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Sternothyroideus Myotomy, Staphylectomy, and Soft Palate Thermoplasty for Treatment of Dorsal Displacement: 102 Thoroughbred Racehorses (21-Nov-2003)

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Abstract
Sternothyroideus myotomy, staphylectomy, and soft palate thermoplasty are effective treatments for Thoroughbred racehorses suffering from the performance-limiting effects of dorsal displacement of the soft palate and offer similar performance outcomes as other surgical procedures.

1. Introduction

Intermittent dorsal displacement of the soft palate (DDSP) is well recognized as a significant cause of exercise intolerance and abnormal expiratory noise production that occurs when the caudal free margin of the soft palate becomes displaced dorsal to the epiglottis during exercise. Despite its importance and seemingly high prevalence among racehorses, the many postulated causes of DDSP and the difficulty in making a definitive diagnosis of a transient event make selection of a rational treatment plan challenging.

Approaches to managing horses affected with DDSP have ranged from conservative medical treatment with rest and anti-inflammatory agents to more invasive surgical procedures. Surgical treatments have included shortening or stiffening of the soft palate, [1-3] transection of the laryngeal retractor muscles, [1,3-6] and stiffening of the epiglottis [7]. Most of these treatments have resulted in moderate success rates (59 - 78%) in treating horses with DDSP. As a result, alternative treatments aimed at improving success rates and our understanding of DDSP have continued to evolve. Ducharme and Woodie [8] have devised a Cornell DDSP collar and a laryngeal tie-forward procedure; however, outcome assessments have not yet been published. Transnasal endoscopic lasing of the palate, originally described by Tate et al., [9] has recently been reported to result in success rates greater than 90% [10].

The staphylectomy procedure was originally developed to reduce the length of what was considered an excessively long soft palate. The proposed beneficial effects of the procedure are now thought to result from less tissue obstructing the airway when the palate becomes displaced, a more rapid return of the displaced palate to its normal subepiglottic position, and/or substantial stiffening of the palate from fibrosis and scar tissue formation at the site of resection, which prevents bending or displacement. Combining this last assumption with endoscopic observations of the caudal region of the soft palate billowing upward just before displacement in DDSP horses led to the hypothesis that laser ablation of strips of the oral mucosa and submucosa of the soft palate would create a large area of fibrosis and stiffen the caudal aspect of the palate. By resecting only a very small amount of the palate tissue on the caudal midline, the risks of dysphagia and aspiration associated with removal of too much tissue, which might occur with a traditional staphylectomy procedure, could be avoided while retaining the beneficial effects of stiffening of the palate.

Based on these concepts and the moderately higher success rate reported for horses treated for DDSP with combined surgical procedures, [3,11] we hypothesized that oral soft palate laser ablation combined with a modified staphylectomy and sternothyroideus myotomy would be an effective method of treating horses affected with DDSP. The purpose of this paper is to describe the soft palate laser procedure used in this study and to compare racing performance before and after sternothyroideus myotomy, staphylectomy, and soft palate thermoplasty for treatment of DDSP in Thoroughbred racehorses.

2. Materials and Methods

Criteria for Selection of Cases

Medical records of horses treated for DDSP at the Rood and Riddle Equine Hospital by sternothyroideus myotomy, staphylectomy, and soft palate thermoplasty over a 4-yr period, from March 1, 1998 to February 28, 2002, were reviewed. To form a more uniform population, only Thoroughbred racehorses were included in the study.

Procedure

Information obtained from the medical records of the Thoroughbred racehorses meeting the criteria for inclusion in the study included signalment, history, primary complaint, previous treatments or surgical procedures, upper respiratory endoscopic examination findings, and date of the sternothyroideus myotomy, modified staphylectomy, and soft palate lasing procedure. Endoscopic examination assessment included grade of pharyngeal lymphoid hyperplasia (PLH), degree of arytenoid abduction, size and character of epiglottis, and presence of soft palate displacement before, during, or after nasal occlusion. Diagnosis of DDSP was based on a history of poor performance and upper airway endoscopic findings during the nasal occlusion test at rest or during treadmill exercise.

