A Comparison of Conventional, Revascularized and Bioengineered Methods of Recurrent Laryngeal Nerve Reconstruction

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ABSTRACT

Although there is some inherent capability for nerves to regenerate, recovery after damage to a peripheral nerve is frequently unpredictable and can result in a poor outcome. When a nerve is completely transected, the distal and proximal stump can often be directly repaired via microsurgical suturing. However, in many cases this primary nerve repair may not be feasible and a bridging component of tissue is used to provide a tension free anastomosis (Siemionow 2009). Structures which typically occur as anastomosis or a neurorrhaphy include using free ansa nerve cable grafts or great auricular nerve conduits. This study has revealed that these specialized methods do not result in additional benefit compared with simple cable grafting or primary repair for reconstruction of the recurrent laryngeal nerve.

METHODS AND MATERIALS

An established canine model of RLN injury was utilized (Paniello 2001). In this model, canine subjects undergo anesthesia per standard protocol and a permanent transection is placed. RLNs are dissected free and laryngeal adductor pressures (LAPs) are measured with a pressure transducer balloon via electrical stimulation of the nerve. The LAPs are again measured 6 months post-injury as a primary outcome of reconstruction. The recurrent laryngeal nerve is then injured and reconstructed with one of the study methodologies listed in table 1. For the acellular, revascularized and conventional nerve grafts, a 5 cm length of RLN was reconstructed. Revascularized nerve grafts were harvested from the saphenous nerve, artery and vein and microvascular anastomosis was performed to the cranial thyroid artery and internal jugular vein. Acellular nerve allografts (5 cm, n=6) were harvested from canine saphenous nerves, engineered via established protocols and had a 5 cm proximal segment. The nerve conduits were each 2 cm long and had 0.5 cm of the transected nerve endings loaded into each side, permitting a 1 cm gap. Conventional cable grafts (5 cm, n=6) were also harvested from the saphenous nerve.

RESULTS

Simple RLN transection with direct neurorrhaphy provided 55.5% (± 12.5%) recovery of baseline LAPs. Reverse autografts provided 60.8% (± 27.5%) recovery of the baseline LAPs. The revascularized grafts and conventional nerve grafts provided a range of recoveries of 50% to 60% for all nerve conduits. Revascularized nerve grafts, neural conduits or nerve growth factor did not provide any measureable benefit. Recovery of nerve function after repair with multiple methodologies to assess for an optimal method of RLN reconstruction.

DISCUSSION

The use of acellular nerve grafts and neural conduits has grown in popularity as this technology improves (Isaacs 2014). A number of inherent disadvantages exist to using autologous nerve grafts, including the limited availability of a suitable donor site, donor site morbidity such as scarring and numbness. There are FDA approved commercially available acellular grafts and conduits in use for multiple indications today. This is the first study to compare the use of vascularized acellular nerve grafts, acellular nerve grafts and specialized coupling techniques with nerve growth factors for recurrent laryngeal nerve repair. This study has revealed that these specialized methods do not result in additional benefit compared with simple cable grafting or primary repair for reconstruction of the recurrent laryngeal nerve.

REFERENCES

18. Lux 1986. This technique assumes that the well-vascularized bed (Lux 1986). This technique assumes that the microvascular anastamosis performed to the cranial thyroid artery and internal jugular vein. Conventional cable grafts (5 cm, n=6) were also harvested from the saphenous nerve. As a comparison group, a section of RLN was removed and anastomotic repair performed via a reverse configuration (2 cm, m=8). Acellular nerve allografts (5 cm, n=6) were harvested from canine saphenous nerves, engineered via established protocols and implanted into research subjects.

Table 1

<table>
<thead>
<tr>
<th>Methods of Recurrent Laryngeal Nerve Repair (number in experimental group)</th>
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<tr>
<td>Transplant autograft (n=4)</td>
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<tr>
<td>Conventional cable graft (n=6)</td>
</tr>
<tr>
<td>PATD nerve allograft (n=4)</td>
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<tr>
<td>PATD nerve allograft with autologous nerve graft</td>
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<tr>
<td>Plastic conduit with empty carrier (n=4)</td>
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<tr>
<td>Plastic conduit with fibrin-desiccated collagen</td>
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<tr>
<td>Plastic conduit with fibrin-embolized gel-collagen derived factor carrier</td>
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<tr>
<td>Acellular nerve allograft (n=6)</td>
</tr>
</tbody>
</table>

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DISCUSSION (CONT)

The use of acellular nerve grafts and neural conduits has grown in popularity as this technology improves (Isaacs 2014). A number of inherent disadvantages exist to using autologous nerve grafts, including the limited availability of a suitable donor site, donor site morbidity such as scarring and numbness. There are FDA approved commercially available acellular grafts and conduits in use for multiple indications today. This is the first study to compare the use of vascularized acellular nerve grafts, acellular nerve grafts and specialized coupling techniques with nerve growth factors for recurrent laryngeal nerve repair. This study has revealed that these specialized methods do not result in additional benefit compared with simple cable grafting or primary repair for reconstruction of the recurrent laryngeal nerve.

CONCLUSIONS

Conventional nerve grafting provided equivalent recovery of laryngeal adductor pressures following recurrent laryngeal nerve repair as to a simple repair or a reverse autograft. Revascularized nerve grafts did not appear to provide additional recovery benefit. The use of bioengineered acellular nerve grafts and nerve conduits for reconstruction resulted in poor recovery of recurrent laryngeal nerve function.