

Neonatal and pediatric ultrasonography- part I

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Introduction

Small animal patients are commonly presented to the veterinarian because of signs referable to the abdominal cavity due to congenital anomalies, dietary indiscretion, parasitic infestation and infectious or inflammatory disease. Abdominal ultrasound provides valuable clinical information about the peritoneal cavity, great vessels, abdominal viscera and lymph nodes obtained in a non invasive fashion, with no confirmed adverse biologic effects, and usually not necessitating sedation or anesthesia. This paper reviews the techniques for performing the pediatric abdominal ultrasound scan.

Abdominal ultrasound provides useful data in a short period of time. The normal paucity of intra-abdominal fat in pediatric patients results in less informative abdominal radiography, but actually improves ultrasonographic imaging. (Abdominal fat attenuates the ultrasound beam.)¹ Image quality is improved with small patient size as a higher frequency scanhead can be employed. Acquisition of special equipment for pediatric ultrasonography is usually not necessary as scanheads selected for small animal (especially feline) clinical use are appropriate for most pediatric cases.

Small animal patients are best evaluated using an ultrasound machine equipped with a curvilinear variable frequency scanhead (6.0-8.0 MHz). Many portable machines

now have available a high frequency linear scanhead (8.0 -10.0 MHz) which will improve quality and also allow evaluation of smaller regional anatomy (thyroid, parathyroid, cryptorchid testes).²

Keywords: Ultrasound, pediatric, abdominal, neonatal

Preparation

The small animal patient is placed in dorsal recumbency within a padded V-trough, and is gently restrained by assistant(s) holding the forelimbs and hindlimbs. Sedation is rarely required for the basic abdominal scan unless marked pain or apprehension is present. Allowing the patient to become accustomed to this restraint before clipping the hair or initiating the scanning process usually minimizes struggling and the resulting aerophagia.³

To prepare the pediatric patient for abdominal ultrasonography, the cranioventral abdominal hair is clipped using a No. 40 blade. Wetting the skin with water, tincture of zephiran or 70% isopropyl alcohol, followed by a liberal application of ultrasound gel, permits the best acoustic coupling of the scanhead to the patient and improves the image obtained. Some pediatric patients have scant ventral haircoats that do not require clipping. Care should be taken to avoid excessive chilling of pediatric patients. Chilling can occur secondary to the application and evaporation of room-temperature wetting agents. Electric warming devices (warm water blankets) may cause electronic interference with the ultrasound equipment; warm water bottles or their equivalent are superior.¹

Patient preparation includes fasting as much as is safely possible given the animal's age and size. Fasting minimizes obscurement of the liver imaging by gastric

ingesta and of other abdominal viscera by gastrointestinal gas accumulation. Preventing urination immediately prior to the examination allows urine to accumulate within the urinary bladder lumen and permits better evaluation of this structure.⁴

Serial evaluations can provide useful information when the clinical status of the small animal patient has changed. Indications for serial ultrasonographic evaluation include clinicopathologic deterioration, progressive lethargy or obtundation, acute pain, changes in abdominal palpation findings and refractory vomiting or diarrhea. All warrant repeat evaluation for signs indicating the development of intussusception, perforation and/or peritonitis.

The normal abdomen

Regardless of the clinical history, the abdomen should be evaluated methodically with the animal in dorsal decumbency. Realize the sector image you are looking at on the monitor screen is perpendicular to that ultrasound beam. You are viewing the sagittal image from the side of the animal and the transverse image from the rear of the animal. (fig 1a-c, fig 2a-c).¹

Place the scanhead under the xyphoid with the beam in sagittal plane. Visualization of the liver is achieved by fanning the beam from right to left. The gall bladder is seen on the right; the left liver lobes are seen ventral and sometimes caudal to the stomach. Turning the beam to transverse allows for visualization of the liver between stomach and gall bladder. This view is useful for evaluation of the hepatic border, echogenicity of hepatic parenchyma and portal architecture. The portal vessels have very echogenic walls.⁵ (fig 3)

Resuming the sagittal plane, scan to the left of the dog past the stomach to the spleen. The spleen will be visualized ventrally in the near field. Splenic border, parenchyma and shape should be evaluated.⁶ (fig 4) Following the spleen transversely down the left body wall, you will image the left kidney. (fig 5)

