Now That I've Got My Ultrasound, How Do I Pay For It?

Elizabeth H. Tabor, *DVM*
P.O. Box 18, College Grove, TN 37046

Abstract

The purpose of this article is to evaluate costs associated with purchasing an ultrasound, and also to consider some applications in a mixed animal practice that may help offset those costs and serve as a lucrative profit center for the clinic.

Résumé

Le but de cet article est d'évaluer les coûts associés à l'achat d'un échographe et aussi de considérer certaines applications dans une pratique animale mixte qui peuvent aider à défrayer ces coûts et devenir un service lucratif pour la clinique.

Introduction

The types of ultrasound on the veterinary market are many and differ according to various factors, among them degree of resolution, size and weight, imaging modes, portability and Doppler capabilities. Deciding which ultrasound to purchase depends on the individual practice type, as well as the confidence and skills of those using it. The decision to add an ultrasound to a private practice must follow a cost:benefit-based philosophy; its addition must produce more benefits than expenses. These benefits are measured not only in monetary profits enjoyed by the practice, but also in improved diagnostic accuracy and services provided to the client. Many more factors than simple purchase price and revenues generated per ultrasound exam should be considered when evaluating cost/benefit ratios. The following brief discussion includes some factors to evaluate and compare when deciding which ultrasound to purchase.

The type of ultrasound that is right for any particular practice depends on the machine's intended purpose. Most mixed animal practices may benefit more from a portable unit than a stationary one, simply due to the greater variation in its uses. Portable units range in weight from a few ounces to several pounds. When used for long periods at a time, such as during a dairy herd check, this weight difference becomes important. These portable units offer different means to view the images while in the field; monocular or binocular goggles, monitors on a wrist mount or those monitors suspended from a strap around the operator's neck or shoulder. Personal preference as well as associated costs will guide the decision which to purchase. Another factor to consider is the number and types of probes used with each machine. Some machines include one or more probes with the purchase price, with the option to add other probes. Some more basic models do not allow for the addition of different probes; this should be evaluated prior to purchase. Probes are available in an array of different frequencies. In general, the higher the frequency, the greater the resolution. However, single probes may be used for a variety of applications. For example, a 5 MHz probe allows reproductive scanning as well as abdominal ultrasound in small animals, with fairly good resolution in both. Also evaluate what each additional probe costs and if a replacement probe and/or ultrasound will be provided by the company if repairs on either are necessary. When a practice depends heavily on an ultrasound, turnaround time for repairs becomes important. Loss or postponement of multiple appointments due to absence of an ultrasound can become significant, both financially and in terms of service to the client. Warranties on both the machine and probe should be evaluated as well. Insurance on the machine and probes should be part of the overall purchase cost consideration, as well as the applicable deductible. If a machine is compatible with laptop, consider whether the laptop can be used for other applications (QuickBooks, inventory, etc). This may increase the overall value of a machine. Other factors to consider include cost of a printer to record images from the ultrasound, quality of those images, and whether an existing office printer is compatible with the ultrasound or a separate ultrasound printer will be necessary.

The examples of financial data in this article are from a two-doctor, mixed animal practice in middle Tennessee at which I am an associate. Prices charged for services obviously vary according to region of the country, as well as demographics. The ultrasound used is a portable battery-operated unit with a linear 5 MHz probe.

Small Animal Applications

The uses of ultrasound in small animal practice are myriad, with reproduction being one area of par-

ticular interest. Pregnancy diagnosis is perhaps the most common application in our small animal practice, which can be done as early as 17 days, with a heart beat detectable at day 23 and fetal activity at day 30. Ultrasound is superior to radiography when determining fetal viability, though inferior when determining the number of fetuses. We often use these diagnostics in conjunction with one another. Clients often need to know early in gestation if their bitch has been inappropriately bred in order to schedule surgical termination of the pregnancy. Waiting until radiography offers a diagnosis may be too late to safely allow surgical intervention. Our clients also appreciate the service we provide when we are able to tell them early if a difficult artificial insemination (AI) breeding was successful. On the other hand, abdominal ultrasound may also be beneficial prior to ovariohysterectomies when clients may be opposed to terminating a pregnancy. When a pregnancy is suspected, many clients are willing to support the additional cost of an ultrasound examination in order to potentially avoid an unwanted surgery. Abdominal ultrasound is quick to perform, and less dangerous to both the veterinary staff as well as the fetuses and dam.

