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Research article

General anesthesia in two Asian elephants (*Elephas maximus*) using combination of medetomidine hydrochloride and etorphine hydrochloride

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Abstract

General anesthesia was performed in two Asian elephants by using the combination 5.5 - 6.0 mg medetomidine hydrochloride (median = 2.29 ± 0.064 µg/kg) and 4.0 - 5.0 mg etorphine hydrochloride (median = 1.84 ± 0.088 µg/kg) via intramuscular administration. The data was collected and analyzed during five times of general anesthesia procedures. Onset time of light sedation effect presented in 2 - 8 minutes after drug administration; the movement of the ears and tail reduced after 2 - 8 minutes, penis or vulva relaxation occurred after 5 - 20 minutes, eyelids were closed after 3 - 15 minutes, relaxation of the trunk after 6 - 27 minutes, ataxia after 6 - 22 minute, and animal presented lateral recumbency posture after 7 - 30 minutes of drug administration. A combination of atipamezole hydrochloride 28 – 30 mg (median = 11.64 ± 0.39 µg/kg) and naltrexone 250 – 330 mg (median = 0.11 ± 0.018 mg/kg) was given as a reversal agent, which was five times the amount of medetomidine hydrochloride and fifty times the amount of etorphine hydrochloride respectively. Recovery effect started from open eyelids 0.5 - 4 minutes, trunk movement 1 - 4 minutes, head lifting 2 - 7 minutes, adjusted to standing position 3 - 25 minutes, and completed full recovery 10 - 142 minutes after administration. This study showed effects of the combination of 2.29 ± 0.064 µg/kg medetomidine hydrochloride and 1.84 ± 0.088 µg/kg etorphine hydrochloride in general anesthesia of 2 domestic Asian elephants. The drug combination is effective to induce animal recumbency within 24 minutes.

Keywords: : Anesthesia, Asian elephant, Etorphine hydrochloride, Medetomidine hydrochloride, Naltrexone

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INTRODUCTION

Anesthesia is an fundamental process for veterinary procedures in zoo and wild animals such as diagnostic procedures, sample collections, trunk laceration, dental surgery, laparoscopic vasectomy, and other treatments (Stegmann, Grobler, & Zuba, 2014). Complication of anesthesia is varied among species and method. Anesthesia is challenging for elephants, the world's largest terrestrial mammal, many cautions should be concerned such as animal health condition, pre-anesthetic procedures, physical restraint, animal positioning, and potency of anesthetic drug or method.

General anesthesia in elephants could be performed by using various combination of sedative and anesthetic drugs. In 1999, Stegmann has performed general anesthesia on oral examination of an elephant using an intramuscular (IM) administration of azaperone and etorphine hydrochloride (M99) then maintained with halothane inhalation (Stegmann, 1999). The usage of azaperone combining with etorphine hydrochloride to anesthetize nine African elephants for semen collection was reported (Howard, Bush, De Vos, & Wildt, 1984). Twenty free range African elephants were anesthetized with 9.5 ± 0.5 mg etorphine hydrochloride intramuscularly by a dart rifle. Lateral recumbency was achieved in 8.7 ± 2.4 minutes (Osofsky, 1997). Thongtip et al. (2015) reported using azaperone (IM) with etorphine hydrochloride (IV) and supported by a crane to remove foreign body from esophageal obstruction. The elephant was arranged in a right lateral recumbency position and supplied with oxygen through its trunk. An endotracheal tube was intubated after the jaw tone was relaxed, then maintained with 5% Isoflurane throughout the anesthesia.