Once visualization of the kidney is achieved, turn the transducer to the sagittal plane and evaluate the renal border, cortical echogenicity and pelvic architecture. Dilatation of the renal pelvis is best seen in the transverse plane. Normal ureters are not usually visible ultrasonographically.^{1,7} The left adrenal gland is located medial to the cranial pole of the kidney. In a sagittal plane, maintaining strong hand pressure, scan medially to visualize the linear aorta and the renal artery. The left adrenal is located cranial to the left renal artery and caudal to the left cranial mesenteric artery. The left adrenal gland is imaged as a bi-lobed structure with the phrenicoabdominal vein at its waist.¹ (fig 6)

With the transducer in a transverse plane in the midabdomen, scan caudally to image a large hypoechoic structure, the urinary bladder. Evaluate bladder wall and lumen contents, and, dorsal to the bladder, the major vessels (caudal vena cava and aorta). Sublumbar lymph nodes will be seen at the aortic bifurcation into the iliac arteries, adjacent to the bladder wall. (fig 7) Sagittal scanning of the urinary bladder caudally will allow visualization of the urethra (and prostate in the male).⁴ (fig 8)

Continuing in methodic fashion, the right kidney will be imaged at the edge of the right ribcage adjacent to the renal fossa of the liver. The right kidney should be evaluated as was the left with respect to renal border, cortical echogenicity and pelvic architecture. By scanning sagittally between the right kidney and the caudal vena cava with a fanning

technique, the right adrenal gland is visualized just lateral to the caudal vena cava. In a transverse plane, the duodenum is imaged lateral to the right kidney.¹ (fig 9)

At the cranial end of the right kidney medial to the duodenum will be the right limb of the pancreas. The right pancreatic limb is identified by visualizing the caudal pancreaticoduodenal vein within the structure. (fig 10) Turning to the sagittal plane, follow the pancreas, scanning medially to the angle of the body and left limb, or sagittally scan the caudal border of the stomach. The pancreatic body is seen caudal to the stomach, cranial to the splenic vein. The left pancreatic limb is found caudal to the splenic vein and midline to the cranial pole of the left kidney.⁵ (fig 11)

Returning to the transverse plane in midabdomen at the mesenteric root, scan for mesenteric lymph nodes and small bowel wall changes. Scanning in a uniform serpentine fashion, 2-3 passes may be required to evaluate the entire bowel. Normally, the small bowel appears sonographically as four distinct layers. (fig 12, 13) The bowel lumen is hyperechoic, as gas and ingesta are compressed. The layer just outside the lumen is the mucosa; it is hypoechoic and normally the thickest appearing section. Outside the mucosa is the submucosa, it is hyperechoic to the mucosa and about one third the thickness. The muscularis, the bowel muscle layer, is outside of the submucosa and appears as a very thin hypoechoic black line. The outermost serosal layer is hyperechoic.¹ (fig 14)

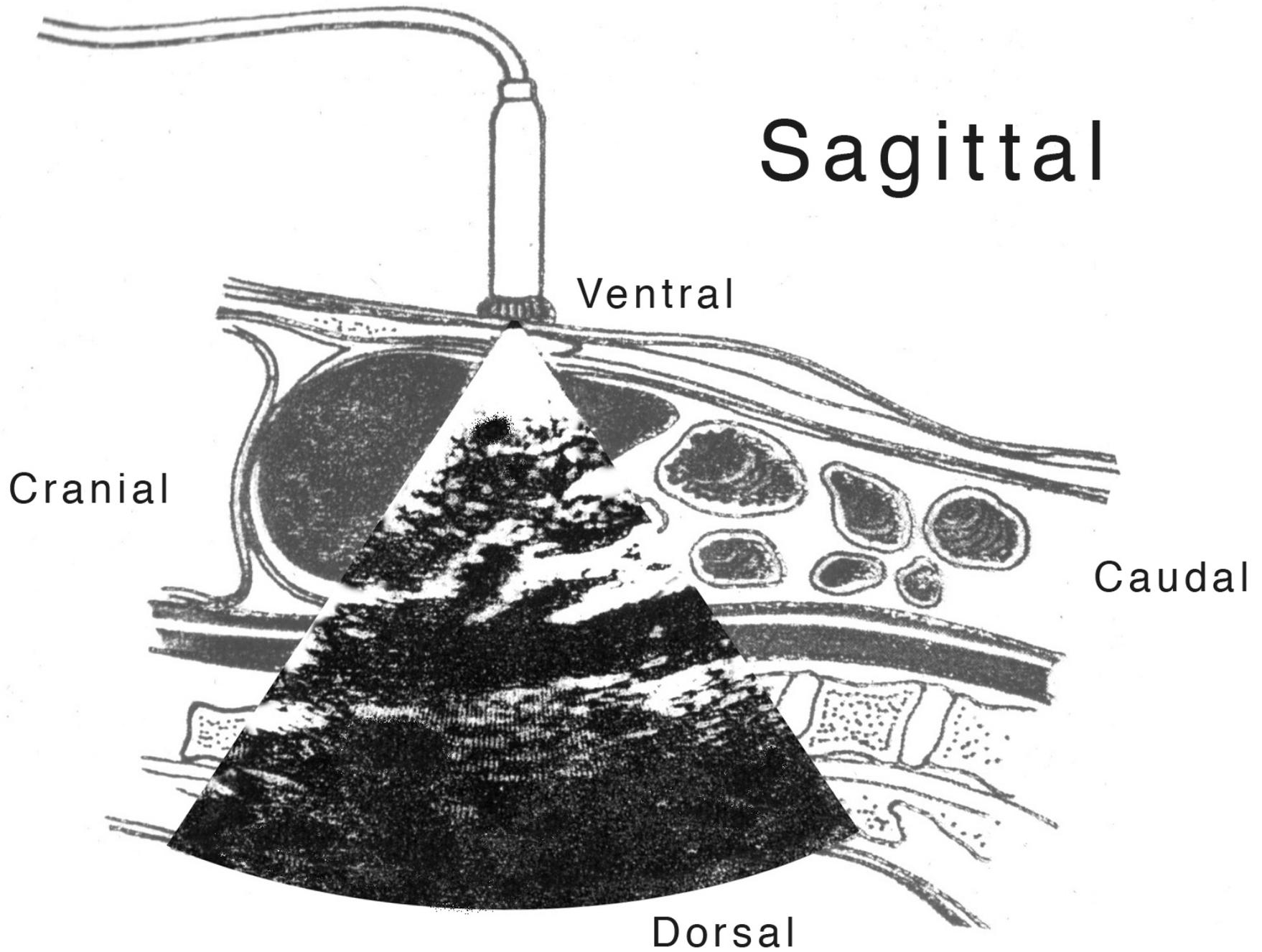
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Sagittal



