Post Mortal Approach to the Endocrine System

System examination

Gross examination of the endocrine glands entails evaluation for hyperplasia, atrophy, neoplasia, cysts, hemorrhage, necrosis, pigmentation and possible amyloidosis. Much of the diagnostic pathology of the endocrine glands relies heavily on histopathology. The various glands constituting the endocrine system are extremely sensitive to early autolysis, warranting that samples be collected into 10% buffered formalin as soon as possible after death. Post mortal artefacts set in within the hour post mortally.

Pituitary Gland

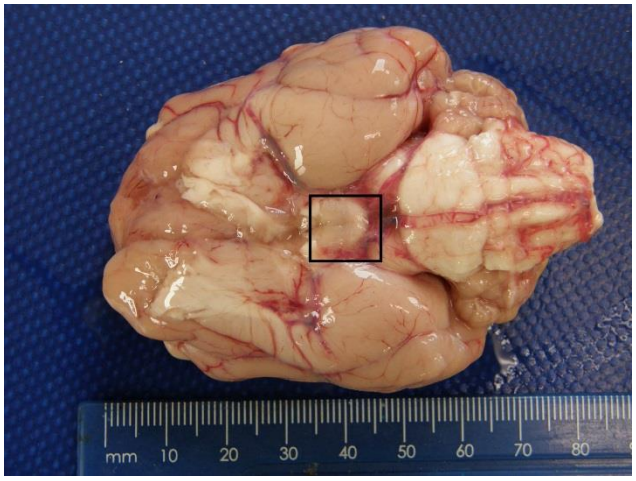

Figure 1

This gland is situated in a depression (sella turcica) of the spheroid bone of the skull, in the area of the optic chiasma (figure 1). It is subdivided into an anterior lobe (adenohypophysis) and a posterior lobe (neurohypophysis). On removal of the gland gross examination should be carried out for the following.

- Cysts: depending on the location of cysts, they may have varying endocrine effects, due to compression and destruction of different types of endocrine cells.
- Neoplasms: functional tumors induce effects in target organs, whereas both functional and non-functional tumors can induce various clinical signs through the local effects of compression and destruction of adjacent tissue.
- Pituitary abscesses: this is most common in ruminants and particularly males, and is believed to be due to fighting.
- Amyloid deposition: can be seen in chronic infectious conditions with deposition of AA type amyloid.

Histological examination is essential for the classification of type of pathology involved.

Parathyroid Glands

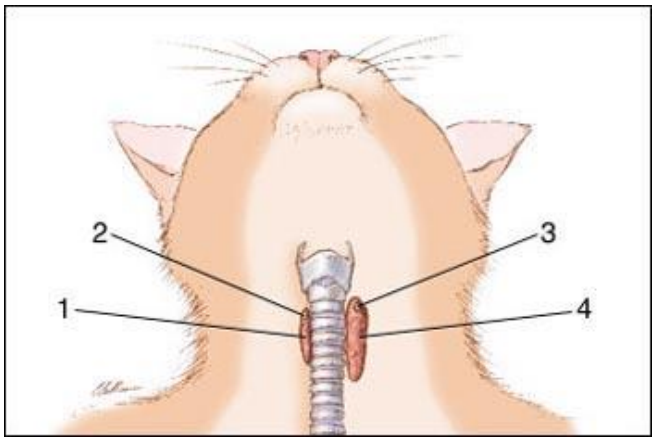

*Image source = http://pedernalesveterinarycentre.com

Figure 2

Anatomical location of the parathyroid glands varies between the species (figure 2). Parathyroid hormone produced by these glands plays a crucial role in calcium homeostasis. They are most frequently examined in hyperthyroid cats which have undergone thyroidectomy to determine whether the parathyroid glands have been removed with the thyroid, as immediate post-operative hypocalcaemia is a frequent complication of parathyroid resection. Histological examination also enables evaluation of the glands for cysts, degenerative changes, inflammatory lesions, amyloid deposition, hyperplastic lesions and neoplasia.