Medetomidine hydrochloride is a high potency lipophilic compound with selective α2-adrenoreceptor stimulating properties. It may, therefore, prove to be a suitable pharmacologic tool in α2-adrenoreceptor mediated effects in the autonomic nervous system (Savola, Ruskoaho, Puurunen, Salonen, & KÄRki, 1986). Medetomidine hydrochloride also induces respiratory rate reduction and bradycardia (Sarma, Pathak, & Sarma, 2002). Thus, to monitor an anesthetized elephant, respiratory system is strictly monitored by observing ventilation rate, pulse oximeter, pulse rate, and body temperature (Stegmann et al., 2014). Etorphine hydrochloride (M99) is a semi-synthetic opioid possessing an analgesic ability approximately 1,000 – 3,000 times that of morphine (Bentley & Hardy, 1967). Although there is a high incidence of side effects, including severe cardiopulmonary depression. This drug plays an important role in large mammals, such as rhinoceroses and elephants, immobilization (West, Heard, & Caulkett, 2014). The main advantage is its onset time, and more importantly as its reversal agent, also has rapid reversal effect.

In previous study, only single anesthesia agent was used to sedate/anesthetize elephant, none were reported using combination of two agents together. Medetomidine HCl is an excellent muscle relaxant while etorphine HCl improves anesthesia efficacy. They both have reversal agents. To reduce each anesthesia agent's side effects, a combination of medetomidine hydrochloride and etorphine hydrochloride were used for general anesthesia in elephants, with atipamezole and naltrexone as their reversal agents. This case report aims to observe the effects, onset time, duration of the drug combination, and recov-

ery effects in two Asian elephants.

MATERIALS and METHODS

Clinical history and symptoms

General anesthesia was performed in two domestic Asian elephants; the first one (elephant A) is a 45 years old female (body condition score = 3/5) was anesthetized for an oral and physical examination while the second one (elephant B) is a 35 years old bull (body condition score = 3/5) with esophageal obstruction problem including aphagia and regurgitation signs for consecutive 3 days. This procedure was approved by elephant's owner.

Animals and anesthetic area preparation

The elephants went through general physical examination and health assessment with blood collection to obtain hematological parameters. The parameters of these two elephants were in normal range. These elephants had no cardiopulmonary abnormality (normal respiratory rate, no arrhythmia) led to anesthesia complications. Food and water were withdrawn for 36 and 12 hours, respectively, in both elephants to reduce a change of pulmonary aspiration (Fowler et al., 2000). Thirty-six square meters flat terrain was prepared as an anesthesia area. Two stable pillars with 3 - 4 meters gap were installed for elephants physical restrain. A 5.0 x 2.8 meters rubber mattress with 10 centimeters thickness was placed to support elephant body weight during anesthesia.

Procedures of elephant anesthesia

Elephants were prepared at the anesthesia area after health assessment, weight recording, and feed withdraw. In case of left lateral recumbency was preferred, the right forelimb and hindlimb will be tied to restrain pillars. Fasten the ropes on each left extremities, then put them under animal's chest and belly. These two ropes will be pulled up, put across elephant's back, and tied 3-4 meters away from its left side (Figure 1). Mattress and rubber tires will be placed under the animal's body to support its body weight. If right lateral recumbency is preferred, complete the process in the opposite direction.

Figure 1 Elephant preparation and positioning before drugs administration; left lateral recumbency position preferred.

Medetomidine hydrochloride (Kyron®, Prescription, South Africa) (Sarma et al., 2002) and etorphine hydrochloride (Captivon®, Wildlife Pharmaceuticals, South Africa) (Fowler, Steffey, Galuppo, & Pascoe, 2000) were administered (IM) at the triceps branchii muscle. Clinical responses to the drugs and onset reactions (i.e. resting, closed eyelids, relaxation of the trunk, and recumbency) duration were monitored and recorded. In case of maintaining the stage of anesthesia, isoflurane (Terrell®, Piramal critical care, Inc., USA) was considered to use through endotracheal tube and anesthetic machine. During anesthesia procedure, all parameters e.g. respiratory rate, pulse rate, oxygen level, body temperature, and blood pressure were measured. The reversal agents i.e. atipamezole hydrochloride (Antisedan®, Zoetis Inc., Finland) and naltrexone (Trexonil®, Wildlife Pharmaceuticals, South Africa) would be administered after veterinary procedure has been completed. Vital and recovery signs were continuously monitored until the elephants gained full recovery. Total amount of drugs usage, dosage, and other clinical parameters measured from both before and after drug administration were presented in median ± standard deviation.

