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Oliphant 40

was negative. Material lung abscess was sent to artment of Clinical Lab- of the National Jewish l and Research Center, Colo, for isolation and ation of the organism. The organism was grown on Löwenstein-Jensen agar and was identified as *Mycobacterium tuberculosis*. It was identified as the causative agent in the lung only, but it is likely that the lesions in other tissues also were caused by this organism. This organism rarely has been isolated from elephants in the United States.[1,2]

The microscopic features of the tubercles in this elephant were those of granulomas, with caseation necrosis and mineralization. These are the features of *M tuberculosis* in man[3] and other animals.[4] Multinucleated giant cells are also a common feature of the disease in man. In this elephant, they were found in small numbers, whereas in other elephants, they have been found infrequently[1] or not at all.[5,6]

The clinical diagnosis of *M tuberculosis* infection in elephants by intradermal skin testing may not be reliable in all cases, since the elephant is considered to be a weak responder to intradermal skin testing for *M tuberculosis*.[3] The elephant of this report had a negative skin test to *M tuberculosis*.

1. Thoen CO, Himes EM: Tuberculosis in Davis JW, Karstad LH, Trainer DO (ed) *Infectious Diseases of Wild Mammals*, ed Ames, Iowa State University Press, 19 pp 263–274.
2. Thoen CO, Richards WD, Jarnagin JL: Mycobacteria isolated from exotic animals. *J Am Vet Med Assoc* 170:987–990, 1977.
3. Francis J: *Tuberculosis in Animals and Man*. London, Cassell and Co, 1958.
4. Thoen CO, Karlson AG, Himes EM: Mycobacterial infections in animals. *Rev Infect Dis* 3:960–972, 1981.
5. Pinto MRM, Jainudeen MR, Pa abokke RG: Tuberculosis in a domestica Asiatic elephant. *Vet Rec* 93:662–664, 19
6. Seneviratna P, Wettimuny SGde Seneviratna D: Fatal tuberculous pneumonia in an elephant. *VM SAC* 60:129–132, 1966.

Etorphine analgesia supplemented by halothane anesthesia in an adult African elephant

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WE WERE REQUESTED by the Knoxville Zoological Park to anesthetize a 25-year-old African elephant *(Loxodonta africana)* weighing approximately 3,000 kg. The elephant had a root infection of the left tusk, with several fistulous tracts and a large subgingival abscess.

While standing, the elephant was positioned with her left side against the bars of the compound, and chains were passed from the bars under her body, to her right fore- and hindlimbs. Etorphine HCl[1] (6 mg; approximately 1 mg/450 kg) was injected, using a dart gun. The injection was made in the hamstring area of the left hindlimb. Forty minutes later, when the elephant became ataxic, ropes were placed on the chained limbs, and she was forced into right lateral recumbency by applying constant pressure on the ropes. Both nostrils were intubated with 13-mm (internal diameter) Murphy endotracheal tubes[2] and the cuffs were partially inflated.

Halothane[3] was administered at a dialed concentration of 2.5%, at an oxygen flow rate of 14 L/min. A semiclosed, large animal circle system was used with one 30-L rebreathing bag. The vaporizer[4] was a manually thermocompensated out-of-circle vaporizer.

At the time of intubation, the heart rate was 42 beats/min, the respiratory rate was 8 breaths/min, and the rectal temperature was 37.1 C. The eyes were closed and there was no corneal reflex. Surgery was initiated and it consisted of pulpectomy, subsequent filling of the pulp cavity, and gingival curettage. After the first 30 minutes of anesthesia, the heart rate decreased to 32 beats/min and respiration was unchanged. The halothane concentration was decreased to 0.5% and the oxygen flow was continued at the rate of 14 L/min. Fifteen minutes later, the elephant opened her eyes, her trunk tone returned, and her ears moved intermittently. Etorphine HCl (1 mg) was administered, and the halothane concentration was increased to 2.5%. During the next 30 minutes, the heart rate varied between 32 and 42 beats/min and respiration continued to be spontaneous, ranging from 5 to 10 breaths/min. The elephant's eyes remained closed and no further trunk or ear movement was noticed. When surgery was completed, the rectal temperature had decreased to 36.4 C. The inhalant anesthetic was discontinued and oxygen was administered to the elephant for an additional 10 minutes. During this period, the heart and respiratory rates remained unchanged. Diprenorphine[5] (1 mg) was given intravenously. Three minutes after the injection nystagmus developed and the elephant regained ear and trunk movement. The oxygen was discontinued, and the elephant was