L I V E R

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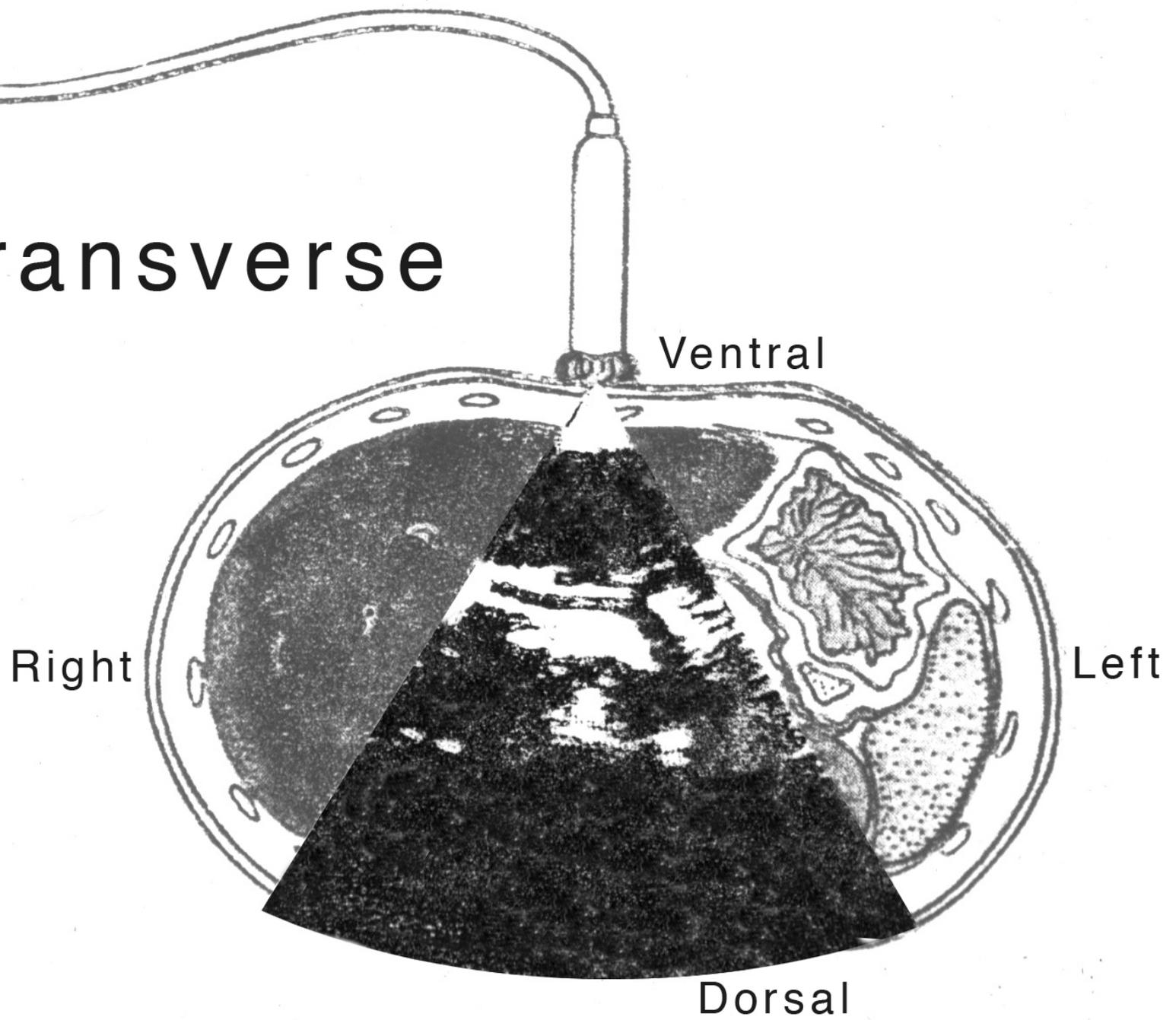