RESULTS

Elephant A and B were anesthetized one and four times respectively. General anesthesia was performed in elephant B every 4 - 7 days for consecutively 4 times within 20 days after the clinical signs were observed. Anesthetic reversal drugs were given after each operation for better recovery. Prior to anesthesia procedures, we weighed the animal with an electronic platform scale. The body weight range was 2,350 - 2,700 kg (median = 2,444 ± 152.2 kg). An amount of 5.5 – 6 mg of medetomidine hydrochloride (median = 2.29 ± 0.064 µg/kg), and 4 - 5 mg of etorphine hydrochloride (median = 1.84 ± 0.088 µg/kg) was administered. The elephants displayed sedated signs at 4.6 ± 2.7 minutes onset time, ears and tail movement declining after 5.2 ± 2.8 minutes, penis protrusion after 10 ± 6.9 minutes, closed eyelids after 10.4 ± 5.5 minutes, relaxation of trunk after 11.4 ± 8.8 minutes, ataxia after 12.5 ± 6.8 minutes, and lateral recumbency after 18.4 ± 8.85 minutes of one injection of this combinable drugs administration (Figure 2). Four general anesthesia was performed with 5.5 – 6 mg of medetomidine hydrochloride (median 2.28 ± 0.067 µg/kg) and 4 – 5 mg of etorphine hydrochloride (median 1.88 ± 0.047µg/kg). However, the forth attempt of general anesthesia in elephant B with the same dosage of medetomidine hydrochloride and 1.7 µg/kg of etorphine hydrochloride did not manage to reach general anesthesia. Thus, 28 minutes after first drugs administration, a supplement of 1 mg of etorphine (0.43 µg/kg) was given intravenously (IV). Two minutes after the supplement, elephant B changed to a lateral recumbency position (Table 1).

Figure 2 The elephant gradually fell down to a right lateral recumbency position after anesthetic drug administration. Tied ropes were pulled to guide the elephant to lay down in the right direction.

Table 1 Anesthetic agents and reversal drugs in each time of anesthesia: total amount, dose, drug supplement time.

Anesthesia data		Elephant A	Elephant B			
			1st	2nd	3rd	4th
Elephant weight (kg)		2,700	2,470	2,350	2,350	2,350
Medetomidine HCl	Total amount (mg)	6.0	5.5	5.5	5.5	5.5
	Dose (µg/kg)	2.22	2.23	2.34	2.34	2.34
Etorphine HCl	Total amount (mg)	5.0	4.5	4.5	4.5	4.0
	Dose (µg/kg)	1.85	1.82	1.91	1.91	1.70
Etorphine HCl supplement	Supplement time/ amount (dose µg/kg)	-	-	-	-	28 min/ 1 mg (0.43)
Etorphine HCl maintain	Supplement time/ amount (dose µg/kg)	-	98 min/ 1 mg (0.40)	91 min/ 1 mg (0.40)	-	-
		-	-	138 min/ 1 mg (0.40)	-	-
		-	1000	1500	4000	-
Isofurane	Percentage	-	-	-	1-4 %	2%
	Minute of isofurane administration	-	-	-	56 - 288	44 - 50
	Duration (min.)	-	-	-	232	6
Atipamezole HCl	Total amount (mg)	30	28	28	28	28
	Times of medetomidine	5.00	5.09	5.09	5.09	5.09
	Dose (µg/kg)	11.11	11.34	11.91	11.91	11.91
	Supplement time/ amount (dose µg/kg)	-	-	-	117 min/ 10 mg (4.26)	-
Naltrexone	Total amount (mg)	250	275	330	280	250
	Times of etorphine	50.00	50.00	50.77	50.91	50.00
	Dose (mg/kg)	0.09	0.11	0.14	0.12	0.11

kg = kilograms, mg = milligrams, µg = micrograms, ml = milliliter, min. = minute

Intubation with 35 mm endotracheal tube was inserted in trachea when animal's jaw-tone is relaxed. The endotracheal tube was then connected to a connecter and two demand valves linked to oxygen (Figure 3 and 4). For isoflurane vaporizer was used for maintain anesthetic stage if necessary. Fluid therapy was given intravenously in case supplemental drugs were required.

