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To: M. Lindsey Galloway, Director, and Dr. MJ Limoges, Veterinarian.

Object: Report for "SKANIK", Edmonton Valley Zoo

"Skanik" has a history of respiratory noise and is breathing through her mouth. No history of cough.

Distance examination:

- A stertor is observed: Loud rattling sound, mostly during inspiration.
- The respiratory rate is decreased at 2.2/min
- The breathing is labored with an abdominal effort during inspiration and expiration: Single phase expiration. The tidal volume seemed to be impressively large considering the amount of chest expansion observed during the breathing.
- During inspiration, Skanik opens her mouth and a severe vibration and partial obstruction of the passage was observed due to axial collapse of the lips/cheeks. This was systematically observed for each breath.
- No obvious dysphagia observed: Skanik can eat her hay and is not coughing when swallowing.
- Some mucoid discharge was noted from the trunk, but it did not have any particular odor. No hay particulates were observed in the nasal discharge.
- No coughing was ever observed at any point during the examination/ interaction with Skanik.

Exercise "test":

- Some exercise was induced by playing "hide and seek" with her keepers. Skanik was excited and walked around her pen area and to the corners of her space. She did not run at any time.
- The breathing rate increased, as well as the severity of the stertor.
- The recovery was longer than expected after the playing session; The time to recover a normal slow respiratory rate was not recorded, but considering that Skanik only walked, it subjectively appeared to take longer than normal to recover her breathing rate.

Buccal examination:

- Skanik is trained to open her mouth and on visual inspection, some abnormalities were obvious:
 - 1- Both maxillary molars had a very abnormal orientation:
 - Both molars had a pronounced dorso-medial and cranio-medial orientation.
 - The maxillary right molar had a dark/ thin proximal root, probably due to abnormal wear of the tooth down to the level of the root.
 - 2- There was a "mass" protruding between the molars in the area of the hard palate.
- On palpation of the mouth, the protrusion on the palate was hard and felt like bone. The teeth were not moving.

Upper airways endoscopy: (See pictures attached)

- Approximately 2hrs after diazepam administration (320mg PO), the endoscopy of the upper airways was done with Skanik standing behind her pen's bars and putting her trunk on a table.
 - A 3m long Storz endoscope was used with lubricant and with instillations of 2% lidocaine neat through the channel of the endoscope to desensitize the mucosa during the progression of the camera.
 - The endoscope was inserted through the right nostril. The lumen in the trunk was large, and no significant mucus accumulation was observed.
 - Some isolated hay particulates were observed all along the trunk endoscopy (mild amount).
 - After ~1m65 of insertion into the trunk, the sigmoid flexure was reached and some narrowing of the lumen could be observed intermittently: It was mostly soft tissue and showed some intermittent voluntary spasms.
 - Once the endoscope reaching the nasal passages in the skull area (length 2m40), the turbinates and ethmoid could be seen. The first approach arrived through the dorsal meatus, facing the ethmoid. However, a protrusion was clearly observed on the medio-ventral aspect of the nasal septum. The mucosa was smooth over that area. The passage was very narrow, and there was a small space in the ventral meatus. In spite of several attempts, the endoscope was too large to pass through the meati and reach the nasopharynx.
- In addition, a puddle of mucoïd fluid (mixed with lidocaine solution at some point) was observed ventrally in the ventral meatus at the level of the nasopharynx. The maximal length of endoscope used was 2m70.

Comparison with the endoscopy performed in 2016 (see pictures attached)

The recording of the endoscopy performed in 2016 was reviewed and compared to the present examination. The subjective assessment showed that the space in the dorsal meatus and immediately proximal to the ethmoid was larger in 2016 than during this examination.

Buccal endoscopy:

- A buccal endoscopy was attempted to reach the oropharynx and to perform a retroflexion during inspiration when the soft palate was displaced dorsally.
- The procedure was less well tolerated and although the soft palate could be observed in the back of the oropharynx, we could not time the endoscopy with an inspiration to observe an eventual dorsal displacement of the soft palate. The procedure was tried twice and then not pursued.

Sleep apnea:

Considering the pathology identified, further questioning about Skanik's respiration during her sleep confirmed a likelihood of sleep apnea. This was not diagnosed and may need further investigation (see below).

Diagnosis:

- Nasopharynx static obstruction due to bone remodeling. Most likely, this is secondary to the very abnormal positioning of the molars. A bone neoplasia is not ruled out but very unlikely considering the smooth mucosa and the long history of the problem.
- Suspicion of sleep apnea.
- Suspicion of mild dysphagia.

Interpretation and recommendations:

1- The primary problem is an obstruction of the nasal passages by some bone remodeling. The remodeling is also seen on the ventral aspect of the hard palate. It is most likely secondary to the very abnormal maxillary molar teeth positioning.

The severity of the obstruction seems to be worse now compared to the observations from 2016. This is a very chronic condition.

A simple illustration of the condition would be to have an animal breathing through a straw: The diameter of the airways is so small that it takes a lot more effort to generate airflow in/out of the respiratory system.

Treatment: There is no therapeutic options to improve this condition. Teeth extraction was discussed but seems to be very challenging and risky in elephants; furthermore, it would probably not reverse the nasal obstruction.

2- The soft palate being complete in elephants (similar to horses), they are obligate nasal breathers. In the case of Skanik, the resistance through the nasal passages is too high and she is using an oral breathing strategy, by probably displacing dorsally her soft palate during breaths. This is probably the source of the rattling/ stertor noise. However, the mouth not being designed for oral breathing, there seems to be also some restriction to incoming airflow due to the axial collapse of the lateral aspects of the lips/ cheeks.

Treatment: A palatoplasty (laser surgery) and lips resection were discussed, but these are again very challenging, risky and undescribed procedures in elephants.

3-Long term potential issues to monitor:

-Dysphagia: The risk of aspiration pneumonia is increased. The presence of small feed particulates in the trunk may be normal or may be a sign of food contamination of the airways. We could not reach the larynx and inspect the trachea to confirm.

Monitoring: Eventually consider monitoring early inflammatory phase proteins to detect some systemic inflammation as early as possible (for example in horses we would use serum amyloid A: SAA). Monitor for cough.

-Lung edema: If the airways obstruction becomes more severe it is possible that the strong negative thoracic pressure necessary to inhale may induce some progressive development of lung edema. This may be expected in the late/ terminal stage of the condition.

-Sleep apnea: I suspected that this condition may cause some sleep apnea, and the information obtained from the keepers seems to corroborate this suspicion.

Recommendation: I recommend documenting Skanik's breathing when she is sleeping/ at night, by using a monitoring camera with sound recording. If the sleep apnea is confirmed, I think that we could try to build some continuous positive airway pressure (CPAP) device that would be used voluntarily by Skanik when she is tired or sleeping.

Sincerely,



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Pictures Next Page.



Trunk with hay particulates. Proximal to the sigmoid flexure.



Sigmoid flexure



Nasal passage obstruction



Mucoid puddle in ventral meatus



See pictures next page

Buccal endoscopy



Softa palate (caudal area, buccal)



Endoscopy from 2016 showing a slightly less severe nasal obstruction.

