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Overview of African Wild Dog Medicine

JENNIFER N. LANGAN AND GWEN JANKOWSKI

Introduction

The African wild dog *(Lycaon pictus)*—also referred to as the African hunting dog, painted dog, and Cape hunting dog—is one of Africa's most endangered carnivores.[1] Owing to its decreasing numbers, it holds an International Union for Conservation of Nature (IUCN) red list priority status for the conservation of canid species in Africa.[2] African wild dogs were formerly distributed throughout sub-Saharan Africa but are now mostly confined to southern Africa and the southern portion of East Africa (Fig. 77.1).[3,4] They require large ranges and live at low population densities. The population is currently estimated at 6600 animals and continues to decline as a result of ongoing habitat fragmentation, conflict with humans, and infectious disease.[1,5] Predation by lions and competition with spotted hyenas also contribute to population suppression.[6] There are approximately 600 African wild dogs in zoos, which serve to educate the public and fulfill an important role as ambassadors aiding the recovery effort for this species.

Biology and Anatomy

The African wild dog is a member of the family Canidae in the order Carnivora; it likely diverged from wolves in the Pleistocene period.[1] Genetic studies demonstrate that it is sufficiently different from other canid species to warrant being classified into a separate genus. Adults weigh 18–35 kg, with males slightly larger than females.[2,3,7] The average age of survival in zoos is 10.3 years[8]; a few animals live 12–16 years.[2,7,9] The African wild dog's most striking characteristic is the tricolored spotted coat, for which it received its Latin name, *Lycaon pictus,* meaning "painted wolf." It has large round ears, lacks a supracaudal (tail) gland, has four digits on each limb (lacks dew claws), and the pads of the middle digits are connected by dermal webbing. Reproductive anatomy is similar to that of domestic dogs in both males and females, but females have 12–14 mammae. They have very sharp, large premolars relative to their body mass, which allow them to consume sizable quantities of meat and bone with impressive speed. The dental formula is I3/3, C1/1, PM3/4, M3/3 = 21, of which the last mandibular molar is vestigial and generally not visualized.[1]

Management, Husbandry, and Behavior

The typical wild pack is composed of an older dominant female paired with a young dominant male and subordinates of both sexes. Dominant males may be displaced as they age or lose strength. Juvenile males are most likely to stay with the pack, whereas females often emigrate. Following the death of the dominant female, significant social changes occur within the group, which can result in pack dispersal in the wild.[1,7]

Social management of African wild dogs under human care is challenging and can have significant health impacts. It involves working across institutions to create and maintain packs that thrive socially, support a healthy population, and sustain genetic diversity. The most stable social groups include a well-established dominant pair with male offspring of any age and young female offspring. The inability to disperse may result in conflict between female offspring above 18 months of age and the dominant female. The decreasing frequency of "hoo-calls" (long-distance communication calls) and distance between resting sites of same-sex groups suggest that unrelated individuals under human care are more likely to integrate into a pack successfully.[10] If animals need to be separated due to social incompatibility, it is recommended that individuals be split up as same-sex packs or with littermates less than 18 months of age.[7] Contraception for reproductively mature individuals intended to reduce aggression has not been successful.[7] Measurement of fecal corticosteroids may be a useful management tool and has demonstrated that dominant animals generally have the highest stress levels.[11–13]

Behavior is a key indicator of social and physical well-being in African wild dogs. "Normal" behavior varies by an individual's status within the pack, and establishing pack hierarchy is essential for avoiding excessive aggression.

• **Figure 77.1** Distribution of the remaining African wild dog *(Lycaon pictus)* populations.

Permanent or even brief temporary removal of an established pack member may have profound social impacts, including changes in social hierarchy with aggression so substantial that reintroduction may not be possible.[7,15] Detailed plans to reduce stress and promote normal behaviors should be implemented if a dog must be isolated, including maintaining olfactory and visual contact. If separation is required, it may be helpful to subdivide the pack and then reintroduce them all simultaneously. Alternatively, introductions of subordinate dogs first, then dominant pairs, may be effective.