Figure 3 Endotracheal tube no. 35 (arrow) prepared for intubation.

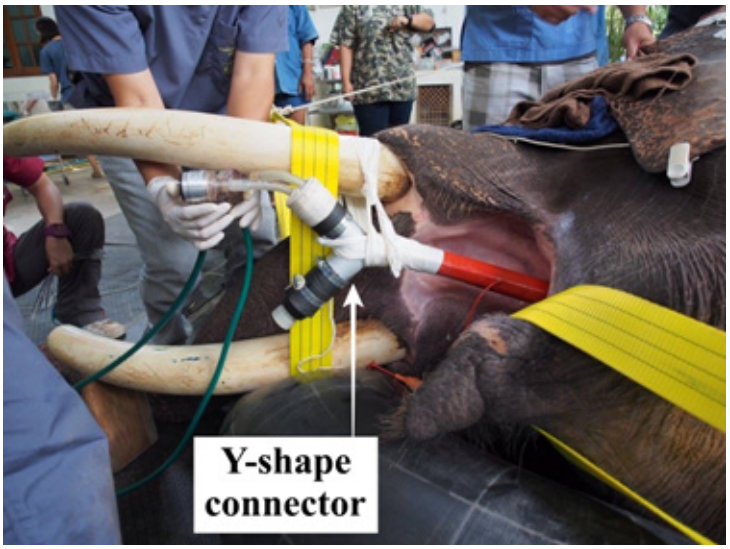

Figure 4 Oxygen was given through two demand valves connected with the endotracheal tube using Y-shape connector (arrow) accessing the respiratory circuit.

Normal respiratory rate before anesthesia was 5 - 8 times/minute which then decreased 3 - 6 times/minute during anesthesia. Pulse rate during anesthesia was 15 - 37 beats/minute minimum, and 40 - 49 beats/minute maximum. Minimum saturated oxygen level was 48-91% while maximum level was at 98 - 100%. Body temperature 96.4 - 99.0 ºF (Table 2).

Table 2 The vital signs recorded during general anesthesia of elephant A and B: Respiratory rate (RR), Pulse rate (PR), Peripheral oxygen saturation (SpO_2).

Vital sign during anesthesia	Elephant A	Elephant B			
		1st	2nd	3rd	4th
RR before anesthesia (tpm)	8	8	8	8	8
RR - min (tpm)	5	3	3	3	3
RR - max (tpm)	6	5	6	6	6
PR- min (tpm)	15	23	24	26	37
PR -max (tpm)	40	49	42	48	48
SpO_2 – min (%)	91	48	72	91	89
SpO_2 – max (%)	100	98	100	100	100
Temp - min (degree Fahrenheit)	96.4	97.6	97.8	97.4	97.8
Temp - max (degree Fahrenheit)	96.8	98.5	98.4	98.6	99

tpm = time per minute, bpm = beat per minute, min = minimum, max = maximum

The duration of each anesthesia was diverse depended on procedures carried on the elephant in each attempt. Anesthesia duration was calculated from the time of recumbent to the administration of reversal agents. The duration of the first anesthesia performed in elephant A was 26 minutes while the second attempt on elephant B was 127 minutes. Total 1 mg etorphine hydrochloride and 1,000 ml of guaifenesin (glycerol guaiacolate; GG) was given intravenously at 98 minute to maintain the anesthesia. The duration of the third attempt on elephant B was 144 minutes, with a maintenance of 1 mg etorphine hydrochloride after the initial dose. Intravenous of GG, 1,500 ml, was given at 91 and 138 minute to prolong the anesthesia time. The fourth attempt totally took 281 minutes and maintained with 1 - 4% Isoflurane during 56 - 288 minute after the initial dose. An amount of 1,500 ml GG was given intravenously to prolong the anesthesia. The duration of the fifth anesthesia was 48 minutes which then maintained with 2% Isoflurane 35 minute after an initial dose.