Abdominal swellings over surgical incisions may also be identified as seromas or hematomas, rather than hernations, with the use of ultrasound. The ability to clarify the difference may prevent the unfortunate lancing of an internal structure.

Reproductive medical cases may also benefit from ultrasound examinations. For example, the flocculent architecture of uterine horns containing purulent material is more easily visualized on ultrasound than radiography, making pyometra diagnosis quick and less stressful to the patient. Such a diagnosis may allow more rapid medical and/or surgical intervention.

Following blunt trauma, such as being hit by a vehicle, ultrasound can be a valuable supplemental tool for diagnosis. Ultrasound is a diagnostic complement to radiography but does not replace it. A diaphragmatic hernia may take several hours to days to become apparent on radiographs, but sometimes is more apparent on ultrasound. A case in point involves a dog hit by a car and presented to our clinic immediately after the accident. Following stabilization treatment consisting of IV fluids and steroids, sequential survey radiographs were performed on the day of presentation and the following day. No disruption in the integrity of the diaphragm was detected. Two weeks later, the dog presented with dyspnea. Radiographs revealed increased soft tissue opacity in the caudal lung fields with general loss of serosal detail. A hernia was suspected, but could not be definitively diagnosed based on radiographs alone. Ultrasonic exam clearly portrayed hepatic architecture in the thoracic cavity, and surgery was quickly performed to correct the diaphragmatic hernia.

Rupture of visceral organs may be detectible with evaluation of fluid accumulation in the abdominal cavity. This generates on ultrasonic image, which is hypoechoic with floating echoes. A ruptured bladder is one such example. On radiography, the absence of a detectible bladder may indicate either rupture or an inadequately full bladder to allow visualization. Ultrasound may allow identification of a flap of bladder wall that confirms diagnosis. Though identification of such a defect is seldom possible due to the rapid sealing over of the lesion, in one instance at our clinic it did allow diagnosis of a bladder rupture in a kid following urolithiasis. The diagnosis prompted the owner to elect euthanasia due to the poor prognosis.

Systemic illnesses may also be diagnosed more accurately with the aid of ultrasound. Many conditions are difficult to diagnose based on clinical signs, bloodwork and radiography alone. Inflammatory bowel disease will portray thickened bowel walls (greater than 5 mm) on ultrasound, but may be difficult to identify on survey radiographs. The appearance of an intussusception as a target lesion allows rapid diagnosis and surgical intervention.

Elevated liver enzymes (production and leakage) coupled with hepatomegaly may prompt ultrasound-guided, fine-needle aspirates. Histopathology of these samples may allow the cause of the hepatomegaly to become clear: severe venous congestion from right heart failure, diffuse inflammation, nodular hyperplasia, or primary/seconday neoplasia, among other possible causes. Microhepatica may indicate necrosis, cirrhosis, or portosystemic shunts. These conditions are often impossible to accurately diagnose with radiography alone. Enlarged gall bladder, as well as dilated ducts and increased sludge, can also be identified by ultrasound. Ultrasound-guided gall bladder aspirates with culture may help diagnose conditions such as chronic cholecystitis. Splenomegaly caused by rickettsial disease, passive congestion, infarction, splenic torsion and neoplasia may be diagnosed with the aid of ultrasound-guided, fine-needle aspirates. Malignant lesions must be differentiated from benign ones through cytology and/or histopathology; radiography does not allow this distinction. Fine-needle aspirates can be successfully accomplished with mild sedation using a combination of butorphanol (Torbugesic; 1.0 mg per 10 lb of body weight) and acepromazine (0.25 mg) intravenously, and may be combined with local infusion of 2% lidocaine. This reduces the anesthetic risk for critical patients.