TABLE 1—Injectable (IM) immobilizing agents for elephants

Agent	Dosage
Xylazine[6,9,10]	0.08 to 0.14 mg/kg*
Morphine[11,19]	0.03 to 0.2 mg/kg
Meperidine[11,20]	0.03 mg/kg
Gallamine[12,21]	0.8 mg/kg†
Thiopentone sodium[12,22]	3 mg/kg†
Fentanyl[13,23]	0.07 to 0.08 mg/kg†
Etorphine[1,14]	Average of 6 mg/adult‡ (weight 2,800 to 6,800 kg)
C1744[15,24]	3 mg/kg‡

*Recommend prior administration of acetylpromazine[26] at a dosage ranging from 0.03 to 0.07 mg/kg. †Recommend prior administration of azaperone[25] at dosage ranging from 0.027 to 0.036 mg/kg. IM = Experimental.

TABLE 2—Reversal agents used with various immobilizing agents

Reversal agent	Immobilizing agents		
	Fentanyl	Morphine-meperidine	Etorphine
Naloxone[16,27]	1 mg: 4 mg of fentanyl	10 mg for a young calf; 30 to 50 mg for an adult	1 mg: 0.12 mg of M99
Levallorphan[13,28]	0.5 mg: 1 mg of fentanyl		0.5 mg: 0.05 mg M99
Nalorphine[14,17,29]			1,000 to 1,500 mg
Diprenorphine[5,7]			2 mg: 1 mg M99
Cyprenorphine[14,18,30]			2 × M99 dose

M99 = etorphine hydrochloride

standing 3 minutes later. The total time of halothane administration was 150 minutes.

Many immobilizing agents and drug combinations have been used for restraint of the elephant. These range from sedative analgesics such as xylazine[6] to the potent narcotic analgesic etorphine. Table 1 is a summary of a few of these immobilizing agents and their dosages. Table 2 is a summary of some reversal agents and their dosages. The reader is encouraged to refer to the reference list for a more detailed description of these agents and their advantages and disadvantages.[7-18]

Several problems are encountered with the administration of inhalation agents to adult elephants. These include effective endotracheal intubation, provision of an adequately sized rebreathing bag, assessment of the proper oxygen flow rate, delivery of this flow rate, and recovery after lengthy anesthesia.

Endotracheal intubation in large elephants is difficult because of the narrow oral cavity. In a report by Fowler and Hart,[7] an adult Asian elephant was intubated with a 30-mm endotracheal tube, which they reported as being the largest they could pass via a cattle speculum. The elephant's weight was not given. Inflation of the cuff was not useful because of the large tracheal diameter. The insufflation method also has been used to administer inhalation agents. In this method, a small diameter (19 to 20 mm) tube is connected to the Y piece of the anesthetic machine, and the tube is passed down the trachea via the oral cavity or through 1 nostril while plugging the other nostril. In the elephant, 70% of air intake is through the trunk and 30% through the mouth.[7] One disadvantage of the insufflation method is the leakage of anesthetic gases and oxygen around the tube, decreasing the efficiency of administration. In other large animals, this usually necessitates higher oxygen flows to effect anesthesia. In this case, one 13-mm Murphy tube was placed in each nostril and the cuffs were partially inflated. These were attached to one Y piece and then to the Y piece of the machine (Fig 1). When the cuffs were completely inflated, the tidal volume exceeded the volume of the anesthetic circuit and the 30-L rebreathing bag. Since the system was not completely sealed, high oxygen flow (14 to 15 L/min) was considered necessary to maintain adequate anesthesia.