Once the veterinary procedures were completed, reversal agents were given and recovery time was recorded. Average recovery time of all anesthesia operations was 143.6 ± 94.4 minutes. Atipamezole hydrochloride 28 – 30 mg (median dose 11.64 ± 0.39 μg/kg) and naltrexone 250 – 330 mg (dose 0.11 ± 0.018 mg/kg), which were five times of the amount of medetomidine hydrochloride and 50 times of the amount of etorphine hydrochloride respectively, were given as reversal agents. Elephant signs responsive to the reversal agents by eyelids opening at 1.5 ± 1.41 minutes, trunk movement 1.6 ± 1.34 minutes, head rising 3.6 ± 2.07 minutes, standing 8.2 ± 9.47 minutes, and fully recovery 42.4 ± 56.5 minutes after administration. Diet and water were offered 4-6 hours after full recovery (Table 3).

Table 3 Initial time of anesthesia and recovery signs, duration of anesthesia procedure.

Anesthesia data time	Clinical signs	Elephant A	Elephant B			
			1st	2nd	3rd	4th
Time of anesthesia sign	Reduce ear & tail movement	8	5	8	2	3
	Trunk down	9	7	8	6	27
	Penis protrusion	-	5	20	6	9
	Leg stiffness	12	10	22	6	
	Eye closing	15	13	15	6	3
	Snoring	-	13	-	-	-
	Sit down	14	-	-	-	-
	Lateral recumbency	16	15	24	7	30
	Salivation	-	-	-	-	25
Time of recovery sign	Eye open (min.)	0.5	1	1	4	1
	Trunk movement (min.)	1	1	1	4	1
	Head up (min.)	2	4	3	7	2
	Sternal recumbency (min.)	2.5	5	3	7	2
	Standing (min.)	3	6	4	25	3
	Full recovery (min.)	10	14	12	142	34
Time of down to antagonist (min.)		26	127	144	281	48
Time of etorphine HCl to antagonist (min.)		42	142	168	287	79
Time of etorphine HCl to full recovery (min.)		52	156	180	429	113

min. = minute

DISCUSSION

Most anesthetic drugs in elephants are highly potent and fatal. Practicing is extremely essential for anesthetist to gain experience. First aid and resuscitation training is also required in case of accidents involving anesthetics intake in human. This study showed effects of the combination of 2.29 ± 0.064 µg/kg medetomidine hydrochloride and 1.84 ± 0.088 µg/kg etorphine hydrochloride in general anesthesia of 2 domestic Asian elephants. The drug combination is effective to induce animal recumbency within 24 minutes. The only

unsuccessful anesthesia in this study occurred during the forth attempt that elephant given 1.7 µg/kg etorphine hydrochloride did not achieve lateral recumbency for 28 minutes. Therefore, a supplement of 1 mg etorphine (0.43 µg/kg) was given intravenously. Two minutes after the supplement, the elephant changed his posture to lateral recumbency position. Supplemental anesthetic agents should be administered with caution. Sudden responses such as immediate collapse could occur. Fowler et al., (2000), anesthetized Asian elephant by three etorphine hydrochloride shots separately; first shot of 0.35 µg/kg etorphine hydrochloride was given via intramuscular route, followed by 0.27 µg/kg intramuscularly at 12th minute, and the last 0.27 µg/kg shot via intravenous at the 40th minutes. The elephant was completely anesthetized at minute 43. In another study, Asian elephant was sedated by 0.0266 mg/kg azaperone via intramuscular route, then anesthetized by 0.66 µg/kg etorphine hydrochloride, IV. After 3 minute, the elephant was down with weight being supported by the sling, however intubation was unsuccessful since the animal still had jaw tone. Anesthetic agent was supplemented by intravenous with 0.5, 1.5, and 1 mg etorphine hydrochloride combined with 5% isoflurane (Thongtip et al., 2015).