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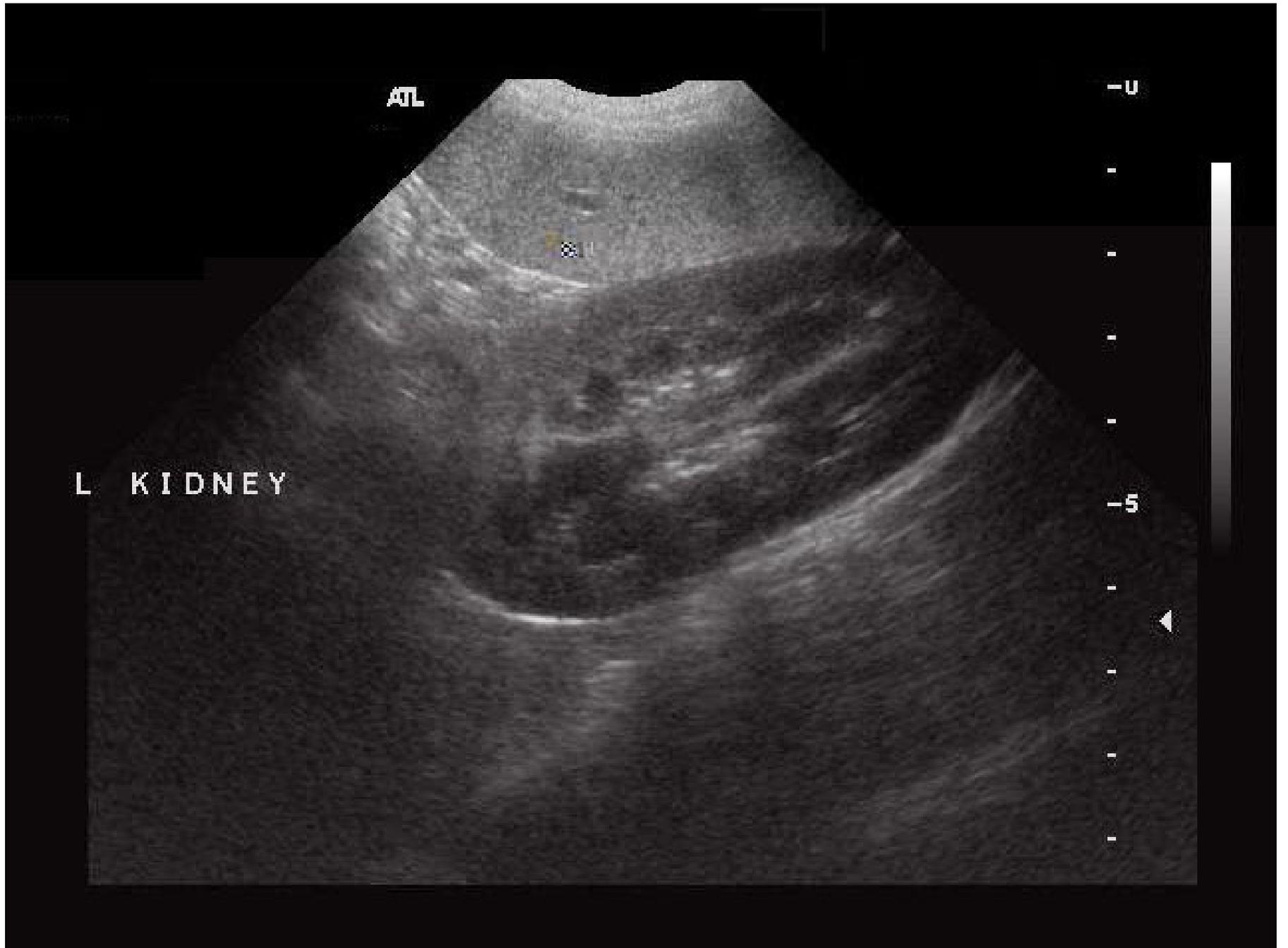
Transverse