Clinical signs of renal insufficiency (polyuria, polydypsia, reduced concentrating ability) may prompt abdominal radiography with subsequent ultrasound evaluation of renal architecture, dilated renal pelvis, increased fibrosis of renal parenchyma and enlarged size. Evaluation of adrenal glands may reveal dimin-

ished cortex size and contribute to a diagnosis of hypoadrenocorticism. Renal calculi, neoplasia, abscesses, granulomas and hematomas are among other conditions detected with ultrasonography. Mineralization and dense fibrous tissue are often visualized earlier on ultrasound images than radiography. As with other organs, fine-needle aspirates and/or biopsy samples obtained with the aid of ultrasound guidance are often necessary to definitively diagnose many conditions.

Urogenital abnormalities, such as transitional cell carcinomas, may be evident on ultrasound but obscured on survey radiographs. Similarly, non-radiopaque urinary calculi may be missed if diagnosed by radiography alone. Hypoechogenicity in the prostate may indicate a cystic disease or abscess; again, fine-needle aspirate allows the distinction.

In our practice, complete abdominal scans average $100 while reproductive exams average $40. Ultrasound-guided, fine-needle aspirates average $80 plus sedation and associated lab accession fees.

Small Ruminant and Camelid Applications

In our practice, ultrasonography is most widely used for reproductive purposes in small ruminants and camelid medicine. As small ruminants and camelids make up a greater percentage of our practice, adept use of ultrasound becomes increasingly important. Linear ray 5 to 7.5 MHz transducers are recommended for transrectal reproductive examinations.[3] Pregnancy can be diagnosed as early as 18 days in sheep and goats and 12-14 days in llamoids, and the heartbeat of a fetus in small ruminants may be visualized between 30 and 35 days of gestation. After 60 days of gestation, the small ruminant fetus usually drops over the pelvic brim and requires transabdominal scanning.[3] Llamoids are best scanned transrectally at less than 120 days.[1] Diagnosis of twins can be made between 45 and 90 days, and may be useful in nutrition and management decisions. However, after 80-120 days of gestation, the number of fetuses in ewes and does may be difficult to determine.[3]

Vegetable oil or methylcellulose are recommended as coupling agents, though isopropyl alcohol has worked well in our practice. Ultrasound probe extensions are available commercially or may be made from PVC pipe. This allows rigid manipulation of the probe rectally for easier visualization of the ovaries and entire uterine body and horns.

Uterine pathologies such as hydrometra, pyometra, fetal mummification and macerated fetuses may be identified. Ovarian pathology, such as persistent corpus lutea and cystic structures, may be identified with ultrasound and treated accordingly. Such pathologies are often associated with failure to conceive or repeated rejection of breeding. Reproductive abnormalities and/or pregnancy diagnosis may be documented by photographs and/or computer discs. Often, valuable pregnant females are sold at considerably high prices and confirmation of pregnancy is important. Liability for open females after sale may be reduced with fetal image verification. Fetal loss may occur at a rate of 30-50% prior to 90 days in alpacas and llamas.[1] The stress of shipping pregnant females may contribute to this early pregnancy termination. If the female is checked by another veterinarian following shipment and determined to be open, questions may arise as to the correct diagnosis of pregnancy in the first place. This doubt should be dissolved with the inclusion of images of the diagnosed pregnancy with the female prior to shipment. Many clients (both selling and purchasing pregnant females) are willing to pay for the ultrasound examination and accompanying images.

Ultrasonic examination of the male reproductive tract may also be used to diagnose testicular fibrotic changes, cystic structures and abscesses. The spermatic cord and epididymis can also be evaluated for fibrotic and cystic changes.[3] These changes may be identified on routine breeding soundness examinations, or upon investigation of poor reproductive performance.