Thyroid Gland

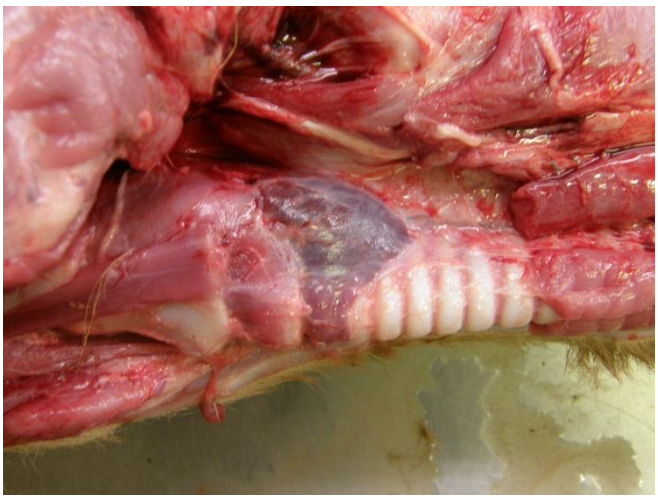

Figure 3

The two thyroid lobes are located on the lateral surfaces of the proximal trachea (figure 3). Accessory thyroid tissue is common in the dog and may be situated anywhere from the larynx to the diaphragm. This accessory tissue can undergo neoplastic transformation. Histological evaluation provides insight into developmental disturbances, degenerative changes, functional disturbances (atrophy, thyroiditis), hyperplasia (goitre) and neoplasia.

Routine gross examination of the thyroid gland forms an integral part of any neonatal mortality investigation, particularly in ungulate animals. The thyroid gland should be carefully dissected out by blunt dissection ensuring that both lobes and the isthmus are collected in their entirety. The gland is then weighed and the thyroid weight : body weight ratio % is then calculated. Ratio's >0.03% (in ruminants) indicate an enlarged thyroid gland. After weighing, samples of thyroid gland are collected and placed in 10% buffered formalin for histopathology. It is important to remember to prepare slices no thicker than 1 cm through the thyroid gland cutting through the capsule. Avoid placing the entire thyroid gland in formalin as formalin penetration through the fibrous capsule is limited and results in poor fixation.

Figure 4

Enlarged thyroid glands (hyperplastic goiter) in late stage abortions, stillbirths, perinatal deaths or weak neonates in cattle (figure 4), sheep, goats and antelope, should alert the investigator to possible underlying micronutrient deficiencies / imbalances (iodine, selenium, copper, manganese, iron, chromium) especially when accompanied by cardiomyopathy, ingestion of goitrogenic plants / anti-thyroid compounds by the dam (in particular prussic acid containing plants), in-utero exposure to certain toxic agents (mycotoxins) or ingestion of endocrine disrupting agents by the dam. In chronic prussic acid ingestion by the dam a combination of goiter and arthrogryposis is frequently documented.

Thyroid gland enlargement in companion animals is more commonly investigated in adult animals searching for evidence of thyroid gland neoplasia. These thyroid masses are usually either adenomas or carcinomas with nodular hyperplasia usually being a microscopic lesion. Thyroid carcinomas are more common than adenomas in dogs while the reverse is true for cats.

Thyroid adenomas are usually white to tan or red solid nodules that are well demarcated from the adjacent thyroid parenchyma, with thick fibrous capsule's in dogs, while in felines capsule's are not common. In dogs usually only a single adenoma is present in an individual lobe, while in cats adenomas may be multiple. Some thyroid adenomas are composed of thin walled fluid filled cysts with a smooth external surface which is covered by a network of blood vessels.

Thyroid carcinomas in companion animals are usually larger than adenomas, multinodular and often have large areas of hemorrhage and necrosis near the center. Thyroid carcinomas may be seen in both lobes of the thyroid gland in dogs. These tumors may be partially encapsulated but usually there is evidence of invasion.