Successful implementation of enrichment has included environmental devices, sensory stimulants, and food, behavioral, and habitat variance.[16] Piles of leaves, dirt, and mulch allow natural digging and rolling behaviors. Rotating exhibits with other predators provides habitat diversity and promotes scent-marking behavior. Offering carcass feeds hung from trees or on zip lines, feeding bones, providing several types of enrichment to the pack simultaneously, and permitting breeding when possible are recommended for this species.[15,16]

Enclosures should be large and contain ample space for exercise to meet the animals' physical, social, behavioral, and psychological needs.[7] Specific size and perimeter recommendations may be found in the Association of Zoos & Aquariums (AZA) *Large Canid Care Manual*.[7] Facilities that allow the public to observe the animals should prevent close contact or inadvertent access to the enclosure. Dogs should have access to multiple heated areas if the temperature regularly drops below 4.4°C–7.2°C (40°F–45°F) and should have shelter from the elements.[7] Additionally, a heated den should be provided if breeding is planned. Facilities should have sufficient holding space to accommodate separating animals for long periods. With the exception of fish, housing African wild dogs with other species is not recommended due to their high predatory drive.

African wild dogs should be moved only in sturdy metal or wood crates with good ventilation that meet US Department of Agriculture (USDA) and International Air Transport Association (IATA) requirements for live animal transport. Completing a written transport plan, health evaluation, and crate training facilitates transitions when animals are relocated.

Nutrition

African wild dogs are generalist predators, occupying a range of habitats where they hunt medium-sized antelope.[6] In natural settings, reduced prey populations and competition from other predators inhibit population growth.[3,17] African wild dogs in zoos are fed a nutritionally complete raw meat–based diet (1–1.36 kg/adult/day) and are supplemented with small whole prey, knuckle/rib/shank bones (one to two times week), and carcasses (pig, deer, calf, horse). Lactating bitches require up to three times

maintenance caloric intake. Specific recommendations for kilocalorie requirements may be found in the AZA *Large Canid Care Manual*.[7] Feeding African wild dogs a portion of their diet while separated from the pack aids in monitoring individual animals' food consumption. Packs are generally fasted from their normal meat diet 1 day per week and may be provided with bones.

Reproduction and Contraception

African wild dogs are seasonally monoestrous obligate cooperative breeders with a brief copulatory tie.[18,19] Within a pack the alpha male and female produce the majority of surviving pups annually.[7,20,21] Most successful reproduction occurs after 2 years of age, with senescence around 8–9 years.[8,21] Subordinate females may reproduce, but offspring typically do not survive. More often, subordinate females develop pseudopregnancy and may lactate in order to help care for the pups of the dominant pair.[1] Females produce an average of six to eight pups[22,23] and up to 21 pups[8] in a den after a gestation of 69–71 days.[24–26] Primiparous females have higher estrogen, which is reported to result in more male offspring.[24] Hand-rearing is not recommended due to the extremely aggressive and social nature of these animals.[8] In zoos, the breeding pair is separated from the pack to prevent trauma to the pups. The group is gradually introduced when the pups begin to emerge from the nest box. A birth plan detailing responses to aggression toward the pups, large litter size, and other contingencies is recommended.

Newborn pups weigh about 300 g, open their eyes around 2 weeks of age, and emerge from the den to start taking solid food at 3 weeks. Sex determination is similar to that for other canids. Pups are weaned and start to follow the pack at 11–12 weeks of age. In free-range settings, all members of the pack raise the pups; they regurgitate food while the young are in the den and relinquish kills to the pups and yearlings.[1,3]

Reproductive anatomy is similar to that of other canid species. Owing to social dynamics, most reproduction has been natural; however, semen has been preserved and used for artificial inseminations.[15] Captive *Lycaon pictus* generally reproduce in the fall in the northern hemisphere.[8] Estrus lasts 6–9 days and includes vulvar swelling and sanguineous discharge with interest from the male. Attraction from the male may be observed for 1–2 weeks prior to tying.[14,25] Males show increased testicular development, spermatorrhea, and semen production; therefore the corresponding seasonal ability to collect sperm via electroejaculation is improved.[15]