Other uses of ultrasound include respiratory and mammary gland examinations. Evaluation of the thoracic cavity can identify pleural effusion, pleural fibrin and adhesions, atelectasis, consolidation and abscesses. Additionally, ultrasound-guided thoracocentesis and lung biopsy can contribute to the diagnosis, as well as prognosis, of respiratory diseases.[3] Pathologies of the mammary gland such as tumors, abscesses, granulomas and excessive fibrosis can also be identified with the aid of ultrasound.[3]

Small ruminant and camelid reproductive exams in our practice average between $40 and $60. Complete thoracic and/or abdominal ultrasound scans average $40 to $100, depending on extent of the exam.

Equine Applications

Musculoskeletal, reproductive, respiratory and gastrointestinal abnormalities are extensively evaluated in equids by ultrasound.

In addition to flexion tests and nerve blocks, lameness examinations often include radiography coupled with ultrasound. Soft tissue abnormalities are not always visualized on radiographs, allowing ultrasound to be a valuable supplemental diagnostic tool. Lesions such as tendon sheath tenosynovitis, joint effusion, articulate cartilage defects, chip fractures, meniscal tears, collateral ligament injuries, and cranial cruciate ligament damage can be identified with the aid of ultrasound.

Thoracic examination allows visualization of pleural effusion, pleuropneumonia and less common lung

lesions such as abscesses and pulmonary granular cell tumors. For example, pulmonary abscesses associated with rhodococcal pneumonia in foals can be detected with ultrasound, allowing an early diagnosis of the condition.[2]

Urinary tract abnormalities seen on ultrasound include cystic calculi and bladder rupture in colts following dystocia. Umbilical infection, persistent urachus and patent urachus are other lesions diagnosed with the aid of ultrasound in neonates.

Horses suffering from colic may be evaluated rectally for bowel dilation, and transabdominally for loops of dilated intestine and lack of peristalsis. Transabdominal examination is especially useful in ponies and foals, since their size often prevents adequate rectal examination. Left-dorsal and left-lateral displacement of the large colon are examples of abnormlities which may be identified and differentiated from one another based on position of the large colon with respect to the body wall and left kidney. Ultrasonic confirmation of the diagnosis helps determine the prognosis as well as the impending treatment plan.

Examination of the neck may include thrombophlebitis resulting from intravenous injections and/or catheterization. Non-septic thrombosis can be differentiated from sepsis based on uniformity of echogenicity. This distinction is important when deciding which diagnostic procedures should follow. Fine-needle aspiration should not be performed on non-septic thrombosis with homogenous architecture. However, culture of sepsis may be required to identify the organism(s) present and which antimicrobials are most appropriate to use.[2]

Perhaps the most widely used application of ultrasound in the equine field is for reproductive purposes, and should be performed using a 5MHz linear array probe.[2] Ultrasound is very beneficial in breeding soundness examinations of mares and can be used to detect ovarian and uterine pathologies. Uterine cysts, granulosa cell tumors, ovarian cysts and chronic metritis are important pathologies to identify prior to breeding or purchase of a brood mare. It is important to keep accurate records of the location and shapes of uterine cysts when performing an ultrasound exam in a mare, because in many cases a uterine cyst may closely resemble a 12-16 day-old pregnancy. Follicular evaluation is used to determine time of ovulation for breeding management. Follicles change shape from spheroid to tear drop within 24 hours of ovulation.[2]

Individual management decisions differ among practitioners, but development of 30-35 mm follicles often indicates that preparations should be made for live-cover breeding or artificial insemination. Use of an ultrasound allows many veterinarians to identify pregnancies as early as 10 days, but is most commonly performed between 14 and 20 days after ovulation.[2] Diagnosis of twins is crucial early, and ideally should be made before fixation in the horn(s) at approximately day 17. If identified prior to fixation, a twin may be terminated more easily than if the twins fix close to each other.[2]

Ultrasound examinations of reproductive tracts for follicular development and early pregnancy diagnosis average $25 to $40 in our practice. Thoracic and/or abdominal scans of foals range $40-$100 depending on extent of the exam. Tendon evaluations range $20-$30 per exam, while the ultrasound portion of a colic exam averages $40.

