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Swallow Syncope After Cardiac Surgery in a Sheep

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To the Editor: We report swallow syncope, a relatively rare, vagally mediated syndrome that occurred in an otherwise healthy 1-year old, 36 kg Dorset sheep, after experimental cardiac surgery with use of cardiopulmonary bypass for cardiac isolation for gene delivery. The gene vector was washed out immediately after bypass and did not enter the systemic circulation, which was shown with real time polymerase chain reaction analysis of peripheral blood and tissue samples. General anesthesia lasted 6.5 hours and included ketamine (4 mg/kg), diazepam (0.5 mg/kg), propofol (6 mg/kg), fentanyl infusion (0.1 µg/kg/min), preoperative fentanyl patch (50 µg/h), and 2–3% isoflurane in oxygen. Intravenous fluids (1.33 mL/min; Normosol-M and 5% Dextrose), oxygen (5 L/min) by nasal cannula until the sheep was able to maintain a pulse oximetry value 95%, and antibiotics (potassium penicillin 22,000 U/kg IV) were administered postoperatively. In the first 14 hours after extubation, the sheep was continuously monitored with ECG, noninvasive blood pressure, pulse oximetry, temperature, central venous pressure, respiratory rate, and every 2 hours arterial blood gases. Eight hours after an uneventful recovery from general anesthesia 2 syncopal episodes occurred after eating pellets and spontaneous recovery subsequently occurred within 3–5 minutes. Syncope was

characterized by transient loss of consciousness and postural tone with temporary loss of vision and hearing. Syncope was not accompanied by severe bradycardia (sick sinus syndrome), or seizures with heart block or another type of arrhythmia (Adams–Stokes syndrome), or disturbance of acid–base and electrolyte balance, and was not induced by medications. Rectal temperature and respiratory rate were stable and no arrhythmias were detected by ECG.

Given that this sheep was administered a large dose of fentanyl during the surgical procedure, after the 2nd syncopal episode, naloxone (0.01 mg/kg subcutaneously) was administered to reverse possible narcotic depression and consequences of anesthesia. The next day, episodic feeding induced ataxia and inability to stand were observed and continued once a day for 14 days. These events occurred during attempts to swallow large boluses of hay and >100 g pellets. Chewing and swallowing small amounts of hay and pellets produced no syncopatic response. Recovery after the 3rd day typically occurred within 10–20 seconds with resumption of seemingly normal behavior and continued interest in eating. During the first 2 episodes, noninvasive blood pressure was slightly increased (125/94 and 135/88 mmHg) and was accompanied by moderate tachycardia (mean, 136 beats/min) and then mild bradycardia (mean, 86 beats/min), but was without evidence of arrhythmia or AV block. Scheduled feedings supervised by a veterinary technician every 6 hours with small amounts of alfalfa hay and pellets were continued as tolerated with less pronounced syncopal episodes after 48 hours. On day 3, glycopyrrolate (0.02 mg/kg IM) was administered with seeming reduction but not resolution of the episodes. Small amounts of feed (half of normal feeding amount) were offered at 6-hour intervals and clinical signs began to resolve. Feedings were continued under observation and syncopal events occurred once a day for 14 days, after which no further syncopal events were observed.

Although swallow syncope has been reported in people,^{1,2} we are unaware of reports in animals. Typically syncope is related to deglutition (food or liquid), is often accompanied by bradyarrhythmias after swallowing leading to cerebral hypoperfusion and unconsciousness. The pathophysiology of swallow syncope is incompletely understood. Swallow syncope has been associated with organic or functional disorders of the esophagus (spasm, achalasia, etc.), cardiac disease (sinus bradycardia, sinoatrial or complete AV block, atrial fibrillation), and after thoracic surgery with transient hypoxia.³ However, in most human cases an underlying disease is not identified. Vagal reflex plays a major role because of the common innervation of the esophagus and heart in people, sheep, and pigs. Efferent signals lead to bradyarrhythmia and a temporary decrease in cardiac output with cerebral hypoperfusion. Management usually involves withdrawal of medications like beta-blockers that can cause a delay in cardiac conduction and vasodilatation, and administration of anticholinergics like atropine used to prevent bradyarrhythmias.

Diagnosis of swallow syncope requires demonstration of a direct relationship between swallowing and syncope. Our sheep had no bradyarrhythmias on ECG monitoring (continuous for first 14 hours and twice daily after that) and postoperative echocardiography showed normal heart valve function with a good ejection fraction. Swallowing syncope started several hours after cardiac surgery and episodes occurred spontaneously when swallowing while the sheep was relaxed. Esophageal abnormalities and impairment of the

sinoatrial or atrioventricular nodes were not identified. An esophageal motility disorder, a known side effect of thoracic or cardiac surgery, may have mediated syncope. One possible explanation for swallow syncope is that afferent sensory fibers may have artificially synapsed with efferent vagal fibers to the heart, producing a parasympathetic vagal impulse from an afferent sensory process like swallowing.¹

Swallow syncope has not been reported in human surgical cases where fentanyl was used for anesthesia; however vasovagal syncopal episodes, decreased peripheral vascular resistance, and cardiovascular effects of opioids have been reported in people and animals.^{4–7} Naloxone was administered to this sheep in the immediate postoperative period because it was suspected that a substantial amount of fentanyl (continuous infusion for 6.5 hours at 0.1 µg/kg/min) used during surgery may have contributed to the onset of the syncopal events.

Swallow syncope should not be considered a benign diagnosis and, depending on the history, animals should be investigated to rule out underlying esophageal or cardiac disease, including autonomic testing while eating.

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