It is important to remember that ectopic thyroid tissue can be found in the tongue, lower neck and anterior mediastinum and so thyroid adenoma and carcinoma must be considered as possible differentials when examining nodules from these sites.

Adrenal Glands

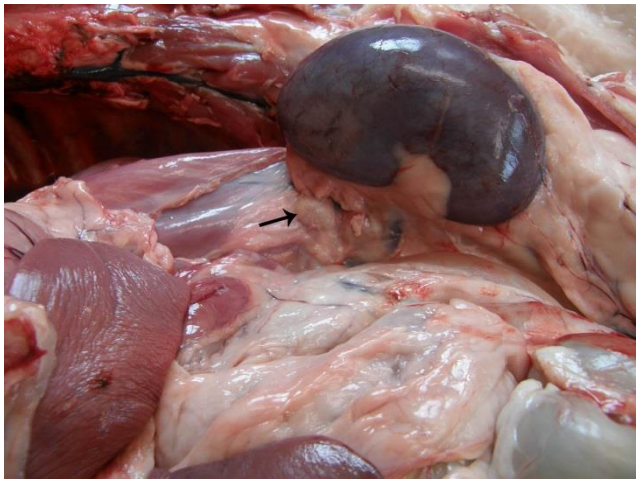

Figure 5

Although part of one organ (figure 5) the adrenal cortex and adrenal medulla are of different origin, have different functions and are morphologically distinct. Histology of the cortex is informative about developmental disturbances, degenerative changes, inflammatory changes, atrophic changes, hyperplasia and neoplasia. Histology of the medulla is largely restricted to evaluation of hyperplastic and neoplastic conditions. The adrenal gland is also a target tissue for viral inclusion bodies with certain viral agents.

Gross examination of the adrenal glands is largely restricted to evaluation for the presence of nodules and evidence of hemorrhage.

Accessory cortical nodules are most commonly found in adult to aged animals and may be located in the capsule, cortex or medulla.

Nodular hyperplasia is characterized by well-defined nodules in the cortex more commonly, and medulla less frequently. They are usually multiple and bilateral and have a yellow appearance.

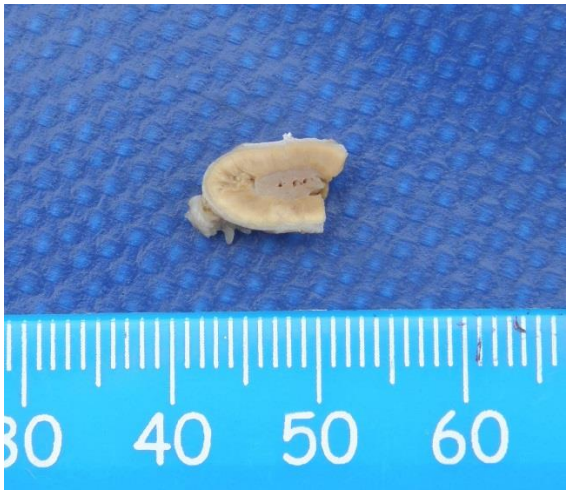

Figure 6

Diffuse cortical hyperplasia is characterized by diffuse bilateral enlargement of the adrenal cortex (figure 6).

Myelolipoma are rare tumors of the adrenal most commonly encountered in cattle and non-human primates, being rare in other species.

Cortical adenomas are most common in old dogs (greater than 8 years) and seen sporadically in horses, cattle and sheep. They are usually well demarcated single nodules with unilateral involvement of one gland, although bilateral tumors have been described. These adenomas are frequently seen in conjunction with nodular hyperplasia.

Cortical carcinoma is most common in old dogs and cattle. They are larger than adenomas, more likely to be bilateral and are composed of yellow red friable tissue. They are often fixed in location, due to their invasion of surrounding tissue. Embolic thrombosis of the caudal vena cava is considered a frequent occurrence.