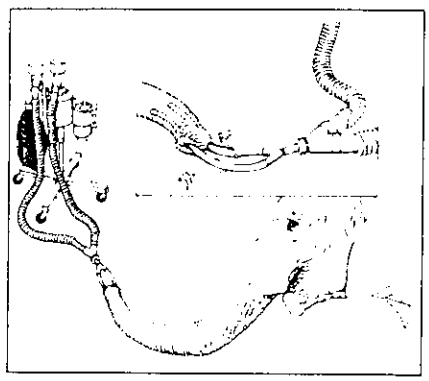

Fig 1—Large animal anesthesia delivery system modified for elephant anesthesia.

In most reported cases of inhalation anesthesia in the elephant,[7,8,11,14,17,18] anesthesia was induced with etorphine or an etorphine-tranquilizer combination. Jarofke[8] maintained anesthesia on halothane alone for 35 to 50 minutes. In our case, total anesthetic time was 150 minutes. The induction dose of etorphine was 6 mg. An additional 1-mg increment was administered 55 minutes later, during which time the elephant was given 0.5% halothane, with oxygen given at the rate of 14 L/min. During the remaining anesthetic period of 135 minutes, additional etorphine was not used and anesthesia was maintained with 2% to 2.5% halothane at an oxygen flow rate of 14 L/min. The addition of halothane to the anesthetic regimen allowed a smaller increment of etorphine for maintenance of surgical anesthesia. As a result, during long procedures the recovery time was decreased, even with the concurrent use of halothane. Diprenorphine (12 mg) was used to reverse the etorphine. Six minutes were required for the elephant to attain a standing position. In most domestic large animals, when anesthesia is maintained with halothane, the recovery time varies from 20 to 60 minutes, depending on the duration of anesthesia. Many animals so anesthetized are ataxic and disoriented when they stand up. For this reason, the combination of etorphine and halothane is better than halothane alone. Jarofke[8] recommends that the reversal agent not be given for several minutes after discontinuation of halothane, thus allowing time for the elephant to begin blowing off most of the gaseous agent. This will reduce the ataxia when the reversal agent is administered. In our case, the elephant was allowed to breath 100% oxygen for 10 minutes, with frequent emptying of the rebreathing bag and with a high oxygen flow rate. Recovery was smooth, with no complications.

The advantage of using etorphine as the sole agent for immobilization of the elephant lies in the quick recovery after administration of a reversal agent. During long procedures, however, additional increments of etorphine may require larger does of the reversal agent and may cause severe cardiopulmonary depression. The addition of halothane inhalation anesthesia to etorphine immobilization reduces the amounts of etorphine and reversal agent necessary for smooth anesthesia and recovery. Halothane, however, must not be overdosed, as it may prolong recovery and produce more ataxia during the recovery period, an undesirable effect in adult elephants.

Additional work is needed on oxygen and anesthetic delivery equipment and systems for these large, unique patients.

1. M99, American Cyanamid Co, Princeton, NJ.

2. Rusch Inc, 53 W 23rd St, New York, NY.

3. Fluothane, Fort Dodge Laboratories, Fort Dodge, Iowa.

4. North American Drager, 148B Quarry Rd, Telford, Pa.

5. Diprenorphine HCl-M-50, American Cyanamid Co, Wayne, NJ.

6. Rompun, Haver-Lockhart Laboratories, Division of Bayvet Corp, Shawnee Mission, Kan.

7. Fowler ME, Hart R: Castration of an Asian elephant using etorphine anesthesia. *J Am Vet Med Assoc* 163:539–543, 1973.

8. Jarofke D: Use of halothane-oxygen anesthesia in elephants. *J Zoo Anim Med* 12:93–95, 1981.

9. Schmidt MJ: The use of xylazine in captive Asian elephants, in *Proceedings.* Am Assoc Zoo Vet, 1975, pp 1–11.

10. Schmidt MJ: A preliminary report on the use of rompun in captive Asian elephants. *J Zoo Anim Med* 6:13–21, 1975.

11. Fowler ME: Elephants—chemical restraint and anesthesia, in *Zoo and Wild Animal Medicine.* Philadelphia, WB Saunders Co, 1978, pp 717–725.

12. Muraleedharan KN, Chandrasekharan K, Jacob V, et al: General anesthesia in an elephant *(Elephus maximus)*—A clinical case report *Kerala J Vet Sci* 10:197–200, 1979.