The progestin-based melengestrol acetate (MGA) implant, previously used in canids, has been associated with uterine pathology.[27] The AZA Reproduction Management Center (formerly the Wildlife Contraception Center) (www.stlzoo.org/animals/scienceresearch/reproductivemanagementcenter) recommends gonadotropin releasing hormone (GnRH) agonists such as Suprelorin (deslorelin acetate) implants or Lupron Depot (leuprolide acetate 4.7 mg implant, Virbac AH, Inc., Fort Worth, Texas). Current estimates show 23% of females have some degree of reproductive pathology,[28] the most frequently reported of which is cystic endometrial hyperplasia (CEH) with or without pyometra and adenomyosis (Fig. 77.2).[27–29] Adenocarcinoma, uterine rupture, and pyometra without other pathology have also been reported (Kinsel, personal communication, April 10, 2017).[23,27,28] The Species Survival Plan Program (SSP) currently recommends that all postreproductive females (>10 years) be spayed.[8] Deslorelin implants have been used for contraception and behavioral alteration in males with variable results (see Table 77.1 for a summary of reproductive information) (see also Chapter 22).[26,30,31]

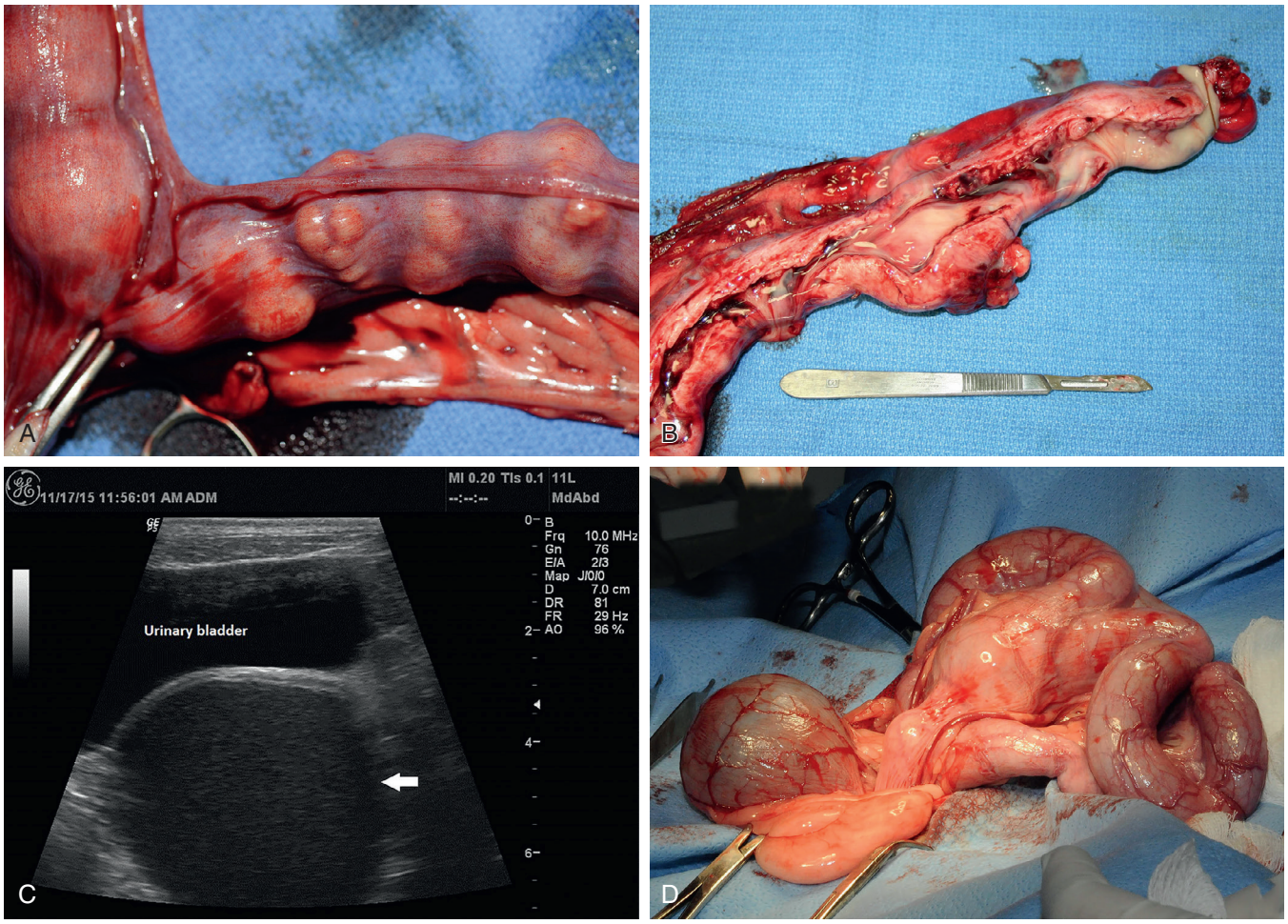
Handling, Restraint, and Anesthesia

Healthy adult African wild dogs are not physically restrained due to safety concerns. Noninvasive procedures including visual examination, hand injections, wound treatment, venipuncture, and crate training may be accomplished with operant conditioning.

Restraint cages are useful and provide a safe, controlled environment to facilitate intramuscular injections of anesthetics. A quiet area away from the pack promotes quick inductions and smooth recoveries. Remote injection systems are recommended for immobilizing free-ranging African wild dogs or in situations when a chute is not available. Anesthetic regimens selected should take into account health status, age, and environmental conditions. In cases where cardiovascular disease has been confirmed or cardiac status is unknown, alpha-2 agonists should be avoided and alternatives such as ketamine-midazolam-butorphanol with propofol or gas anesthesia (isoflurane, sevoflurane) should be considered. Chemical restraint protocols used in African wild dogs may be found in Table 77.2 and have been previously published.[32–34] Drug combinations at higher dosages for free-ranging African wild dogs are available in the literature.