ALTERNATE APPROACHES TO ADRENAL SURGERY
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Key Points:
- A paracostal approach allows excellent visualization of the adrenal glands, especially on the right side. This approach may be most useful in right side adrenalectomies, especially in larger dogs.
- In select cases, partial adrenalectomy is an option to preserve adrenal function post-operatively. Minimally disruption of the adrenal remnant is important to prevent damage to the remaining blood supply.

Background
Adrenalectomy in dogs is routinely performed and several recent studies documented risk factors and survival. Massari et al (JAVMA 2011) evaluated risk factors for survival in 52 dogs undergoing adrenalectomy. The authors found dogs with adrenal cortical carcinomas, adrenal tumors \( \geq 5 \) cm, dogs with documented metastasis, venous thrombosis, and those requiring additional abdominal interventions had reduced survival times. Another study by Schwartz et al (JAVMA 2008) investigated 41 dogs undergoing adrenalectomy. In that study 22% of dogs did not survive until discharge and about 5% died intra-operatively. Overall median survival was 690 days. The authors found that dogs with preoperative weakness or lethargy, thrombocytopenia, increased BUN concentration, increased partial thromboplastin time, increased AST, hypokalemia, intraoperative hemorrhage, and concurrent nephrectomy had reduced survival times. Additionally, dogs with pancreatitis or renal failure post-operatively did worse. When evaluated with multivariate analysis preoperative hypokalemia, preoperative increased BUN concentration, and concurrent nephrectomy were significantly associated with a shorter survival time. Kyles et al (JAVMA 2003) investigated whether dogs with caval thrombi had a worse prognosis. Those authors evaluated 40 dogs, of which 25% had caval thrombi. In that study, the overall mortality was 22% and was not influenced by the presence of a thrombus. Finally, Herrera et al (JAVM 2008) evaluated the influence of preoperative treatment with phenoxybenzamine in dogs with pheochromocytomas. The authors found that in dogs pretreated with phenoxybenzamine had a mortality rate of 13% compared with non-pretreated dogs, which had a mortality rate of 48%. The authors also found younger age, lack of intraoperative arrhythmias, and decreased surgical time had a significant positive effect on survival. The effect of pretreatment of dogs with functional adrenocortical tumors with adreno-toxic drugs like mitotane is unknown.

Most commonly right or left adrenalectomies are performed through a ventral midline incision. The advantages of this approach include the ability to fully explore the abdomen for other disease, the ease of exposing the left adrenal gland, and the relatively atraumatic approach as compared to a paracostal approach. There is also a benefit in routine; this is our most common approach to the abdomen and it is what we are accustomed to doing. The disadvantage of a ventral midline approach is that the adrenal glands are retroperitoneal structures located on the dorsal aspect of the abdomen, which can make exposure of the adrenal glands, most
obviously on the right side, difficult. This exposure is especially difficult in large and obese dogs or when an adequate number or adequately trained surgical assistants are not available.

Paracostal Approach

The paracostal approach is an alternate approach which allows for better exposure of the adrenal glands in some situations. This approach is not the answer for all adrenalectomies and should not replace the ventral midline approach for all patients. Dogs are positioned in lateral recumbency and an incision is made through the skin just caudal to the last rib. Dorsally, the incision turns cranial into the 12-13 intercostal space to allow exposure of the cranial abdomen. The approach crosses the abdominal wall and dorsally requires the diaphragm to be removed from its attachment on the body wall. Because of this, intraoperative mechanical ventilation is required when using this approach. A retractor is used to maintain exposure. Exposure of the adrenal glands, especially on the right side is dramatically improved as compared to a ventral midline approach. Also the dorsal aspect of the vena cava is readily visible and the adherent adrenal can be safely removed or a cavotomy can more easily be performed. Closure is routine as muscles are reapposed followed by subcutaneous tissue and skin. We commonly place a wound soaker catheter in the muscle layers to augment post-operative analgesia.

Partial Adrenalectomy

Generally veterinary surgeons tend to completely remove a diseased adrenal gland. For most situations this is probably the best strategy to reduce the risk of leaving tumor cells behind and because frequently adrenal tumors efface the entire adrenal gland. However, in some situations, such as dogs with bilateral adrenal disease, dogs with a history of a contralateral adrenalectomy, or dogs with a small polar adrenal mass, a partial adrenalectomy may be a better option. The advantage of a partial adrenalectomy in these situations is the requirement for lifelong medical management of iatrogenic hypoadrenocorticism is avoided.

Partial adrenalectomy is possible due to the abundant collateral blood supply of the adrenal gland. Dogs have 20 to 30 arterioles supplying and approaching the adrenal gland from all surfaces. These arterioles arise from the aorta, renal, and phrenicoabdominal arteries. The venous drainage of the adrenal gland is mainly through the phrenicoabdominal vein, but also capsular veins provide some venous drainage. We have experience removing cranial aspect of the adrenal gland including the phrenicoabdominal vein in a dog with a history of a contralateral adrenalectomy, and that dog had adequate adrenal function documented post-operatively. Importantly, excessive mobilization of the adrenal remnant should be avoided to prevent disruption of the remaining blood supply. In people it is recommended to leave a minimum of 25% of the adrenal gland for adequate function.