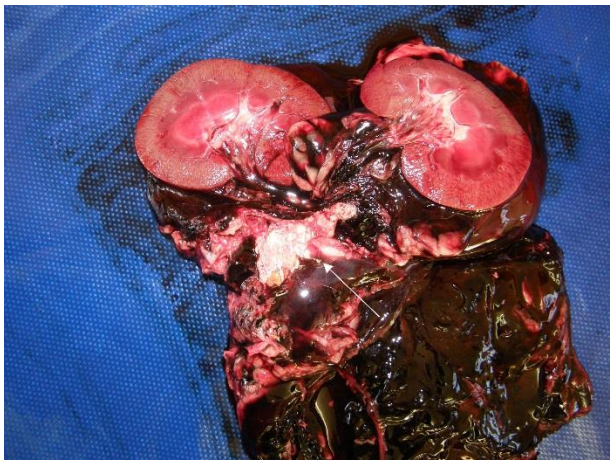

Figure 7

Pheochromocytoma is the most common tumor of the adrenal medulla in animals and are usually unilateral. Tumor cells often invade the capsule and penetrate through

the wall of the caudal vena cava, forming a large thrombus that partially occludes the venous return from the caudal extremities. These invasive tumours are considered malignant and may be associated with vascular rupture and fatal haemorrhage (figure 7). Metastasis occurs to the liver, regional lymph nodes, spleen, and lungs in ±50% of dogs with malignant pheochromocytomas.

Neuroblastoma and ganglioneuroma of the adrenal medulla can only be distinguished from pheochromocytoma histologically.

Metastatic tumors are frequently encountered as the adrenal is a common site for metastatic disease. The average rate of adrenal involvement with metastasis is rated at 21% in dogs, 15% in cats, 27% in horses and 31% in cattle. In dogs pulmonary, mammary gland, prostatic, gastric and pancreatic carcinomas plus malignant melanomas, have the highest rate of metastasis. In horses hemangiosarcoma and melanoma have the highest rates.

Adrenal gland mineralisation is reported frequently in aged cats (30% incidence), less commonly in dogs (6% incidence) and commonly in monkeys. The cause remains unknown and this condition is usually not associated with clinical signs of hypoadrenocorticoidism (Addisons).

Paragangliomas (Chemodectomas)

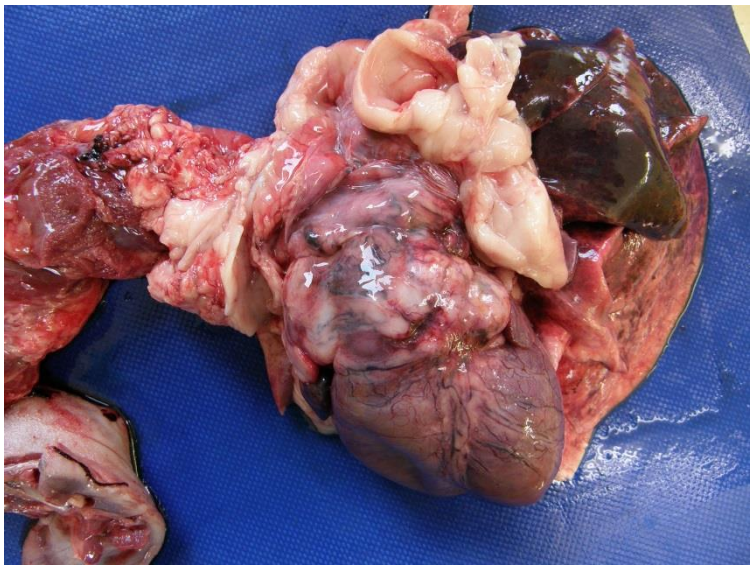

Figure 8

Paragangliomas (chemodectoma's) are neuroendocrine tumors derived from cells of the neural crest and occur in association with the sympathetic or parasympathetic ganglia in the body (head, neck, thorax and abdomen). In domestic animals, these tumors are usually benign and are most frequently encountered in dogs derived from the chemoreceptor organs (non-chromaffin extra-adrenal paraganglia).