[35,36] Reversal of alpha-2 agonists and opioids with atipamezole and naloxone decreases recovery time. To avoid dysphoria, it is advised to wait at least 60 minutes postinduction before administering reversals. Recovery in a crate or nest box may reduce struggles to stand during recovery. Telazol (tiletamine HCL and zolazepam HCL, Zoetis, Parsippany, New Jersey) as a sole agent or used in combination with medetomidine is a reliable option during an emergency response but often results in a prolonged recovery time.[34] Vascular access, intubation, and monitoring equipment are applied as in other canids. Every wild dog anesthesia should include oxygen supplementation, electrocardiography (ECG), and monitoring of pulse oximetry, heart and respiratory rate, blood pressure, and temperature.

Clinical Pathology

As in other canids, the jugular, cephalic, and saphenous veins are commonly used sites for venipuncture. Tables 77.3



• **Figure 77.2** Common uterine pathology in African wild dogs *(Lycaon pictus)*: (A) uterine hyperplasia and pyometra, (B) uterine adenocarcinoma with associated pyometra, (C) ultrasound image of a dilated uterine horn filled with hyperechoic material *(arrow)*, and (D) and corresponding intraoperative image in the same animal with pyometra.

TABLE 77.1 Reproductive Information for African Wild Dog *(Lycaon pictus)*

Reproductive Cycle	Monestrous
Usual age of first reproduction	21–22 months
Copulation (North America)	August–October
Length of estrus	6–9 days
Gestation (from first day of copulation)	69–71 days
Parturition (North America)	October–January
Mean/maximum litter size	6–8/21

and 77.4 show normal hematologic and serum chemistry reference ranges for captive African wild dogs.[9,37]

Diseases

Rabies and distemper have contributed to mortality in African dog populations, occasionally resulting in local extinction events.[38–41] There is serologic evidence of exposure to canine parvovirus, canine distemper virus, adenovirus, rabies virus, coronavirus, rotavirus, and *Ehrlichia canis*.[21,42,43] Outbreaks of anthrax in Kruger National Park occur, but infected animals commonly survive.[43] Contact with domestic dogs has been reported to increase exposure to some canid pathogens, but sylvatic viral strains also pose a significant threat.[5,44]

Parasitic disease and infection has rarely been described.[44–46] *Toxocara canis, Dipylidium caninum, Spirometra* sp., Taeniidae, and *Ancylostoma* spp., as well as two genera of canid protozoan gastrointestinal parasites, *Sarcocystis* and *Isopora,* were identified in fecal samples from free-ranging animals but were not associated with clinical disease.[44,47] Standard anthelmintics at canine dosages have been successfully used to treat internal parasites. It is recommended that African wild dogs be routinely tested and maintained on prophylactic heartworm preventative in endemic areas.

