CHAPTER 9

General discussion
Portosystemic shunting occurs when anomalous veins allow the portal blood, which carries toxin-rich blood from the guts, to enter the systemic veins directly without first flowing through the hepatic sinusoids. Portosystemic shunting can occur via acquired portosystemic collaterals or via congenital portosystemic shunts and may result in clinical signs of hepatic encephalopathy due to high blood ammonia levels.

**Preoperative ultrasonography**

It is necessary to differentiate congenital portosystemic shunts non-invasively from other conditions that cause hyperammonemia, such as acquired portosystemic collaterals and urea cycle enzyme deficiency, since congenital portosystemic shunts require surgical treatment while the other conditions do not. Portography, ultrasonography, scintigraphy, computed tomography, and magnetic resonance imaging have been used to diagnose portal vein disorders. Although Doppler ultrasonography is the only technique that does not require the use of anesthesia, and can provide detailed anatomic as well as hemodynamic information about the abdominal vasculature, its accuracy in detecting congenital portosystemic shunts was reported to be insufficient.

In the present studies, real time two-dimensional gray scale ultrasonography combined with color Doppler mode appeared to be an accurate method to: (1) diagnose a congenital portosystemic shunt, (2) specify its type, (3) distinguish it from acquired portosystemic collaterals and (4) rule it out. Four elements are needed to be able to reach a high diagnostic accuracy. The first two, experience and a high quality ultrasound system, are a question of time and money, respectively. However, the other two points, the knowledge of the examination protocol and of the ultrasound anatomy of the abdominal vessels and portal vein anomalies, can be learned from this booklet. Once sonographers know what they are looking for and how they can find it, they will find it. As a result of our studies, dogs with hyperammonemia do not have to undergo a diagnostic laparotomy. Furthermore, ultrasonographic examinations are quick and can be performed on unsedated animals without the use of ionizing radiation.

**Intraoperative ultrasonography**

The definitive therapy for congenital portosystemic shunts would ideally be complete occlusion of the shunt at a location closest to the systemic venous circulation. However, in most dogs, only partial shunt ligation can be performed because attenuating the shunt vessel forces blood to flow through the portal branches that are frequently hypoplastic, which results in post-ligation portal hypertension. Acute portal hypertension can usually be successfully avoided, though development of chronic portal hypertension remains a frequent complication.

Regardless of the technique used for shunt attenuation and for assessing post-ligation portal hypertension, the clinical outcome remains unpredictable. This is largely because there is no method currently available to determine the optimal degree of shunt narrowing.

Most surgeons aim to narrow a congenital portosystemic shunt as narrow as possible. However, as a consequence of an exaggerated closure, dogs may develop postoperative complications related to acute or chronic portal hypertension.
To help avoid this problem, intraoperative ultrasonography greatly increases the likelihood of determining the optimal shunt diameter. Congenital extrahepatic portosystemic shunts do not have to, and actually should not, be completely occluded. Once the flow becomes hepatopetal in the entire portal vein and in the shunt adjacent to the portal vein, further narrowing of the shunt is unnecessary, and would increase the chance for development of portal hypertension.

Surgical ligation of an intrahepatic portocaval shunt is challenging because the anomalous vessel is hidden in the liver lobes. We have shown that intraoperative ultrasonography helps the surgeon to select the optimal point for dissection of the liver and ligation of the shunt.

Postoperative ultrasonography

Complete occlusion of a congenital extrahepatic portosystemic shunt has been suggested to result in a better clinical outcome compared to partial ligation.\textsuperscript{4,14,19,25-27} However, other surgeons have not been able to confirm this finding.\textsuperscript{11,17,18,28,29} It has been suggested that, if complete shunt-occlusion is not feasible, a second surgery should be performed to attempt a complete shunt-occlusion.\textsuperscript{4,19} Partial attenuation of a congenital portosystemic shunt is believed to result in a less favorable outcome than a complete occlusion. Therefore, several surgeons propose that a second surgery should be performed in every dog whose shunt has partially been attenuated in order to occlude their shunt completely.

We have shown that dogs that underwent a partial ligation of a congenital portosystemic shunt do not have to be routinely re-operated on. Color Doppler ultrasonography performed at least one month after surgical ligation of a shunt can reveal whether a persisting hyperammonemia is the result is of a functional shunt, acquired portosystemic collaterals, or both. Dogs that have developed acquired portosystemic collaterals should not be re-operated because they already suffer from portal hypertension. Dogs, whose extrahepatic portosystemic shunt was partially ligated and the flow direction in the entire portal vein and in the shunt adjacent to the portal vein became hepatopetal, should not be re-operated on. This is because their shunt is not functional (though it is patent) and their blood ammonia levels are within the normal reference range.

References