Usage of medetomidine hydrochloride as a premedication anesthesia leads to mild sedation and muscles relaxation, animals in this study showed signs of premedication such as ears and tail movement declining, penis protrusion, closed eyelids, and relaxation of trunk within 20 minute. Moreover, other side effects which can also present after lateral recumbency including bradycardia, decreased respiratory rate, and decreased body temperature (Stegmann et al., 2014).

For African elephant, general anesthesia was performed in higher dose of etorphine hydrochloride than Asian elephant dosage. Free ranging African elephants in Northern Botswana were immobilized with 9.5 ± 0.5 mg (2.21 µg/kg) etorphine hydrochloride and hyaluronidase by intramuscular dart. The onset effect was 3.8 ± 1.8 minutes (range: 1.6 – 9.5 minutes), the average time to recumbency was 8.7 ± 2.4 minutes (Osofsky, 1997). There is no difference concerning time of drug effectiveness between Osofsky's compared to our study, hence the higher dose of etorphine was proved to promote more rapid induction (Kock, Martin, & Kock, 1993). Elephants with body mass less than 600 kg showed significant changes in the alveolar-arterial and arterial-peripheral venous parameters, compared with elephants with a body mass larger than 600 kg, they used higher dose in elephants with less than 600 kg body weight (Still, Raath, and Matzner, 1996).

Restrain method and position of anesthetized animals during veterinary procedures were tremendously essential. In this study, elephants were put in custom-made rope, administered with etorphine hydrochloride in standing position, then adjusted the animal's position to lateral recumbency with the support of rubber mattress and rubber tires. Elephants showed no trauma evidence. Thongtip et al., (2015) reported a case study of 30-year-old female domestic Asian elephant sedated by 80 mg azaperone, weight-bearing support was provided by crane. No complication was found on the animal after the sedation. A previous report of general anesthesia in an elephant required for foot orthopedic care used ropes and slings to support the elephant prior to anesthesia (Fowler et al., 2000). Proper elephant positioning by experienced staffs is one of the important key during anesthesia.

Once the elephant is reclined, the position is difficult to adjust. Full growth elephants with body weight ranged from 3,000 to 5,000 kg can cause physiological implications when anesthetized. Appropriate padding is required to prevent complications such as myositis and neuropraxia during recumbency (Stegmann et al., 2014). In this study, pressure sores caused by mattress appeared at the tips of shoulder and hip area in case of more than 2 hours of lateral recumbency. Recumbency position also result in hypoventilation associated with hypercapnia and hypoxemia. Yet lateral recumbency is mandatory while sternal recumbency can lead to fatal result.

Intubation of endotracheal tube is considered to be necessary in all general anesthesia practice. In this study, 35 mm endotracheal tube was intubated in 2,350 – 2,470 kg elephant without traumatize the trachea while Fowler et al., (2000) intubated the anesthetized 2,817 kg Asian elephant using 30 mm tube. The ventilation device was constructed from a large animal breathing circuit Y-piece and two high-flow demand valves. The end of Y-piece was free allowing an attachment to endotracheal tube (Horne, Tchamba, & Loomis, 2001). Elephant B was successfully intubated and supplied oxygen by two demand valve via endotracheal tube and Y-connector. Oxygen supplement is recommended to prevent the respiratory depressant and sympathomimetic effects from etrophine hydrochloride (Still et al., 1996). From Dunlop and other studies in 1994, tachycardia and hypertension were developed in lateral recumbency-air breathing elephants after intramuscular administration of etorphine hydrochloride. Though it could be resolved after isoflurane and oxygen were administered without antidote administration. Sub-anesthetic effects of etrophine hydrochloride was persisted for at least 3.75 hours (Dunlop, Hodgson, Cambre, Kenny, & Martin, 1994).