Over the last decade, valvular dysplasia of varying severity has been increasingly recognized as a significant concern in African wild dogs in North America. Sibling groups and offspring have been affected over multiple generations,

TABLE 77.2 Select Chemical Restraint Agents Used in African Wild Dogs *(Lycaon pictus)*

Drug Combination (mg/kg) IM	Reversal Agent (mg/kg) IM	Comments
Medetomidine (0.025–0.04) Ketamine (2.5–3) ± Midazolam (0.1–0.15) ± Butorphanol (0.1–0.2)	Atipamezole (0.14–0.24) ± Flumazenil (0.01–0.05) ± Naloxone (0.02)	Excellent muscle relaxation, quick recovery
Medetomidine (0.03) Midazolam (0.3), Butorphanol (0.3)		Completely reversible
Dexmedetomidine (0.025), Ketamine (3), Midazolam (0.15)	Atipamezole, flumazenil	Generally larger dart volume
Ketamine (2–4), Midazolam (0.15–0.3), Butorphanol (0.3–0.4), ± Supplemental Propofol (0.4–0.5 IV) or Gas anesthesia	Flumazenil, naloxone	Suggested alternative for cardiac cases
Tiletamine-Zolazepam (Telazol) (2–5)		Reliable plane of anesthesia, prolonged recoveries

IM, Intramuscular; *IV,* intravenous.

TABLE 77.3 Hematologic Values for African Wild Dogs *(Lycaon pictus)*

Parameter	Mean	SD
White blood cell count ($\times 10^3/\mu L$)	10.7	3.53
Red blood cell count ($\times 10^6/\mu L$)	7.98	1.61
Hemoglobin (g/dL)	15.1	2.43
Hematocrit (%)	43.7	7.33
MCV (fL)	55.6	4.53
MCH (pg/cell)	19	1.75
MCHC (g/dL)	34.1	2.08
Platelet count ($\times 10^3/\mu L$)	451	183.8
Segmented neutrophils ($\times 10^3/\mu L$)	7.44	3.34
Neutrophilic bands ($\times 10^3/\mu L$)	0.508	0.025
Lymphocytes ($\times 10^3/\mu L$)	1.9	5.37
Eosinophils ($\times 10^3/\mu L$)	0.458	0.396
Basophils ($\times 10^3/\mu L$)	0.014	0.039

General ZIMS database reference: Species360 (2017), ZIMS.Species360.org.

suggesting that the condition has a genetic, inheritable basis, as is well documented in domestic dogs.[8] Cases range from minor to severe valvular insufficiency with congestive heart failure (Fig. 77.3). Mildly affected animals exhibit no clinical signs, making the condition difficult to detect. The extent of this disease is uncertain, but it is highly probable that cardiac disease is underdiagnosed. Incorporating echocardiographic examination with preventative health evaluations for captive wild dogs is recommended by the SSP in order to identify and medically manage affected individuals.[8] Treatment recommendations are based on those for domestic dogs and have included angiotensin-converting enzyme (ACE) inhibitors, diuretics, and inodilators (pimobendan). Despite the challenges associated with a progressive genetic bottleneck, it is strongly recommended that individuals with cardiac disease not be selected for breeding to prevent further incorporation of genetic defects into breeding lines (Briggs, personal communication, April 22, 2017).

Neoplasia has not been extensively reported in the literature but appears to play an important role in the health of captive populations.[48] Apocrine gland tumors have been documented in clinical settings, presenting as single or multiple dorsal cutaneous masses that can progress to large regionally invasive tumors (Fig. 77.4) (Agnew, personal communication, April 25, 2017). Cases from females are overrepresented in pathology reports submitted to the African wild dog SSP (Kinsel, personal communication, April 10, 2017). Surgical excision is recommended, although large tumors may require other forms of treatment. Tumor growth results in ulceration and necrosis and negatively affects an animal's quality of life. Other common neoplasias include hemangiosarcoma, peripheral odontogenic fibroma (fibromatous epulis), adrenocortical adenoma/carcinoma, and mammary and uterine neoplasia.

