How to Use Hoof-Wall Resection and Amniotic Membrane as a Treatment for Coronary-Band Prolapse

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1. Introduction
Coronary-band prolapse caused by severe abscessation is a life-threatening complication of severe laminitis. Vascular leakage from trauma associated with coffin-bone sinking or rotation often results in the formation of submural or subsolar abscessation. Inflammation of tissue at the draining orifice of the coronary band results in a cycle of pressure necrosis, prolapse, and trauma that leads to further inflammation (Fig. 1). Removal of the hoof wall under the prolapsed tissue is the authors’ only way to resolve the continued trauma at the coronary band.

Healing of the coronary groove, lamina, and underlying soft-tissue structures after successful hoof-wall resection can be a lengthy process. Expedient of epithelialization is imperative for stabilization and protection of underlying tissues. Additionally, it decreases the costs associated with bandage changes and the possibility of further trauma from the proximal aspect of the transected wall. Severely traumatized tissue can take weeks to months to completely epithelialize.

Amniotic membrane is used in human medicine for the treatment of non-healing ulcers, burns, corneal lesions, and pressure sores. Advantageous properties of amniotic membrane as a biological dressing include its function as a protective barrier, heat reduction at wound site, prevention of fluid and protein loss, good wound adherence, bacteriostaticity, reduction in incidence of infections, analgesic affects, no immunological reactions, light weight, and elasticity. It is histologically similar to skin. Amniotic membrane contains growth and angiogenic factors, and it serves as a promoter for granulation tissue. The use of preserved amniotic membrane is a cost-effective way to expedite epithelialization of hoof-wall resections associated with severe coronary prolapse caused by abscesses in laminitic horses.

2. Materials and Methods
The horse is tranquilized with detomidine (20 μg/kg body weight, IV). Medial and lateral abaxial sesmoidian blocks are used to anesthetize the hoof. The hoof is cleaned of debris and scrubbed with a
disinfectant. A felt marker is used to draw a line where the hoof wall will be transected. A 2-cm margin distal to the top of the hoof wall and a 1-cm margin medial and lateral to the prolapsed tissue at the coronary band are used to insure complete removal of the impinging section of the hoof wall. A groove is made into the hoof wall with a dremmel or a rasp (Fig. 2). Care is used not to dremmel at a high speed in a concentrated area for extended periods to avoid heat necrosis of underlying tissue. When the groove is deep enough that the non-pigmented inner hoof wall is pliable, a hoof knife is used to remove the final layer of epidermal lamina. A small pair of custom-made half rounds are used to peel the wall from the lateral to medial edge. A hoof knife, forceps, or a towel clamp can also be used. Many times, the underlying tissue is detached and necrotic, and when grooved, the piece of hoof wall will fall off. The inner edge of the transected hoof wall is beveled with a knife and carefully examined for sharp edges. The resected area is firmly packed with betadine-soaked gauze. The gauze is held snuggly in place with 2-in elastic tape. Care is taken to avoid wrapping elastikon tightly over the coronary band without appropriate padding. A foot pack is placed to ensure security of bandage material and keep stall debris from the surgical site.

In most cases, the horses are already on variable doses of phenylbutazone depending on the treatment course for the laminitis. Twenty-four hours after resection, the bandages are removed, and preserved amniotic membrane is applied.

The amniotic membrane is harvested at birth, cut into appropriate sizes, rinsed, and soaked for 24 h in dilute betadine solution at room temperature. It is then transferred to a 19:1 part distilled water to white vinegar solution and soaked for another 24 h at room temperature. Individual pieces are frozen in plastic freezer bags in the distilled water and vinegar solution. The amniotic membrane can be thawed in tepid water before bandage removal. The resected area is rinsed with saline solution and covered with amnion. Saline-soaked gauze is placed over the amnion. The gauze is held in place tightly with 2-in elastikon. A foot pack is placed over the hoof to ensure that the surgery site is kept clean.

The amniotic membrane is left in place for 5 days. On the fifth day, the gauze is removed, and the resection is cleaned with sterile saline. At the time of removal, the amniotic membrane will be desiccated or gone. If complete epithelialization has occurred, a dry bandage is placed to protect the new epithelial cells as they dry and become hard. If a section has not epithelialized, the process of amniotic membrane application is repeated.

3. Results

Eight horses with partial hoof-wall resections caused by coronary prolapse were treated with amniotic membrane 24 h after partial hoof-wall resection. Epithelialization was greatly expedited in all eight cases. Four horses required only one application. Lamellar and coronary tissues were completely epithelialized at the bandage change on the fifth day post-amniotic membrane application. Two horses required two applications, but they were completely epithelialized by the second bandage change five days after the second amniotic-membrane application. Two horses showed significant epithelialization at the proximal aspect of the resection, but they suffered further complications because of coffin-bone sinking;
epithelialization at the proximal aspect of the transected hoof wall did not occur in these horses because of further trauma from wall impingement (Table 1). Speed of epithelialization seemed to be directly correlated with the size of the hoof-wall resection and the degree of trauma present to underlying soft-tissue structures.

Before the use of amniotic membrane, the authors’ treatment was to pack the hoof-wall resection with antiseptic-soaked gauze (2% betadine solution mixed with sugar). With the use of the betadine-soaked gauze, the time required for complete epithelialization was markedly longer. Along with longer healing time, there was greater expense and less stability of the hoof capsule using this method. The difference in healing times with the betadine-soaked gauze compared with the amniotic membrane was an average of 3–4 wk.

No matter the treatment method, after the resection had completely epithelialized, pain relief as well as capsular stabilization was achieved. Long-term results did not seem to be different in texture or strength than previous treatment with betadine and sugar. In both cases, the epithelialized area filled in to a thickness equal to the hoof wall and appeared grossly similar to the hoof wall.

4. Discussion

The results of using partial hoof-wall resection and preserved amniotic membrane for treating coronary-band prolapse show significant expedition of epithelialization of traumatized coronary and lamellar tissue. Because horses with severe laminitis require long-term rehabilitation, expense of treatment often becomes a determining factor for continuing treatment. Significant savings in cost occur by cutting weeks to months out of daily bandage changes. Additionally, complications caused by capsular instability and exposure of underlying soft-tissue structures by resection of hoof wall are lessened by the presence of epithelial cells.

One case of significant prolapse of the entire coronary band requiring a large resection was originally packed with betadine-soaked gauze. Almost 4 wk after the resection, daily bandage changes with antiseptic-soaked gauze yielded only small islands of epithelialization (Fig. 3). Application of amniotic membrane resulted in nearly complete epithelialization after two applications (Fig. 4).

Expediting epithelialization of hoof-wall resections and traumatized soft-tissue from coronary prolapse is extremely beneficial in reducing hospitalization and stabilizing laminitic horses both in comfort and structure. The use of hoof-wall resection and preserved amniotic membrane is an inex-

Table 1. Amniotic Membrane Treatment

<table>
<thead>
<tr>
<th>Number of Horses</th>
<th>Number of Amniotic Membrane Applications</th>
<th>Amount of Time Required for Total Epithelialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>6 days</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>11 days</td>
</tr>
<tr>
<td>2*</td>
<td>&gt;3</td>
<td>&gt;21 days</td>
</tr>
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*These horses required more than one resection.

Fig. 3. Epithelial islands present 4 wk after a large hoof-wall resection and bandaging with antiseptic-soaked gauze.

Fig. 4. Epithelialization present after two amnion-membrane treatments over a 10-day period.
pensive, effective treatment for coronary band prolapse over the hoof wall.

References and Footnotes

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