OPEN RESECTION OF LIVER TUMOURS
D.J. Brockman, BVSc, CVR, CSAO, DACVS, DECVS, MRCVS
Department of Small Animal Medicine & Surgery, The Royal Veterinary College University of
London, Hawkshead Lane, North Mymms, Hatfield, Herts

Hepatic Anatomy:
Lobes: 6 lobes, 3 major divisions
  Left division - Left lateral and medial lobes
  Central division - quadrate and right medial lobes
  Right division - right lateral and caudate lobes
Parenchyma is continuous near hilus. The right division surrounds the caudal vena cava.

Ligaments:
Liver is fixed to diaphragm by right and left triangular ligaments. Hepatorenal ligament
attaches right kidney to caudate lobe. Gastrohepatic and gastroduodenal ligaments form
the lesser omentum.

Blood supply:
Hepatic artery
supplies 20-25% of blood flow to liver; comes from coeliac artery and enters free margin
of hepatoduodenal ligament at antimesenteric border of duodenum. Branches supply
right, then left, and finally middle division, and then continues as gastroduodenal artery.
(cat usually has 3 branches)

Portal vein
supplies 75-80% of blood flow to liver; collects blood from intestines, pancreas, spleen,
and stomach; near hilus of liver divides into right branch to the right division and into a
larger left branch to the central and left divisions.

Major hepatic veins
drain in the caudal vena cava (cvc); entry points into c.v.c. form a spiral around the c.v.c.
Left division - single vein which receives individual veins from left lateral and medial
lobes
Central division - vein from quadrate lobe and left border of right medial lobes, single
vein from right medial lobe
Right division - caudate vein and right lateral vein enter right side vena cava either via a
common trunk or independently.

PHYSIOLOGY OF THE LIVER (Relevant to Surgical Intervention)
70% of the liver can be removed before signs of liver disease occur. The liver has tremendous
capacity for regeneration.
1. Metabolism of nutrients - major site for glycogen storage - monitor glucose levels. only
  site of albumin production - hypoproteinemia can affect wound healing, drug
  metabolism, circulatory volume, etc.
2. Blood coagulation factors - I, II, V, VII, VIII, IX, X, XI, XII synthesized in the liver,
  short half life (24 hours in man).
  Vitamin K stored in the liver - jaundiced animals may have reduced bile salt excretion,
  resulting in a deficiency of the fat soluble vitamins - check coagulation (prothrombin
time (PT) may be elevated if vitamin k is low).
3. **Detoxification** - major site for metabolism and inactivation of endogenous and exogenous compounds eg. anesthetics - consider drugs that are the least hepatotoxic eg. narcotics can be reversed, gaseous anesthetics can be excreted through the lungs.

4. **Phagocytosis\immune reactions** - portal blood in the dog is septic - the liver normally contains Clostridia and coliforms tissue damage resulting in hypoxia can cause proliferation - antibiotics may be necessary, use Penicillin and Aminoglycosides.

**NEOPLASIA**

Secondary (metastatic) neoplasia is more common than primary neoplastic disease (which represents approximately 1% all hepatic neoplasia). Metastatic disease is usually generalized and therefore not amenable to surgery. Occasionally, primary hepatic neoplasia is confined to one or two lobes and surgery should be considered for such patients. Tumour types include:

- Hepatocellular carcinoma 50%
- Cholangiocarcinoma (bile duct) 25%
- Carcinoids (neuroectoderm) 15%
- Sarcoma
- Hepatocellular adenoma
- Cholangiolar adenoma
- Fibroma
- Hemangioma
- Nodular hyperplasia

**CLINICAL FEATURES**

Clinical features of hepatic neoplasia can include the following:

- Anorexia and weight loss
- Ascites
- Weakness and collapse
- Hypoglycaemia (Hepatocellular adenoma and adenocarcinoma)
- Hypercalcaemia (lymphoma)

However, occasionally an abdominal mass is identified as an incidental finding during routine physical examination.

**DIAGNOSIS**

Radiography, ultrasound, CT and MRI all have potential roles in the anatomical diagnosis and radiography or CT are necessary to evaluate the thorax for metastatic involvement. Ultrasound guided aspirates or tru cut biopsies or surgical biopsy are needed for a definitive diagnosis.

**DECISION MAKING**:

Complete excision of a benign hepatic tumour is curative. Excision of even massive solitary hepatocellular carcinoma is associated with long survival time if “clean” surgical margins are achieved and also has the potential to be curative. An extended good quality life can also be attained even if surgical margins are “dirty”. Whether complete excision of all tumour is feasible depends on the liver lobe involved and whether transcoelomic spread has occurred.
(which may not be easy to determine even with modern diagnostic techniques). Despite advances in diagnostic imaging allowing better identification and localization of neoplasms, the author has resected hepatic masses that were deemed to be non resectable on the basis of the preoperative imaging; so a final assessment at exploratory coeliotomy is often the only way to determine whether a mass in the liver can be resected or not.

**SURGICAL TECHNIQUES**

Ultrasound and harmonic scalpel/dissectors have joined the traditional finger fracture and suction tip assisted dissections, to make liver dissection more safe. In addition, vessel sealing devices and stapling devices further add to the options for safe dissection and excision of hepatic tissue. Detailed description of the hepatic lobar anatomy and hilar dissection techniques to remove liver lobes was provided by Covey and others in 2009. A comparison of five different techniques for partial lobectomy was reported by Risselada and others (2010) describing different combinations of the previously mentioned devices. The main conclusion of these is that there are several safe techniques to remove part or all of the liver lobes or divisions but the passage of the caudal vena cava through the right division makes this division the most difficult to resect.

2. **Partial Lobectomy**

   The "finger fracture" technique, suction tip skeletonisation, ultrasound dissection, can be used. The parenchyma is separated and the vessels and ducts are ligated, stapled or sealed, as they are encountered. Alternately, interlocking sutures can be placed near the area for excision. They are pulled tight to cut through liver parenchyma and ligate vessels and ducts.

3. **Lobectomy**

   It may be necessary to incise the cartilaginous portion of the xiphoid for exposure. If further exposure is needed, transverse paracostal incision and/or diaphragmatic incision towards the postcaval foramen is made. The triangular ligaments to the diaphragm are severed. Laparotomy sponges can be packed between the diaphragm and the liver to displace the liver more caudally. Only branches of the portal vein, hepatic artery, and bile ducts to the particular lobe are ligated. Stapling devices make this act more straightforward for most lobes. The left division lobes are pedunculated and are easier to remove than are the right lobes which are closely associated with the c.v.c. It may be necessary to reflect the hepatic parenchyma from the c.v.c., identify the veins and ligate or oversew the short and broad hepatic veins from the central and right divisions. It may be helpful to pre-place umbilical tapes around the caudal cava in front of and behind the liver, the portal vein before it enters the liver, and the celiac and cranial mesenteric arteries. If hemorrhage becomes uncontrollable, the tapes can be used temporarily to occlude blood flow to the liver while haemostasis is restored.

   In young dogs after lobectomy, regeneration begins with 24 hours and peaks in 3 days. There is compensatory hypertrophy and hyperplasia of the remaining hepatocytes. After 70% heptectomy the weight of the liver approaches or exceeds the preheptectomy weight by 6th week. The degree of the post operative hypoglycaemia depends on the amount of liver removed. Postoperative glucose supplementation may be necessary. There may be a decrease in the albumin for 2-3 weeks. Nutrition should be resumed by an early resumption of a normal diet or
with enteral alimentation. Bilirubin and SAP levels may be elevated but should return to normal within a week. Persistently elevated levels suggest obstruction of the hepatic duct or inflammation.

