

Limb fracture during recovery from general anaesthesia: an often tragic complication of equine anaesthesia

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ABSTRACT

A 10-year-old Thoroughbred mare was presented for lameness of the left hindlimb as a result of an apical fracture of the lateral proximal sesamoid bone. The mare was ultimately euthanased after suffering catastrophic fractures of the 3rd and 4th metatarsal bones of the contra-lateral hindlimb during an uncoordinated attempt to rise during recovery from general anaesthesia after undergoing arthroscopic surgery. The case report focuses mostly on horse anaesthesia-related mortality, anaesthetic procedure in the horse, possible causes of fractures in horses during recovery and ways in which rate of occurrence of these fractures can be minimised.

Key words: equine, anaesthetic mortality, recovery.

Dzikiti T B, Bester L, Cilliers I, Carstens A, Stegmann G F, Hubert J **Limb fracture during recovery from general anaesthesia: an often tragic complication of equine anaesthesia.** *Journal of the South African Veterinary Association* (2008) 79(3): 145–148 (En.). Department of Companion Animal Clinical Studies, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort, 0110 South Africa

INTRODUCTION

Ever since the advent of anaesthesia in 1846, the subject of anaesthetic mortality has been a source of considerable debate and discussion¹⁵. Post-operative complications related to the musculoskeletal system (fractures and post-anaesthetic myopathy) are more common in the horse than any other commonly anaesthetised animal and have been attributed to the size of the horse and its unique cardiopulmonary physiology as a highly evolved athletic animal^{7,10,15,19}. Peri-anaesthetic mortality of about 1.9 % has been reported when emergency abdominal cases are included in the surveys and about 0.1–1.0 % when only elective surgical cases are considered^{6,13,15,16,18,20}. Furthermore, approximately one quarter of anaesthesia-related deaths may be due to fractures occurring during recovery^{17,19}. There seems to be quite a wide discrepancy in equine anaesthesia-related mortalities from different studies, with a recent publication based on data from one private practice revealing rates as low as 0.21 %².

A number of measures can be used to minimise the risk of fractures in horses during recovery from anaesthesia. The horse can be given a central nervous system depressing drug, usually an alpha-2

adrenergic agonist, to calm it down while it recovers. This form of intervention tends to prolong the duration of the recovery period^{13,19}. Over the past few years, a number of sophisticated recovery systems such as the Anderson 'airlift' sling, the pool raft system and a rapidly inflating-deflating air mattress have been developed^{20,23}. Simpler approaches like the use of ropes to steady the head and tail and use of experienced personnel within a well-padded stall to assist the horse are also employed^{22,23}.

While published retrospective anaesthetic mortality prevalence data due to fractures exist in abundance, there is little information on reports of how individual cases occur.

CASE HISTORY

A 10 year-old Thoroughbred mare weighing 435 kg was presented to the Onderstepoort Veterinary Academic Hospital for weight-bearing lameness of the left hindlimb with mild swelling around the fetlock. The leg had been swollen and non-responsive to medical treatment for 5 months.

Physical examination of the horse confirmed the swollen left fetlock and tentatively diagnosed a proximal sesamoid bone chip fracture. The horse was in good body condition, had normal vital signs as well as normal body temperature, pulse rate and respiratory rate. Results of preoperative haematology profiling were

within normal ranges except for the thrombocyte count, which was 127×10^9 per litre (normal range: $200\text{--}600 \times 10^9$ per litre). Radiography revealed a chronic apical fracture of the lateral proximal sesamoid bone of the left hindlimb with signs of early degenerative joint disease of the fetlock. Ultrasonography revealed mild chronic interosseous medius branch desmitis and confirmed the presence of the apical chip fracture observed on radiograph. Two bone fragments measuring 7 mm and 10 mm in diameter were removed arthroscopically from the left fetlock joint under general anaesthesia (anaesthetic procedure described below). Preoperatively the horse received phenylbutazone (Equipalazone[®] Powder (Bute), Kyron Laboratories, Benrose, South Africa for Arnolds Veterinary Products, UK) at 2.2 mg/kg twice *per os*, procaine penicillin (Depocillin[®], Intervet SA, Isando, South Africa) at 22 mg/kg and 1 ml tetanus toxoid (Tetanus, Onderstepoort Biological Products, Onderstepoort, South Africa).