Other notable conditions diagnosed in African wild dogs include dental disease—particularly fractured teeth—pancreatitis, diabetes, spina bifida, syringomyelia, keratitis, snake bites,[49] and trauma from conspecifics (Kinsel, personal communication, April 10, 2017). African wild dogs mask signs of illness and may have advanced disease by the time a change in behavior or appetite is observed.

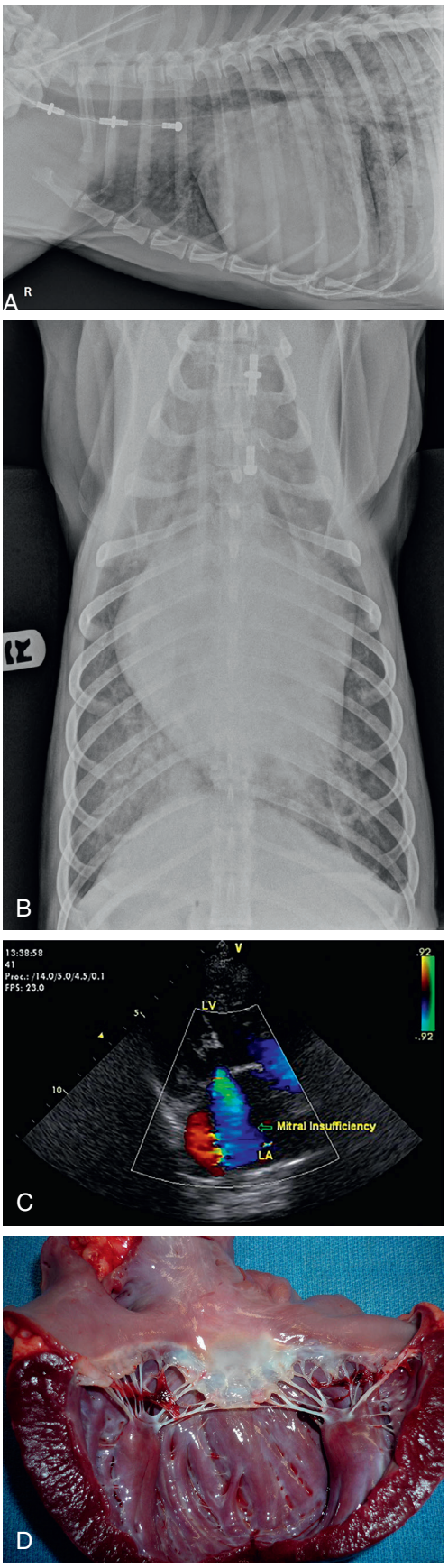
TABLE 77.4 Serum Chemistry Values for African Wild Dogs *(Lycaon pictus)*

Parameter	Mean	SD
Calcium (mg/dL)	10.2	0.78
Phosphorus (mg/dL)	5.5	1.88
Sodium (mEq/L)	148	4.75
Potassium (mEq/L)	4.6	0.75
Chloride (mEq/L)	116	5.25
Bicarbonate (mEq/L)	20	5.25
Carbon dioxide (mEq/L)	19.6	4.25
Blood urea nitrogen (mg/dL)	25	8.75
Creatinine (mg/dL)	1.1	0.35
Total bilirubin (mg/dL)	0.2	0.1
Glucose (mg/dL)	148	39.3
Cholesterol (mg/dL)	260	74
Triglyceride (mg/dL)	69	43.25
Creatine phosphokinase (IU/L)	229	141.75
Alkaline phosphatase (IU/L)	55	45.25
Alanine aminotransferase (IU/L)	50	21
Aspartate aminotransferase (IU/L)	36	15.75
Gamma glutamyltransferase (IU/L)	6	3
Lactate dehydrogenase (IU/L)	181	172
Uric acid (mg/dL)	0.4	0.35
Amylase (IU/L)	375	199.5
Lipase (IU/L)	123	70.5
Total protein (colorimetry) (g/dL)	5.9	0.63
Globulin (colorimetry) (g/dL)	2.8	0.6
Albumin (colorimetry) (g/dL)	3.2	0.4

General ZIMS database reference: Species360 (2017), ZIMS.Species360.org.