Lifetime race records of Thoroughbreds included in the study were obtained from the Jockey Club Information Systems. The race records were examined for average earnings per start for the three races before and after surgical intervention and days to first start after surgery. Success of the surgical procedure was defined as an increase in average earnings per start for three races after surgery compared with three races before surgery. The surgery was considered unsuccessful if the average earnings per start after surgery decreased or remained unchanged compared with average earnings per start before surgery. No comparisons were made for horses that did not race before surgery but did race post-operatively, that did race before surgery but did not race post-operatively, or that did not race before or after surgery.

Surgical Procedures

All horses diagnosed with DDSP received potassium penicillin G (22,000 IU/kg, IV), gentamicin sulfate (6.6 mg/kg, IV), flunixin meglumine (1.1 mg/kg, IV), and tetanus toxoid (1 ml IM) pre-operatively. The horses were sedated with xylazine HCl (0.88 mg/kg, IV) and induced with a ketamine HCl (2.2 mg/kg, IV) and diazepam (0.088 mg/kg, IV) mixture. An oral endotracheal tube was placed, and horses were positioned in dorsal recumbency with their head extended. Anesthesia was maintained using a slow IV drip of guaifenesin in 5% dextrose (50 g), ketamine HCl (1 g), and xylazine HCl (500 mg).

The hair was clipped over the surgical site, and the skin was prepared for aseptic surgery. Using a CO_2 laser (35 W), a standard laryngotomy incision was made through the skin and the SC tissue. Before entering the larynx, the musculotendinous junction of the left and right sternothyroideus muscles were exposed and transected at this site. The cricothyroid ligament was then incised to allow entry into the larynx. The endotracheal tube was withdrawn from the trachea into the mouth to expose the soft palate. The palate was grasped on its caudal midline with Allis tissue forceps and retracted caudally. The CO_2 laser was used to lase several parallel lines through the oral mucosa and submucosal along the caudal edge of the soft palate. A small piece of tissue was then resected from the caudal midline of the soft palate. The endotracheal tube was replaced within the trachea, and the floor of the larynx was closed in a simple continuous pattern using 1-0 polyglactin 910. The muscles and skin around the laryngotomy were left open to heal by contraction and epithelialization.

Post-operatively, horses received trimethoprim sulfamethoxazole tablets (30 mg/kg, PO, q 12 h) and flunixin meglumine (1.1 mg/kg, PO, q 12 h) for 3 days. The surgical site was cleaned twice daily with dilute povidone iodine solution. Recommended post-operative care included 1 wk of walking and 1 wk of jogging before returning to training. The same clinician (R.M.E.) performed this surgical procedure on all the horses. No significant complications were observed after the surgical procedure.

Statistical Analysis

The Wilcoxon signed rank test was used to analyze average earnings per start before and after surgery. The Fisher's exact test was used to determine if outcome was associated with signalment or upper endoscopic examination findings. Results were considered statistically significant when $P < 0.05$.

3. Results

Of the 153 Thoroughbred horses identified, 102 met the criteria for inclusion in the study. Among the 102 medical records reviewed, 35 2-yr-old horses, 46 3-yr-old horses, 16 4-yr-old horses, 3 5-yr-old horses, and 2 6-yr-old horses were identified. The mean and median age of population was 3 yr. There were 43 females, 52 males, and 7 geldings in the population. Historical findings revealed 79 horses to have a history of DDSP based on poor racing performance, characteristic noise production, or referral endoscopic examination findings. Exercise intolerance was noted in eight horses, abnormal noise production was observed in seven horses, and no historical data was recorded for eight horses. Endoscopic exam findings revealed 20 horses with grade 1 PLH, 66 with grade 2 PLH, 5 with grade 3 PLH, 0 with grade 4 PLH, and 11 without assessments. Degree of arytenoid abduction was assessed as grade 1 left laryngeal hemiplegia (LLH) in 15 horses, grade 2 in

78 horses, grade 3 in 3 horses, and no grade in 4 horses was identified. Six horses were not graded. The epiglottis was evaluated as normal size and characteristic in 28 horses, mildly flaccid in 51 horses, short, narrow, and flaccid in 16 horses, misshapen in 2 horses, and undescribed in 5 horses. Eighteen horses displaced their soft palates spontaneously during resting endoscopic examination, 36 horses displaced during examination after nasal occlusion, 45 horses did not displace their soft palate during examination, and 3 horses were lacking information of soft palate function. Signalment and endoscopic examination findings were analyzed categorically in relation to the success or failure of the surgical procedure using the Fisher's exact test. No significant correlations were identified between signalment or pre-surgical endoscopic findings and racing performance after surgery.