Anaesthetic procedure

Sedation was achieved by administration of romifidine hydrochloride (Sedivet[®] 1.0 %, Boehringer Ingelheim, Randburg, South Africa) at a dose of 20 µg/kg intravenously 30 minutes prior to induction of general anaesthesia. After local infiltration of 2 ml mepivacaine hydrochloride (Mepivacaine HCl[®] 2 %, Kyron Laboratories, Benrose, South Africa), a 12-gauge catheter (Intraflon[®], Vygon Laboratories, Ecouen, France) was placed aseptically into the left jugular vein for administration of drugs and fluids peri-operatively. Glyceryl guaiacolate ether (GGE Powder 100 %, Kyron Laboratories, Benrose, South Africa) which had been dissolved in sterile water (Intra-Pour Sterile[®], Fresenius Kabi, Bodene, trading as Intramed, Port Elizabeth, South Africa) to a 5 % solution was administered at a dose of 50 mg/kg intravenously for muscle relaxation, just before ketamine hydrochloride (Anaket - V[®] 10 %, Centaur Laboratories, Isando, South Africa) at a dose of 2.2 mg/kg was administered for induction of general anaesthesia. The mare was endo-

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Received: January 2008. Accepted: August 2008.

tracheally intubated using a 26 mm internal diameter cuffed silicone endotracheal tube (Bivona Incorporated, Indiana, USA). General anaesthesia was maintained with halothane (Halothane – M & B®, Safeline Pharmaceuticals Pty Ltd, Florida, South Africa) using a Tec 3 vaporiser (Fluotec 3®, BOC Health Care, West Yorkshire, England). The halothane was delivered in oxygen *via* a large animal anaesthesia machine (Vet-Tec LAVC-2000®, JD Medical Distributing Inc., Phoenix, USA). Intermittent positive pressure ventilation was instituted immediately after induction of general anaesthesia, aiming to maintain end-tidal carbon dioxide tension between 35 and 45 mm Hg. The horse was hoisted from the induction stall into the operating theatre. It was positioned on a well-padded operating table in dorsal recumbency with the forelimbs maintained in a semi-extended position by holding them up with the hoist, while the hindlimbs were unsupported in semi-extended position. Butorphanol tartrate (Torbugesic®, Fort Dodge Animal Health, Fort Dodge, USA) at a dose of 40 µg/kg was administered intravenously for analgesia about 15 minutes after induction of general anaesthesia. Perineural block of the tibial nerve was performed by injecting 5 ml of mepivacaine hydrochloride 2 % medially into the groove between the gastrocnemius and the deep digital flexor tendons, while the peroneal nerve was desensitised by injecting 5 ml mepivacaine hydrochloride 2 % into the groove between the tendons of the long and lateral digital extensors about 10 cm proximal to the lateral malleolus of the tibia. An intravenous crystalloid (Sabax Plasma Vet®, Adcock Ingram Critical Care Ltd, Johannesburg, South Africa) was administered throughout the anaesthetic period at a rate of approximately 6 ml/kg/h. A 20-gauge catheter (Jelco®, Medex Medical, Rosendale, Great Britain) was placed into the facial artery for direct arterial blood pressure measurements using a transducer (Manda Medical Systems, Bryanston, South Africa). An intravenous infusion of dobutamine (Dobutamine-Fresenius®, Fresenius Kabi, Bodene, trading as Intramed, Port Elizabeth, South Africa) was used at 2–10 µg/kg/min to maintain systolic arterial blood pressure above 90 mmHg and mean arterial blood pressure above 70 mmHg. Monitoring devices such as a pulse-oximeter, an electrocardiogram, a direct arterial blood pressure measurement line, a temperature probe and a respiratory gas analyser were connected to the patient and read from a multi-parameter monitor (Cardiocarp/5®, Datex-Ohmeda Instrumentation Corpo-



Fig. 1: Euthanased horse in the recovery room with the open fracture of the right metatarsal bones clearly visible.

ration, Helsinki, Finland).

The vital parameters monitored intra-operatively were stable throughout. Mean arterial blood pressure was maintained between 71 mmHg and 82 mmHg by intermittent administration of dobutamine. With respiratory rate set at 6 per minute and target maximum intra-thoracic pressure at 20 cm H₂O on the mechanical ventilator, the end-tidal carbon dioxide tension ranged from 38–44 mmHg. The period of general anaesthesia was 1 h 30 min, while surgery lasted 45 min. Before the horse was hoisted back to the recovery stall, 0.5 ml of romifidine hydrochloride 10 mg/ml was administered intravenously for sedation during the recovery period, and a Robert-Jones bandage covering parts distal to the tibio-tarsal joint was applied on the left (operated) hindlimb.

