Sedation Procedures for Dental Surgery on a Female Asian Elephant

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In January, 1996, the Houston Zoo's Elephant Management Committee (EMC) made the decision to sedate the 32 year old female Asian elephant, Indu, for dental surgery. The Elephant Management Committee consists of the elephant staff, large mammal curator, assistant general manager of animal services, chief veterinarian, and the zoo's general manager. Each member of this group had responsibilities to ensure the procedure was well planned; additionally, consultants were hired to meet the anesthesia, dental, and animal restraint needs.

The Houston Zoo has managed a breeding herd of Asian elephants in a protected contact style of management for four years. Protected contact training opportunities were quite limited by the existing facilities until December of 1994, when major facility renovations and construction of new training and exhibit yards were completed. The new training yards allowed for many new training situations, including this procedure, to be much safer for both the animals and the staff.

Indu had not been restrained in any manner since 1991 when her demeanor and personality began to change dramatically. She refused chaining and became aggressive to both trainers and herd members. Indu attacked and seriously injured a trainer in late December 1991; her training in protected contact was initiated in 1992. Due to her aggressive nature and limited available facilities for protected contact training, progress was slow. Once the improved training facilities were available, all aspects of her training improved.

Indu has had a history of poor molar and tush condition. She has historically had infections in her tushes and her molars have worn irregularly making floating and filing them necessary on numerous occasions. Her molars were last filed in 1990 and she was last recorded to have shed a molar in 1991. By 1995, the condition of her molars had worsened to the point that filing them was no longer an option, leaving a sedation for dental surgery as the best option. Due to the fact that she had not shed her upper left tooth as the new one grew in, an irregular wear pattern developed resulting in the severe malocclusion that resembled a train wreck. The misaligned teeth did not allow her to chew normally and therefore interfered with her ability to properly process her grain and hay. Because of the severity of the malocclusion, all the molars were not visible when she would open her mouth, making a thorough diagnosis difficult.

Dental consultant, Dr. Boyd Welsch of the University of Florida, College of Dentistry, experienced in elephant dental procedures, and Dr. Gary Goldstein of Gulf Coast Veterinary Dentistry, inspected the molars by video and in person, respectively. The initial diagnosis was that extraction of one to three of the molars may be necessary; fortunately, this was not the case.

The planning of this procedure was critical to its success. Each member of the EMC had responsibilities as well as a 'team' to coordinate. Teams consisted of veterinary, lead by the zoo's chief veterinarian; animal husbandry, lead by the curator; and the coordination of non-animal staff (PR, heavy equipment and operators, maintenance staff, and of course food and coffee) lead by the assist. general manager.

In addition to the dental consultants, several other experts were assembled. The veterinary team also included veterinary anesthesiologists, Dr. Darryl Heard of the University of Florida College of Veterinary Medicine and Dr. Sandee Hartsfield of Texas A & M University College of Veterinary Medicine. Marsha Goldstein, a dental assistant, and Dr. Mark Peckham, formerly of the Houston Zoo also assisted in the procedure.

Elephant care specialist, Alan Roocroft, of the San Diego Wild Animal Park, was invaluable as a consultant for the procedure. He worked with the staff in the planning stages to ensure that animal positioning and restraint were appropriate. He was on site several days before the procedure to assemble and check equipment and to ensure that the staff involved in moving Indu clearly understood what individual responsibilities were to be the day of the sedation.

The elephant staff's primary focus for the months preceding the sedation was to prepare Indu for the entire process she was about to experience. With the consultation of Alan Roocroft, a plan was developed that would meet the needs of the veterinarians and dentists, and would allow for Indu to be positioned and restrained safely.

The first step to prepare Indu was to condition her to wear chain bracelets and accept chaining restraint. The duration she was asked to wear the chains was gradually increased one leg at a time, then the process was repeated working up to both fronts and one rear leg chained. Once she was fully accustomed to the chains, she was introduced to having ropes around her back legs as this is what would be used in the actual sedation.

Trainers also worked with Indu so that she would open her mouth to allow it to be rinsed with a garden hose mister (as shown on the left of the slide). This was to prepare for the possibility of tooth extractions that would result in large holes in her mouth that could be kept clean by rinsing. The rinsing itself turned out to be positive for Indu as she seemed to enjoy the sensation. The open mouth behavior improved as she presented a wider open when her mouth was rinsed; a benefit we had not anticipated.

Indu is accustomed to having blood drawn weekly; this behavior would be important to monitor her condition after the procedure. In final preparation for the procedure, all four of Indu's feet were trimmed just in case she was in a great deal of pain following the surgery and would not be able to participate in lengthy training sessions necessary for foot care.

Indu's post-sedation diet was also a concern since we were unsure of the extent of the surgery that might be necessary. The dentist's initial diagnosis was that extractions would be unavoidable; we wanted to prepare for the worst case scenario. Six months before the surgery, Indu's daily diet was increased. She was offered her normal diet of Mazuri Elephant Supplement, hay and alfalfa, and added to this was 25 pounds of sweet feed.

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The goal was to give Indu added reserves in anticipation of a reduction in feeding due to pain following the procedure. If extractions had been necessary, Indu's ability to process the Mazuri grain or sweet feed would decrease. Therefore, we investigated a variety of grain and feed types ranging from crimped oats to a senior horse feed. These were offered to Indu in dry and soaked forms to see which she would most readily eat.