Information obtained from the lifetime race records of the Thoroughbred horses revealed that 63% (46/73) of the horses that raced at least once before and after surgery improved their performance based on mean earnings per start. Mean and median earnings per start before surgery were $2792 and $1300, respectively. After surgery, mean and median earnings per start increased to $3806 and $1885, respectively. The mean number of days to first start was 109 days (median = 69, range = 5846). The Wilcoxon signed-rank test was used to analyze average earnings per start before and after surgery. Mean earnings per start were significantly greater after surgery than before surgery for the population of Thoroughbred racehorses examined ($P = 0.02$).

4. Discussion

Soft palate laser thermoplasty performed in conjunction with a modified staphylectomy and sternothyroideus myotomy significantly improved the racing performance in Thoroughbred racehorses diagnosed with DDSP. The success rate for this procedure (63%) is similar to the success rates reported for other surgical procedures used to treat horses with DDSP [1-7]. The mean number of days to first start after soft palate lasing, staphylectomy, and sternothyroideus myotomy was also comparable with other studies.

Of the number of proposed etiologies for DDSP, Holcombe's [12] hypothesis that DDSP is a result of a primary dysfunction of the neuromuscular regulation of the soft palate seems to hold the most validity. By blocking the pharyngeal branch of the vagus nerve bilaterally, Holcombe et al., [12] induced persistent DDSP in normal horses and implicated dysfunction of the pharyngeal branch of the vagus nerve and palatinus and palatopharyngeus muscles in the pathogenesis of the disease. This is the only reported study to date that was able to replicate the disease and produce evidence for a cause of DDSP.

Based on Holcombe's [12] findings, perhaps the improvement in performance of the Thoroughbred racehorses treated for DDSP by soft palate thermoplasty, modified staphylectomy, and sternothyroideus myotomy is caused by an alteration in soft palate structure and function. Thermal modification of connective tissue is a well-described phenomenon, resulting in tissue shortening, collagen contraction, and fibrosis [13-15]. Heat transfer to the collagen has been demonstrated to be the reason for the tissue shortening [13-15]. Based on the shrinkage observed in soft tissues during and after lasing of soft tissues, the lasing procedure used in our study could result in shortening or tightening of the caudal margin of the soft palate, thereby decreasing the likelihood of laryngopalatal dislocation. By reducing flaccidity of the soft palate after the lasing procedure, less negative pressures in the nasopharynx would develop and dorsal billowing of the soft palate could be prevented.

The 63% success rate found in our study for the combined sternothyroideus myotomy, staphylectomy, and soft palate thermoplasty procedure lies within previously reported ranges for treating horses with DDSP by laryngeal retractor muscle resection alone (58 - 70%). Although direct comparison of outcomes across different studies can be problematic because of variation in diagnostic and inclusion criteria, as well as definitions of success, it could be argued that the success rate for the combined sternothyroideus myotomy, modified staphylectomy, and soft palate laser procedure may have been caused by the effects of the myotomy alone. However, of the horses included in our study, nine had previously been treated for DDSP with sternothyroideus myotomy alone without a noted improvement in performance. After subsequent treatment by soft palate thermoplasty, 88% (8/9) of these horses increased their mean earnings per start after surgery compared with before the procedure. These findings lend further support to soft palate lasing as a useful treatment for horses with DDSP.

The results of this study suggest that the soft palate thermoplasty, modified staphylectomy, and sternothyroideus myotomy procedure is an effective treatment for DDSP in Thoroughbred racehorses. The success of the surgical procedure is comparable to other surgical procedures previously described to treat DDSP. The proposed alterations in structure and function of the soft palate after the laser thermoplasty procedure lend further support to Holcombe's [12] hypothesis of soft palate dysfunction as a cause of DDSP. Continued investigation of the soft palate's role in DDSP will hopefully provide a more detailed explanation as to why DDSP occurs and what can be done to treat the disorder.

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