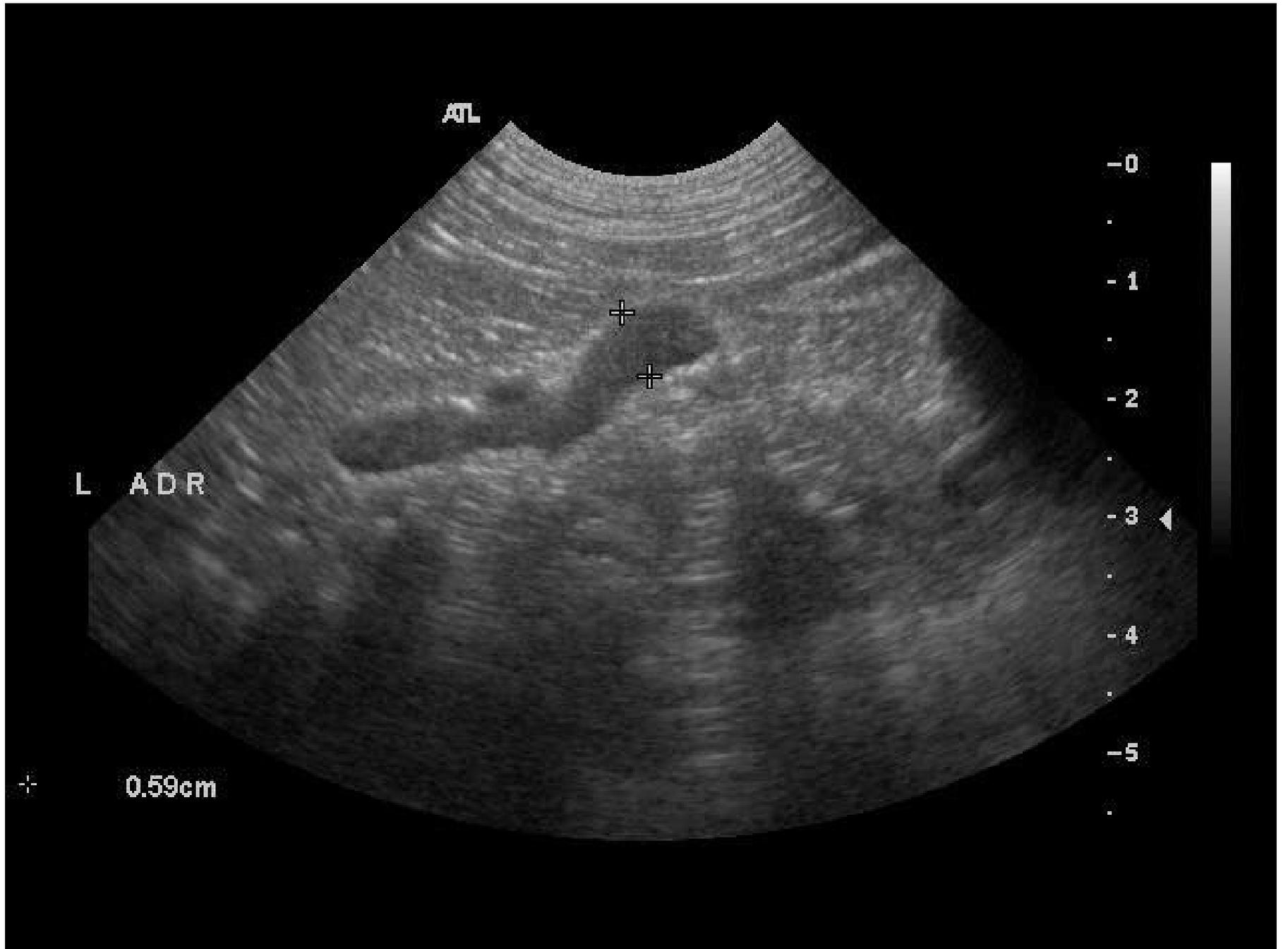














SAGITTAL

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