In the recovery stall, the horse was positioned in right lateral recumbency with the dependent forelimb stretched as far forwards as possible to reduce pressure on the radial nerve. The endotracheal tube was removed and a smaller nasopharyngeal tube placed to keep a patent airway. Oxygen was insufflated through a delivery tube directed into the vacant nostril at 12.0 l/minute to provide supplemental oxygenation to the recumbent horse. A head support rope attached to a halter and controlled from outside the recovery box was used to assist the horse to stand during recovery from anaesthesia. The recovery box measuring 4.3 m in length and 3.0 m in width has a completely rubber-padded floor. The wall is about 4 m in height, is foam-padded up to a level of 1.9 m. The lights were dimmed to minimise stimulation of the horse. The horse positioned itself in sternal recum-

bency 15 min after termination of halothane and prematurely tried to regain standing position. It made its first attempt to stand with the right hind fetlock joint over-flexed, which meant that it was bearing full weight on the dorsum of the hoof and pastern region. The right metatarsus fractured within seconds of the horse bearing weight in this abnormal position. The horse managed to regain a standing position, but without bearing weight on the fractured limb.

The horse was quickly re-anaesthetised using diazepam (Pax®, Pharmicare Limited, Port Elizabeth, South Africa) at a dose of 0.1 mg/kg, butorphanol tartrate at a dose of 20 µg/kg and ketamine hydrochloride at a dose of 2.2 mg/kg intravenously and general anaesthesia was again maintained with halothane. Radiography showed an acute, open, oblique and comminuted displaced fracture of right third metatarsus extending from proximo-medially to disto-laterally as well as mildly displaced fractures of the right second and 4th metatarsi. The owner reluctantly opted for euthanasia as the fracture was of such a nature that it carried a poor prognosis. The horse was euthanased using 100 ml of sodium pentobarbitone (Euthapent®, 20 %, Kyrion Laboratories, Benrose, South Africa) administered intravenously (Fig. 1). Unfortunately, a *post mortem* examination on the horse was not performed as the owner did not consent.

DISCUSSION

Significant improvements in drugs, techniques and equipment for anaesthesia have been made over the past 100 years. However, deaths, disasters and minor mishaps continue to occur during the

anaesthetic period⁸. In equine practice, where anaesthesia-related mortalities are substantially higher than in small animal practice, fractures (accounting for about a quarter of the mortalities) come second to cardiac arrests among the major causes of anaesthesia-related deaths^{2,3,14,20}. Unfortunately, these fractures occur mostly during the recovery phase of anaesthesia, a critical phase indeed, but one which in many ways is the least controllable^{4,13,14,17}. Recovery from general anaesthesia in the horse is not always a predictable event, since it is influenced by multiple factors such as surgical procedure, duration of anaesthesia, anaesthetic drugs, breed and age of the horse, assistance during recovery and pain^{6,25}.

Horses are mostly euthanased as a result of re-fracturing along a recently repaired fracture line, unlike in this case where the contra-lateral leg was involved. We learn from this case that there is always a real danger of a horse fracturing any limb during anaesthesia, especially with orthopaedic surgical intervention²⁶. In 2007, Bidwell and colleagues reported anaesthetic-related mortality in horses following arthroscopy to be as low as 6 out of 10 000, suggesting that the fracture suffered by the horse under discussion here is highly unlikely to be directly linked to the procedure for which the horse had been anaesthetised². We suspect that the horse fractured the leg as a result of bearing excessive weight on the sound leg whilst avoiding bearing weight on the operated limb. The fact that excessive weight was placed on the right hind-limb while it was over-flexed on the fetlock joint may have increased the chances of the horse fracturing this leg. Peri-neural analgesia of the tibial and peroneal nerves, performed on the operated limb to provide additional analgesia, could have resulted in mild loss of proprioceptive function in that limb, which may then have compromised limb coordination as the horse attempted to stand. Although local anaesthetics block pain perception, they also impair proprioception, which inhibits the ability of a horse to determine location and orientation of the blocked area¹¹. It is also possible that 1 of the bones that fractured at recovery had a micro-fracture or stress fracture prior to anaesthesia and therefore could have failed to withstand the extra stress induced by the horse attempting to stand in an uncoordinated manner. A retrospective study on equine perioperative fatalities reported that thoroughbred mares aged above 9 years, as in this case, are more susceptible to fractures, especially of the tibia, during recovery, and this could be attributed to poor bone strength associated

with old, non-active, multi-parturient broodmares^{2,9,12}.

