterior to the dome of the liver a second one periportal and a third mass is also noted in the region of the Morison's pouch. There is soft tissue mass located anterior to the spleen and in the region of the falciform ligament. There is a heterogenous soft tissue mass located anterior to the cecum in the right lower quadrant and multiple soft tissue nodules within the lower pelvis is seen.

Free fluid in the pelvis is noted. Diffuse wall thickening involving the entire colon with lesser involvement of descending colon is seen. The visualized portions of small bowel are normal without evidence of small bowel obstruction. Mild dilatation of common bile duct is noted. VP-shunt catheter with its tip located within the left lower quadrant is noted.

Check the lesion at the level of the pineal gland.
14-year-old girl with metastatic melanoma with abdominal pain and constipation.

Within the mesentery of the mid abdomen, there is a mass containing three dominant lobulations. The more posterior component, adjacent to and slightly compressing the IVC. There is an ill-defined soft tissue density within the right lower quadrant of the abdomen and appears to represent markedly thickened bowel secondary to tumor infiltration. There are numerous small mesenteric lymph nodes. No free fluid or free air.
Mesenteric plexiform neurofibroma

- 9 year old girl with history of large mesenteric plexiform neurofibroma.
- The entire mesentery is extensively infiltrated by a homogeneous and low-attenuation mass that encases and stretches all of the mesenteric vessels. There appears to be displacement and compression of most of the large and small bowel to the periphery as defined by the opacified loops. The ascending colon is clearly infiltrated by the tumor with concentric bowel wall thickening over a continuous segment. A similar more proximal bowel loop with thickened walls is seen in the left lower quadrant adjacent to the lateral peritoneal wall. The low-attenuation lesion extends along the periportal regions, and there is apparent thickening of the gallbladder wall. There is also retrocrural extension encasing the aorta superiorly and only minimal retroperitoneal involvement.
Abdominal lymphoma

- Additionally, several low density areas are seen within the head, body and tail of the pancreas, likely representing metastatic disease.
- The liver, spleen and adrenal glands are normal. The kidneys enhance normally. Bilateral hydroureteronephrosis is present with dilation of the ureters to the level of a large pelvic mass. The jejunum demonstrates focal low density thickening of the wall.
- A 14.8 cm transverse x 9.6 cm AP x 19.5 cm soft tissue mass is identified within the midline of the lower abdomen and pelvis. Two large vessels are seen within the mass, fed from the branches of the left internal iliac artery. Multiple other vessels are seen within the mass.

Back to case
16-year-old boy with left upper quadrant mass.

There is an encapsulated mass in the left upper quadrant. The mass appears to arise from the tail of the pancreas and displaces the stomach medially and anteriorly. At the lower aspect of the mass, the capsule appears to be disrupted and there is mixed density material within the lesser sac. The mass is heterogeneous with cystic and solid appearing areas.

Free fluid is present within the abdomen and pelvis. The fluid in the more dependent portions of the pelvis is of higher density than the anterior portion, which suggests a hematocrit effect.
Axial and coronal enhanced CT images show a very large soft tissue epigastic mass. This mass has a nice peripheral hypervascular, hyperenhancing rim, and internal low attenuation, of non-vascular area representing cystic degeneration.
5 year-old girl with a 9 cm pelvic mass, vaginal spotting, and breast development.

There is breast tissue bilaterally. There is a 2.5 mm nodule in the right lower lobe just posterior to the major fissure.

There is a heterogeneous midline pelvic soft tissue mass containing areas of low attenuation likely representing necrosis. There are prominent veins in the right lower quadrant. There is ascites in both lower quadrants. The endometrium is hypertrophied. The bladder is normal. There is no abdominal or pelvic lymphadenopathy.
Ovarian fibroma

- Patient with a large pelvic mass and sacral agenesis.
- A large, heterogeneous mass that is arising from the right pelvis and filling most of the abdominal cavity, displacing the abdominal organs and structures and appears to arise from the right adnexa. Just anterior to the abdominal portion of the mass is a nodular appearance of the peritoneal fat with adjacent stranding. Modest amount of ascites is identified. No abnormal pelvic or inguinal lymph nodes are identified. The inferior vena cava is significantly compressed and difficult to visualize. The right internal iliac artery caliber is slightly enlarged, and the right ovarian neoplasm appears to be predominantly supplied by the right gonadal and uterine arteries, which are enlarged. Both external iliac arteries appear normal. Bony abnormalities consistent with sacral agenesis.
There is a large heterogeneous pelvic mass measuring Very large vessels originate from the left renal hilum, surround and feed the mass laterally and anteriorly. The uterus is pushed anteriorly by the mass. The ovaries are no seen in this study. There appears to be a cyst in the right anterior abdomen separate from the mass. There is a moderate amount of ascites.
Bladder rhabdomyosarcoma

- This is an 8-year-old girl with intermittent abdominal pain and a notable suprapubic abdominal mass.
- A large heterogeneously enhancing mass is noted centered in the pelvis and extending into the abdomen. It measures 10 x 10.5 x 7 cm. The bowel is displaced but there is no obstruction. There are multiple enlarged nodes in the mesentery. The mass also compresses the distal right ureter causing hydronephrosis. The left kidney appears normal. There is no free fluid. The ovaries are difficult to distinguish in this study. The liver is homogeneous with no focal mass or metastasis seen in the liver. The spleen is normal. The visualized lung bases are clear. There is no evidence of any focal lesion in the lung seen to suggest lung metastases in the visualized portion.