13. Haigh JC: Fentanyl based mixtures in exotic animal neurolept-analgesia, in *Proceedings.* Am Assoc Zoo Vet, 1976, pp 164–179.

14. Wallach JD: Etorphine (M-99). *VM SAC* 64:53–58, 1969.

15. Gray CW, Bush M, Beck CC: Clinical experience using CI-744 in chemical restraint and anesthesia of exotic specimens. *J Zoo Anim Med* 5:12–21, 1974.

16. Smuts GL: An appraisal of naloxone hydrochloride as a narcotic antagonist in the capture and release of wild herbivores. *J Am Vet Med Assoc* 167:559–561, 1975.

17. Harthoorn AM: The use of a new oripavine derivative for restraint of domestic hoofed animals. *J S Afr Med Assoc* 36:63–66, 1965.

18. Wallach JD, Anderson JL: Oripavine (M.99) combinations and solvents for immobilization of the African elephant. *J Am Vet Med Assoc* 153:793–797, 1968.

19. Morphine Sulfate, Eli Lilly & Co, Indianapolis, Ind.

20. Demerol, Withrop Laboratories, New York, NY.

21. Flaxedil, American Cyanamid Co, Pearl River, NY.

22. Intraval Sodium, May & Baker, Dormorte St, Bromfontain, Johannesburg, South Africa.

23. Fentanyl Citrate, McNeil Laboratories, Ontario, Canada.

24. Parke-Davis and Co, Ann Arbor, Mich.

25. Azaperone, Pitman Moore Ltd, Washington Crossing, NJ.

26. Acetylpromazine malate, Ayr Laboratory Inc, New York, NY.

27. Naloxone HCl, Pitman-Moore Inc, Washington Crossing, NJ.

28. Levallorphan Tartrate, Hoffman LaRoche, Quebec, Canada.

29. Nalorphine-HCl-Nalline, Merk Sharp & Dohme, Rahway, NJ.

30. Cyprenorphine (M-285), American Cyanamid Co, Princeton, NJ.

Pyometra in an African lioness

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A 16-YEAR-OLD, 145-kg African lioness *(Panthera leo)* owned by the Atlanta Zoo had become progressively anorectic, depressed, and wet in her perineum during a 3-week period. She was anesthetized with 500 mg of ketamine HCl and 75 mg of xylazine IM for examination. A purulent vaginal discharge and neutrophilic leukocytosis were found. The following day she was referred to Auburn University, Small Animal Clinic. A hemogram confirmed the neutrophilic leukocytosis and left shift, but serum chemical values were normal.

Abdominal radiography revealed 2 abnormal fluid-filled densities indicative of pyometra. Blood was recovered by needle abdominocentesis.

Later, anesthesia was induced with 500 mg of ketamine HCl and 75 mg of xylazine IM, then maintained with halothane and nitrous oxide in a semiclosed rebreathing system. Laparotomy revealed thrombosed ovarian vessels and a distended necrosing right uterine horn, which accounted for the blood recovered by abdominocentesis. The left uterine horn was dilated. The ovarian vessels were ligated, the uterus and ovaries were removed, and the uterine stump was closed with a Parker-Kerr suture pattern. The abdomen was closed by layers, using simple continuous sutures, and the skin was apposed with subcuticular guard suture to obviate suture removal. Polyglactin 910 (2-0 or 1-0) was used throughout.

A single IM injection of ampicillin (2,500 mg) was administered after surgery. The lioness recovered without complications and has remained normal for [illegible] months.

Escherichia coli was isolated on bacteriologic culture of the uterine contents. The organism was sensitive to several antibiotics, including ampicillin. Histopathologic findings included large corpora lutea in both ovaries, chronic endometritis characterized by exudation of neutrophils into endometrial glands, and lymphocytes and plasma cells in the submucosa.

Pyometra in the lioness has been reported only one other time, and that case was complicated with peritonitis.[1]

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1. Bush M, Montali RJ, Neeley LM, et al.: Pyometra with peritonitis in a lion. *J Zoo Anim Med* 5:21–23, 1974.