The horse's 'flight behaviour', which prompts premature and violent recovery from anaesthesia, could be one of the reasons why horses panic as they regain consciousness from anaesthesia and suffer such injuries as fractured limbs and necks^{2,4}. Ideally, horses regain consciousness within 1–20 minutes of anaesthetic agent discontinuation, roll to sternal position for a brief period and then rise¹³. The fact that the horse tried to stand prematurely without staying in sternal position for a while could be an indication of a temperament leaning towards high excitability. A conscious healthy horse usually never lies in dorsal recumbency, but sometimes spends short periods lying in lateral recumbency^{7,20}. A wide variety of recovery protocols intended to assist the horse during awakening from general anaesthesia have evolved over time²³. Interventions that can be used to minimise the occurrence of excitement during recovery of a horse from anaesthesia include head and tail support using ropes and administration of sedatives just before the horse is taken to the recovery area. These 2 approaches were not enough to prevent the horse in this case from fracturing its limb. Drugs that can be administered during the pre-recovery phase to render the horse calm include alpha-2 adrenergic agonists (romifidine 8 µg/kg, detomidine 2–4 µg/kg, xylazine 0.1–0.2 mg/kg, medetomidine 1–2 µg/kg), acepromazine 5–15 µg/kg and propofol 2 mg/kg^{5,21}. Sedatives administered during the pre-recovery phase are used to prolong the recovery time as it is well recognised that horses that take longer to stand often have smoother and more controlled recoveries from general anaesthesia. The time a horse takes to rise is often considered a temperament-dependent occurrence, and keeping the horse sedated and quiet may help decrease the rapidity with which it recovers¹⁷.

Providing optimum analgesia for the horse is known to improve quality of recovery by decreasing recovery time, decreasing physiologic stress and providing comfort during the post-operative period²⁴. Drugs commonly administered for post-operative analgesia include butorphanol at 0.05–0.1 mg/kg and non-steroidal anti-inflammatory drugs like flunixin meglumine at 1.1 mg/kg, phenylbutazone at 4.4 mg/kg and ketoprofen at 2.2 mg/kg^{1,24}. Horses may be stressed during recovery due to a full bladder. It is therefore advisable to catheterise and drain the bladder before taking a horse to the recovery area, especially after long surgical procedures²⁴. If a

horse suffers a fracture while recovering from anaesthesia, it is advisable to induce general anaesthesia again, as well as provide adequate analgesia and physical support of the fractured limb for the welfare of the horse while a decision is being made on management of the fracture, because fractures are extremely painful and can cause severe distress¹⁶.

Techniques that can be employed for assisted recovery of the horse include use of experienced personnel within the recovery box, head and tail support, deflating air-mattress, vertical lifts or slings (Becker sling/lift, UC Davis lift, Anderson sling, Liftex sling) or pool systems like the Hydro-pool and Pool-raft systems^{5,6,22}. However, each recovery method has its advantages and disadvantages and none is suitable for every situation⁴. Having people within a recovery box while a horse is recovering can be potentially dangerous to the attendants involved^{5,6}. While the head and tail rope recovery technique offers better protection to the attendants, there is always a chance that the ropes might be lost after knot failure^{5,6,22}. The sling and pool recovery systems, which have been developed with the sopecific aim of reducing risk of fractures after orthopaedic surgery, are expensive to set up and maintain and also require well trained personnel^{15,22,25}.

The overall anaesthesia-related mortality rate in equine anaesthesia of about 1 % is still substantially high and thus equine practitioners are encouraged to be ever vigilant and anticipatory in order to be better prepared to manage mishaps if and when they occur. In retrospect, the accident reported here might have been avoided had the peri-neural analgesia of the tibial and peroneal nerves, which likely caused reduced proprioceptive function of the operated limb and then resulted in compromised limb coordination as the horse attempted to stand, not been performed.

ACKNOWLEDGEMENTS

The input of the nursing staff, support staff as well as final year veterinary and nursing students at the Onderstepoort Veterinary Academic Hospital who were involved in the management of this horse during the period of hospitalisation is greatly appreciated.

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