Bovine Applications

Applications for ultrasound in bovine medicine span all classes of animals; cow/calf, feedlot and dairy. Reproductive work is perhaps the most common use in bovine medicine. Early pregnancy diagnosis, around day 26, allows management decisions to be made to reduce days open, a factor especially important in dairy. During routine pregnancy checking, other reproductive abnormalities may be diagnosed such as endometritis and uterine and cervical masses, as well as ovarian abnormalities. Luteal cysts may be differentiated from cystic corpus lutea based on echogenicity of the structure, and may be more difficult to accurately diagnose based on palpation alone. Fetal sexing has been performed between days 55 and 90 at our clinic in middle Tennessee, however, our preference for fetal sexing is 58 days. Testicular cysts and fibrosis may be detected with ultrasound on breeding soundness examinations if abnormalities are palpated. Prostatic abscesses may be identified and aspirated with the guidance of ultrasound. Bovine udders may be scanned for the presence of scarring or cystic structures, as well abscesses and other abnormalities. Examination of retrobulbar masses, though mostly diagnosed on physical examination, may help determine the extent and size of the mass. Backfat thickness is a carcass characteristic that may be important for some producers to track and record in the marketing of their animals. Measurements are taken, recorded, and evaluated for comparison to other animals in a similar group. The added expense of training and additional equipment (probe, stand-off pad) should be considered when adding this service to a practice. Other ultrasound applications in bovine medicine are discussed in more detail in other sources.

Herd checks and fetal sexing are charged on an hourly basis at our clinic, with an additional $40 ultrasound set-up fee. Backfat thickness evaluation is not part of our practice.

Conclusion

When comparing ultrasound companies from which to

purchase a machine, a report card approach might be beneficial. First, consider service availability and home base. Optimally, the vendor should service the sales. Next consider image quality, followed by price, including any accessories. Also consider the options available on a unit. A wider array of options may allow the practitioner to accomodate any request from the client (fetal sexing using Cine, freezing images, exporting images to a computer or printer). A variety of options on a unit may also increase resale value, allowing it to be sold to a bovine, equine, or mixed animal practice in the future. More basic models may not fit as well into a variety of practices. Lastly, consider upgradability. Can additional probes be added? Can goggles be used? Can the monitor be upgraded to a daylight monitor, so images can be more easily seen on sunny days?

The machine in our practice costs $12,000 new as of July 10, 2006. The unit includes a travel case, one probe of choice (again, we have a linear 5 MHz probe), smart card for recording images, a battery charger and two batteries. A reconditioned unit with a 90-day guarantee runs $7500. National ultrasound companies cannot provide insurance on units due to individual state codes and variations, so it must be added on the clinic policy as a line item. When insuring the unit, it is advisable to get an all-risk policy. Therefore, any mishap covers the machine. Binocular goggles were added to our unit at a cost of $600. The company offers a backpack or front harness for carrying the unit in the field at $300 each. Instead, we use a regular backpack to carry our machine while doing herd checks. The backpack provided by the company allows the monitor to be rotated 180 degrees to allow a viewer in the back to see the images on the screen. We have had to purchase three new batteries at $150 each. To finance the machine, our clinic took out a bank loan. However, leasing options exist. Leasing essentially allows the practitioner to rent money and if this option is used to purchase the unit, it is advised to do a $1 purchase option.

The examples of ultrasound application will vary, depending on number and type of clients a practice serves as well as skills of the operator. Financial data associated with purchasing and operating an ultrasound will also vary considerably among practices, and in this article only apply to a single practice in middle Tennessee. Despite the variables to consider when evaluating an ultrasound, the value of the technology must justify its presence in a practice. That value is expressed in monetary profits as well as service to the client.

References

1. Fowler ME: *Reproduction,* in: Bravo PW, Fowler ME (eds): *Medicine and Surgery of South American Camelids,* ed 2. Ames, Iowa State Press, 1998, pp 397-403.
2. Hodgson DR, Rose RJ: *Manual of Equine Practice,* ed 2. Philadelphia, WB Saunders Co, 2000, pp 88, 194, 348-350.
3. Pugh DG: *Sheep and Goat Medicine*. Philadelphia, WB Saunders Co, 2002, pp108, 135, 161, 342.