Chemoreceptor tissue occurs at various sites including the carotid body and aortic body at the heart base, nodose ganglion of the vagus nerve, ciliary ganglion in the

orbit, pancreas, bodies on the internal jugular vein and along the recurrent branch of the glossopharngeal nerve.

Although chemoreceptor tissue is widespread through the body, neoplasia is largely restricted to the aortic and carotid bodies in animals. Tumors are most commonly reported in dogs, infrequently in cats and cattle. Brachycephalic breeds of dogs show increased incidence with the Boxer and Boston Terrier showing high predisposition. Aortic body tumors are encountered more commonly than carotid body tumors in animals (figure 8), whereas the reverse is true in humans. Histology is required for definitive classification of chemoreceptor pathology.

Sample Collection

Histopathology

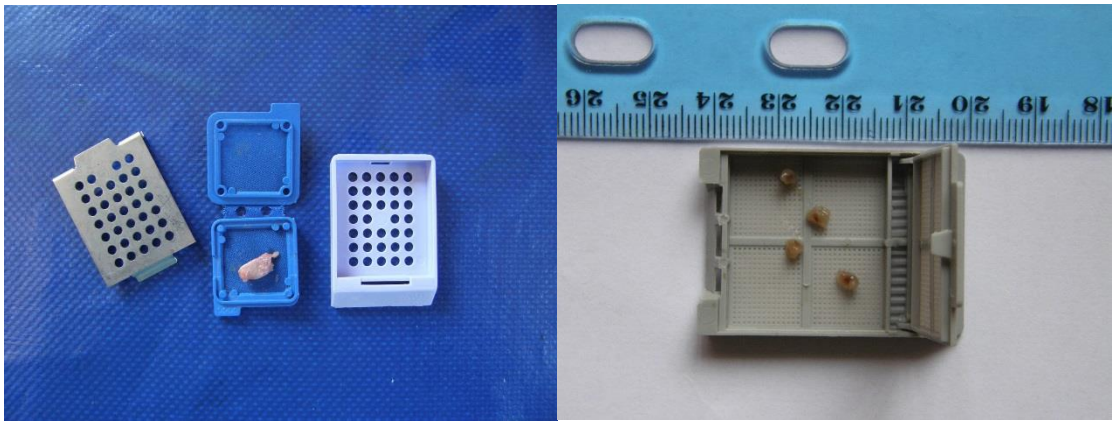

Figure 9

Endocrine tissues collected are frequently of extremely small size and so there is a risk of tissue being lost in the formalin container. Therefore, small tissues should be placed into a blue, fine mesh, Cell-Safe® flip-lid sample container or fine mesh cassette (figure 9). Once the tissue has been placed in the cassette, the lid is closed, and the cassette loaded directly into the formalin container.

Figure 10

The sealed cassette is placed directly into 10% buffered formalin and submitted to the laboratory (figure 10). This cassette is then directly processed through the histology lab with the cassette only being opened after histology processing, prior to embedding, eliminating the risk of the small tissue fragment being lost during processing. The histology technician can then easily identify the tissue and embed it for sectioning.

Further Reading

1. Evans, H E & deLahunta. 2004. *Guide to the dissection of the dog*. 6th edn. Elsevier Saunders, St Louis.
2. King J M, Roth L, Dodd D C & Newson M E. 2005. *The Necropsy Book* 4th edn. C.L.Davis, Gurnee.
3. Last, R D; Hill J M, Vorster J H, Bosch S J & Griffiths C. 2010. *Vetdiagnostix Laboratory Manual* 2nd edn. Serrati Publishers, Pretoria. AC/0492-10.
4. Maxie, M G. 2016. *Pathology of Domestic Animals*. 6th edn. Saunders Elsevier, St Louis.