Ultrasound from Basic to Advances

Claudia Hochleithner, DVM
Manfred Hochleithner, DVM, Dipl. ECAMS

Tierarztpraxis Strebersdorf

VETERINARIA

Mühlweg 5, 1210 Vienna
Austria

Ultrasound is an important diagnostic procedure in small animal practice since many years. For „exotic practitioners“ this diagnostic procedure also became a routine investigation tool as the comercial available Ultrasound machines with high frequency scanners are no longer limited only to Universities or spezial equiped laboratories. As well as the „exotic owner“ is well educated and wants the best investigation and treatment for his animal. Only a few limiting factors exist, where this diagnostic procedure cannot be used.

In our clinic we use the Mindray M9Vet Ultrasound machine with a Micro-convex transducer with the frequency range from 5 – 11 MHz, one Linear transducer from 10-14 MHz and one Ultra high linear transducer who can be pushed up to 24 MHz.

Normally all animals are investigated in lateral or dorsal recumbency without anesthesia, as they tolerate this procedure very well, but we prefere to examine birds under isofluran anesthesia like for radiographs, as this makes it easier to investigate them without having them moving too much. Larger birds like chicken can be also investigated in standing position.
The only exception are animals with cardiac or respiratory distress, where it has to be evaluated, whether the duration of this procedure is not too stressful for the client (often in birds), and then it is better to hold them just in their normal position (ventral recumbancy) and just place the animal onto the probe without anesthesia.
Like in small animals also in exotics this procedure should follow a certain routine investigation route not to miss anything. In snakes we start with the heart and go caudally to the liver, stomache, gallbladder, intestine, gonads, kidneys and cloaca. In all other animals it is helpful to start with the liver and gallbladder (if available) and then monitore the whole abdomen in a certain routine way. It has to be kept in mind that some organs e.g. kidneys look different in birds and reptiles compared to small mammals – so the basic ultrasound knowledge is helpful but has to be extended to these species.

Ultrasound in the avian client

As airsacks are the first limiting factor for ultrasound as the beam is totally reflected from the layer of air with distal extinction of the beam, which means underneath the layer of air nothing can be seen. Therefore especially in birds the indications for this special investigation are limited, as well as the acoustic windows are very small:

* cranioventral behind the Xiphyoid

* caudoventral in the pelvis
* lateral parasternally (almost impossoble in psittacines)
* transintestinal with spezial high frequency scanners (expensive)

Indications in birds

In any kind of abdominal enlargement like tumors of unclear origine, ascites ultrasound is the investigation of choice. As the liquid filled abdomen in ascites is a perfect contrast medium for ultrasound, and in these cases ultrasound can replace radiology. It only has to be kept in mind that birds with ascites often have a respiratory problem, and in these cases it has to be investigated which is more important, maybe not a perfect diagnosis on ultrasound and a live bird or a perfect diagnosis and maybe a dead client....
The size of the organs can be investigated, changes in shape and sonographic pattern of the single organ can be vizualised like cycts, cirrosis of the liver and tumors.
For the female reproduction tract ultrasound can be used for controlling the function of the ovary, for detecting egg binding with deformed or multilayerd eggs.
Cardiac diseases as well as pericardial effusions can be easily seen using this investigation tool.
Tumor of the skin, the muscles and also bones can be measured and monitored – sometimes it is also necessary to use a stand off pad as these structures are normally situated very close to the probe which can be difficult with transducers less than 10 MHz. Always investigate also the healthy side to see the changes of the individual client to compare.
Especially in old animals or trauma birds swollen joints or muscles as well as tendons can be scanned for signs of inflammation, cartilage damage, fissures or changes in the structure.

Some special thought about old parrots and Cardiovascular disease diseases:

Cardiovascular disease is common in avian species as well as increasing commercial economic losses and demand for healthcare in the household or smallholding veterinary sector has resulted in increased research into these disorders. This has highlighted the importance of breeding, genetic testing and possibilities for future prognostic and diagnostic testing. Research into avian cardiovascular genetics has rapidly accelerated.

Acute heart failure and chronic heart failure are of great concern in avian species. Heart failure represents the main cause of morbidity and mortality in older birds (30+) in our experience. The flight activity that birds have results in a higher metabolic demand than mammals of a similar size. This means they have a higher cardiac output which is achieved by having larger hearts and pumping more blood per unit time.

Similar to mammals, birds have a four-chambered heart surrounded by pericardium. The chambers effectively function as two separate pump systems to circulate blood around the body, with cardiac valves ensuring unidirectional flow of blood through the chambers and blood vessels. The mammalian heart apex lies just into the left side of the thoracic cavity, whilst the avian heart lies slightly to the right of the midline.