Placing an oxygen hose through elephant trunk is an alternative method of respiratory assist. Some elephants with dental abnormalities or oral cavity decrement could be nearly impossible to intubate. Elephant A from this study, was not intubated due to dentition malformation therefore oxygen was supplied through trunk during anesthesia. Anesthesia elephant were breathing spontaneously, initial respiratory rates ranged from 6–12 times per minute (Horne et al., 2001). In this case report, respiratory rate was reduced during anesthesia, however dyspnea was not present. Hypoxia was prevented by connecting oxygen tank through demand valves to the endotracheal tube. Minimum saturated oxygen levels of this study was 48 - 91%, while maximum levels should be at 98 - 100%. Reading errors might occurred while using pulse oxymeter sometimes. During the anesthesia, animal's mucous membrane was pink. However, when performing etorphine immobilization, intermittent positive-pressure ventilation (IPPV) delivering 100% oxygen should be utilized to reduce risks associated with hypoxia problem (Horne et al., 2001).

The anesthesia monitoring protocol including cardiothoracic auscultation, palpation of auricular pulse for quality and regularity, rectal temperature recording, respiratory and heart rates monitoring, hemoglobin oxygen saturation percentage (SpO_2) monitoring (Osofsky, 1997). Cardiovascular monitoring should be performed by checking heart rate and mean arterial blood pressure (MAP) placing a 12 x 30 cm. cuff on base of tail. Direct arterial pressure can be monitored using a sphygmomanometer connected to a catheter in the auricular artery at the level of the heart. End tidal CO_2 ($ETCO_2$) and respiratory rate were

monitored by sidestream capnography (Horne et al., 2001). A 18-gauge catheter, connected to a transducer and cardiovascular oscillographic recorder, was placed in elephant's auricular artery, positioned level with elephant's thoracic inlet, for direct measurement of arterial blood pressure. Wire leads were also attached to skin surface to record a base-apex electrocardiogram (Fowler et al., 2000). In this case report, three parameters were recorded including respiratory rate, pulse rate, and peripheral oxygen saturation. To improve monitoring accuracy, more parameters and equipment (e.g. direct left atrial pressure monitoring) should be installed during anesthesia.

From this study, the elephant could stand up within 6 minutes and reach full recovery within 34 minutes in cases of anesthetic duration that less than 144 minutes; while the anesthetic duration that longer than 281 minutes, the standing and full recovery time would hold up to 25 and 142 minutes respectively. Hence, the longer time of elephant under anesthesia correlated with prolong recovery time. In the other studies, full recovery time after anesthesia performed in (number) elephants was discordant, the animals displayed standing posture between 1.8 and 9.6 minute post administration of diprenorphine. Total elapsed time of procedure ranged from 21.9 - 39.4 minutes (Osofsky, 1997). Lüders et al. (2016) reported that the recovery time from medetomidine hydrochloride and butorphanol took 3 – 8 minutes after intramuscular atipamezole and naltrexone administration. Neiffer et al. (2005) had observed a recovery time from elephant using naltrexone after butorphanol administration, it ranged from 2 - 20 minutes.

Medetomidine-etorphine combination is efficient drug combination in not only elephant with normal condition but also ones with upper gastrointestinal tract problems. Medetomidine hydrochloride is an excellent muscle relaxant while etorphine hydrochloride improves anesthesia efficacy (Sanchez, 2015). Since they both have reversal agents, this drug combination is recommended in large animal general anesthesia practice. To avoid their side effects and physical complications from prolonged recumbency, this drug combination is recommended for short duration. In addition, the study could be the preliminary study to develop the use of these two drugs as a guideline for performing the general anesthesia in elephants. So, further study is needed by including more number of animals.

CONCLUSION

In this case report, five general anesthesia were conducted in two elephants for veterinary procedures. Both elephants were successfully recovered from every anesthesia attempts. One elephant was anesthetized four time within period of 16 days, there was one out of four attempts that the elephant had stayed in lateral recumbency for more than 4 hours.

General anesthesia in elephants is an important process for specific diagnosis and treatment in some circumstances. However, possible complications may cause panic or anxiousness to many practitioners. If the anesthetic process is performed with the correct principles by experienced staffs, the chances of complications will decrease. The anesthesia is recommended for short duration

without any complication. General anesthesia has saved many elephants by providing access to a more precise diagnosis and efficient treatment, which is not common in the elephant practice. Planning and practicing should be performed and ready for the unexpected event.

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