Preventative Medicine

Preventative health, preshipment, and quarantine examinations should be conducted to determine an animal's health. A complete physical exam—including a dental examination, complete blood count, chemistry panel, heartworm testing, urinalysis, radiographs of the thorax and abdomen, and evaluation for endo- and ectoparasites—should be completed on a routine schedule as part of a preventive medicine plan. Additionally, abdominal ultrasound examination or computed tomography in females and echocardiograms for both sexes are recommended owing to disease predilection in this species.



• **Figure 77.3** Images from African wild dogs *(Lycaon pictus)* with heart disease: (A) Lateral and (B) ventrodorsal radiographs of the thorax consistent with congestive heart failure. (C) Echocardiography image showing mitral insufficiency. (D) Necropsy image of mitral valve dysplasia.

• **Figure 77.4** Advanced apocrine gland neoplasia along the dorsum in an African wild dog *(Lycaon pictus)*. (Courtesy A. Moresco, Denver Zoo.)

TABLE 77.5 Selected Vaccination Schedules Used for African Wild Dogs *(Lycaon pictus)*

Disease	Vaccine	Schedule (Weeks)
Canine distemper	PUREVAX Ferret Distemper Live Canarypox vector vaccine (Merial)	Begin at 6–9 weeks, booster subcutaneously every 2–3 weeks through 16–20 weeks and repeat annually
Rabies	Imrab 3 (Merial)	Initially at 14–16 weeks, booster at 1 year and then every 1–3 years thereafter

External and internal parasites should be treated according to domestic dog guidelines. Fleas, ticks, and ear tip trauma from biting flies have responded well to products containing carbaryl or pyrethrins. Good hygiene, removing standing water, fly traps, and premise sprays help control fly and mosquito populations.

Newly acquired animals should be quarantined away from the collection for a predetermined period based on a thorough risk assessment by the supervising veterinarian and have at least two negative fecal examinations. Animals should be individually identified with microchip transponders placed subcutaneously between the shoulder blades or to the left of midline over the shoulder.

Currently there are no universal recommendations for vaccination protocols. The safety and efficacy of vaccines in African wild dogs have historically been unsatisfactory. Vaccination strategies to conserve free-ranging populations have been reported and continue to be investigated.[50] Modified live canine distemper vaccinations have failed to produce protective antibody levels in some cases[51] and have induced distemper resulting in mortality in other cases.[7,45,52,53] Vaccine-induced distemper can be avoided by using killed vaccines, and at least one vaccine (Purevax ferret Distemper, Merial Inc., Athens, Georgia) has been shown to produce measurable titers after a series of three injections at 2- to 3-week intervals.[54] Subunit canine distemper vaccines (CDV-ISCOM, Erasmus MC, Rotterdam, The Netherlands) stimulated appropriate titer formation, but titers did not endure relative to the Purevax Ferret Distemper vaccine. Vaccine recommendations for domestic dogs have been reduced from yearly to triennially; however, it is unknown whether nondomestic canids maintain titers in a similar manner. In one study, protective titers from the Purevax vaccine persisted in 39%–85% of African wild dogs for a minimum of 1 year.[55] Early studies have indicated that vaccination with killed rabies vaccines may not be sufficient for protection.[5,50,56] However, a recent study showed that a single intramuscular vaccination of dogs older than 14 weeks with Imrab 3 (Merial Inc., Athens, Georgia) provided persistent protective titers.[57] A survey in 2006 showed that most African wild dogs maintained presumably protective titers after vaccination for canine distemper and rabies for 1 year; however, few dogs maintained titers for 2–3 years.[58] There is a paucity of scientific information regarding vaccination against canine parvovirus and leptospiral infection. Protocols should be developed that take into consideration local environmental disease prevalence, animal health, and risk factors. Select vaccination protocols for captive African wild dogs are listed in Table 77.5 (see also Chapter 79).

Acknowledgments

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