Cardiovascular disease has usually been reported to be much more common in pet birds compared to wild birds, which is thought that this is due to the longer life span of pet birds but may also be linked to exercise and diet.

Despite the high levels of heart disease in many flocks of commercial birds, understanding avian cardiovascular disorders is not always easy. There are difficulties when examining a bird for cardiovascular defects. It is possible to auscultate the heart, but this would give little information that would help form a diagnosis. In addition birds do not really have a palpable pulse, therefore more profound diagnostic techniques such as radiology, echocardiography, electrocardiography and even post mortem investigation often need to be considered.
Another issue is that signs of cardiovascular disease are often non-specific and could be caused by an overlying problem. Some general signs include lethargy, dyspnoea and exercise intolerance. It is also important to understand the bird's history, diet, environment and reproductive ability.

The incidence of congestive heart failure in a study of 269 Psittaciformes was as high as 9,7%. Of the psittacines observed with cardiac problems, 58% had coronary heart failure considered as the cause of death, 10% with right ventricular or biventricular failure and the remaining 5% with left ventricular failure. 42% of birds affected by cardiac disease had lesions which were considered incidental or secondary.

Moreover, in a second study where 107 captive Psittaciformes (budgerigars (Melopsittacus undulatus) and Australian king parrots (Alisterus scapularis)) were compared, 36% had gross lesions of the heart and/or major blood vessels. Interestingly 99% of the birds examined had some degree of pathological changes to blood vessels and/or the heart with 6% of the birds showed pericardial effusion, 15% showed serofibrinous coating on the pericardium and other 15% showed hypertrophy or dilatation of the ventricular myocardium. It is interesting to note that these captive birds with a relatively long livespan had a high incidence of cardiovascular disease.

Frequently the larger cardiovascular studies are carried out on commercial flocks. These flocks hold significant economic value worldwide, but breeding genetics may also be part of the cause of the high incidence rates of cardiovascular conditions observed, therefore their findings may not be as applicable to wild populations and other avian species.

Atherosclerosis
Atherosclerosis is a condition that has been reported to affect a variety of avian species. It is particularly recognised within parrot species. A study carried out in 2013 finding the prevalence of advanced atherosclerotic cases to be 6,8% within a population of 7683 parrots.
The authors noted that the incidence of advanced atherosclerotic lesions was similar to that in humans aged 45–75 years old and that advancing age was an important determinant in the birds, as with humans.

Ultrasound in the reptile client

As there are aproximately all together 8000 different species in snakes, lizards, chelonians, crocodilians spezial knowlede of the anatomy of the single individuum´s species is necessary to know where to look for which organ in this particular species. Similar like in avians there are also some limiting factors which have to be kept in mind:

* in some snakes and lizards the lungs can reach very far caudally, almost to the pelvis
* some species have ossified scales (Tiliqua and Heloderma spp.)
* some species have strongly calcificated abdominals scales
* prior and during ecdysis it is also impossible to use ultrasound, as there is air between and in the layers of the skin.

Indications in reptiles

The female and male reproduction tract is the most important indication for ultrasound in these species. With ultrasound the ovary function can be monitored through all reproduction stages until monitoring possible eggbinding, which can be differentiated from preovulatory follicle stasis by vizualizing the shape and size of the follicle/egg. As well in ovovivipar snakes the embryo in the uterus can be monitored. The advantage of ultrasound compared to radiology is in detecting abdominal enlargements of unclear origine seen on x-ray.
The inner organs are investigated, changes in size, shape and pattern can be vizualised like in all other animals. Foreign bodies can be found in the intestine with the typical sonographical changes, but also foreign material in the anal bladder can be found.

<u>Ultrasound in small mammals</u>

Like in dogs and cats Ultrasound can be also performed in these exotic small mammals. The only limiting factor in some of these species is too much gas in the intestine like in guinea pigs and rabbits. Most of the animals tolerate this procedure without any stress.
Again all organs are investigated in a certain route. Sometimes we start with the urinary bladder to set the ultrasound machine and go on further cranially from the intestine to the kidneys and in female the ovaries until we end with the liver and gallbladder. In some cases we start with liver and gallbladder and end with the urinary bladder, depending on the main question being investigated.

Indications in small mammals

This investigation is as well as in the other exotics the diagnostic procedure of choice for the female reproduction tract. Suspected ovary cysts can be diagnosed easily in guinea pigs. Changes of the uterus can be monitored, pregnancy is easily detected by finding the embryos on ultrasound. Tumors of the reproduction tract, the testicles and the mamma can be measured and monitored, as well as tumors of the adrenal glands in ferrets.
All organs can be vizualised, changes in the echostructure, size and shape are monitored. Stones in the urinary tract can be easily detected using this procedure. Especially in older animals cardiac diseases can be detected and therapy sucssess can be followed by regular investigations of the single client.