The majority of Indu's training occurs in the training yards; these off exhibit yards offer a good working environment for both trainer and animal. The flexibility that is inherent in the design of the yards allows for the training of many husbandry behaviors, but this was not the ideal area to perform this procedure, so the sedation took place in the cow exhibit yard. Concerns about using the training yards included: the size of the yards was less than adequate to allow room for the necessary equipment and personnel; injury to Indu resulting from the concrete and steel during both initial sedation and during recovery (extractions would have weakened the mandible and bumping into the walls could potentially shatter the jaw). Indu was moved from the training yard through the cow barn into the cow yard where she was positioned for the sedation. Indu was first put on two front leg chains and one rear leg chain. She was securely held in this position while Alan Roocroft placed the fourth rope on her rear leg. Indu was then slowly turned from the training yard towards the barn and moved through the barn. She received treats of raisins and cinnamon candy as she moved. The rear leg ropes controlled her forward movement; as she advanced the slack in the fronts was taken up to prevent her from backing up. Once in the cow yard, she was positioned so that when she laid down, her left side, which needed the most dental work, would be up.

Once positioned, with all four leg ropes secure, a hobble rope was placed on her to reduce any additional movement of her rear legs. The anesthesia drug etorphine (M-99) was delivered by an intramuscular injection. As Indu began to get drowsy, additional ropes on her right rear leg and neck were added to aid her in lying down in the appropriate position. The leg rope ran under her chest and then fed through the neck rope and connected to a block and tackle. As the anesthesia took further affect, Indu started to lie down, the lay down rope was tightened up slightly to direct her. It was important not to put too much pressure on the rope or she may try to fight it rather than be directed by it. Donated mattresses were placed under her hip and then under her head as she was lying down.

Immediately after Indu was down, her vital signs and respiratory rate were checked prior to administering any additional anesthesia. Additionally, she was monitored by a pulse oximeter. Indu's severely malformed teeth prevented insertion of the trachea tube, so tubes to deliver the gas anesthesia (isoflurane) were placed in her trunk. Once stabilized, the dental team moved in to begin the surgery. A baseball bat was useful in prying her mouth open so the dentists could reach into her mouth.

The dental team discovered the 'train wreck' in Indu's mouth where the upper left molar had not shed causing the new molar to become misshapen as it grew in behind the existing tooth and fused to it. This prevented Indu from masticating properly, which resulted in severe overgrowth and malformation of the remaining molars. Fortunately, the teeth were all healthy and extraction was not necessary. The dentists were able to reshape the teeth by chiseling off portions and filing to shape. The largest piece removed

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was the unshed portion of the upper left molar. Overgrown sections of the other molars were also removed. Most of the re-shaping of the teeth had to be done by feel as the position of the teeth prevented the dentists from seeing as they worked. Indu's teeth are still far from normal in appearance, but her ability to process food appears to have improved.

After only one hour of hammering and chiseling on Indu's teeth, the dentists had done an excellent job of giving Indu a new and improved mouth. The yard was cleared of all unnecessary equipment and personnel prior to administering the antidote drug. The antidote drug, naltrexone, was delivered by intravenous catheter. Indu responded well and was up in a matter of minutes. She was easily moved on ropes back through the cow barn into the training yards where she could be closely monitored. Indu showed no signs of adverse affects from anesthesia and was immediately responding to commands, including open mouth.

The following day, Indu was reintroduced to the herd of 2.3 and she interacted in a normal fashion. She was offered a variety of foods to see if she had a preference. Immediately, we noticed that her chewing pattern had changed. Instead of moving her jaw vertically, she now began to move it horizontally as well. This was new for Indu, as the overgrowth had previously prevented this type of movement. She appeared comfortable and was eating well until the third day following the procedure. Naltrexone has a strong analgesia affect which had begun to wear off. It was apparent that Indu was in pain as her behavior changed; she became intolerant of conspecifics and was not responding to commands as she had been. Her chewing pattern also changed for several days. She demonstrated a two stage methodical opening and closing of her mouth. It is likely her jaw muscles were sore as they had not supported so much movement in a long while. On this third day, we began treatment with the analgesia, torbutrol; she responded so well to the treatment that it was discontinued with no further signs of pain after only three days.

This sedation procedure proved to be successful without requiring major surgery to repair Indu's molars. Although her teeth are far from normal and will need long term monitoring, she is in better overall physical condition as a result of her improved ability to process her full diet. Currently, the elephant staff is taking steps to help Indu wear her molars properly. She is offered various browse items including thick pieces of oak and hackberry to chew on. We are also working on behaviors and modifications to the existing facilities that will enhance our ability to work with Indu's teeth. However, it is possible that a sedation procedure may need to be repeated in the future if her molar condition should worsen.

Being a part of the sedation team was a rewarding experience. We felt very fortunate to have had the opportunity to work with and learn from Alan Roocroft. His guidance was invaluable throughout the entire process. Once Indu was positioned, we knew she was under excellent care in the hands of Dr. Welsch and Dr. Heard; whose experience and reputations speak for themselves. The right people, the right equipment, and all the planning made this team effort a successful endeavor.

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