Developing A Long-term Survival Hemi-facial Vascularized Composite Allotransplantation Swine Model To Study Facial Nerve Regeneration

Anita T. Mohan, Marissa Suchyta, Maria Yan, Stacey Bernard, Joanne Pedersen, Lisa Yngsdal,, Amy Benike, Basel Sharaf, Karim Bakri, Waleed Gibreel, Hatem Amer, Samir Mardini

Mayo Clinic, Rochester, Minnesota

Purpose

We present a survival large animal model for preclinical facial transplant research to evaluate facial nerve regeneration.

Methods

Previous work defined vascular territories of the swine hemi-face (Fig 1). 19 survival surgeries (16 auto-transplant, 3 allotransplant) were performed to develop and validate a hemi-facial composite flap to evaluate nerve regeneration (Fig 2). Assessment of nerve regeneration using serial compound muscle action potentials (CMAP), electroneurograms (ENG) and histology in a 3-4 month survival model was established. Immunosuppression in allotransplanted pigs started on POD-3 and maintained with weight-based Cyclosporin (CSA) (target levels of 200-300), mycophenolic acid and prednisone (Fig 3). Postoperative course and complications were documented.

Fig 1. Vascular Territories of Swine Hemi-Face

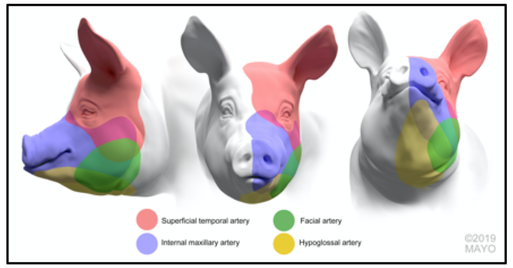


Fig 2. *Top Left:* Final hemi-facial composite flap (including the auricle, parotid, muscles & facial nerve branches). *Top Right:* 3D Anatomic modelling for flap planning, and vascular planning. *Bottom Left:* Intraoperative photograph of flap harvest. *Bottom Right:* Intraoperative photograph to demonstrate final flap inset.

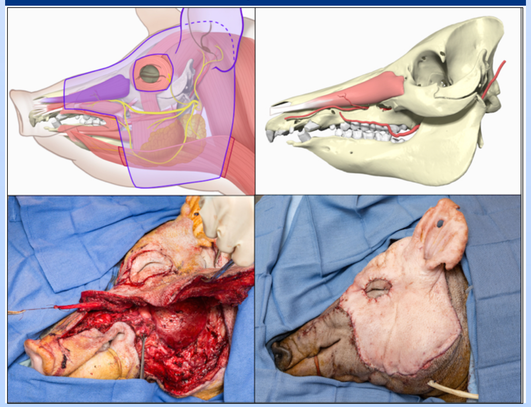


Fig. 3 Immunosuppression

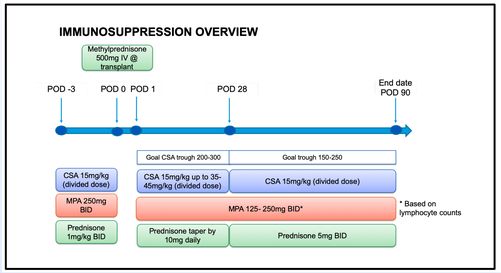
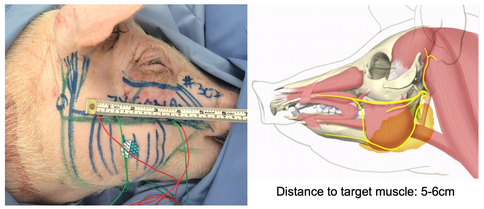
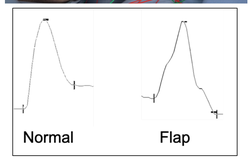


Fig. 4 Allotransplant Nerve Conduction Studies



Distance to target muscle: 5-6cm



- Comparable amplitude, ↑ latency
- Some motor recovery on EMG ↓ amplitude, ↑ latency
- Minimal motor movement

Results

The buccal facial nerve branch was selected the most optimal to assess nerve regeneration using nerve conduction studies. In our allotransplant and auto-transplant models minor wound breakdown and sialoceles were managed conservatively or superficial debridement in the first 4-6 weeks.

There were no flap losses. No systemic infections were experienced in the allotransplanted pigs(n=3); one pig developed an abscess requiring debridements, extended antibiotics usage, but complete resolution at 8 weeks.

At 3 months nerve regeneration reached 75% distance to target muscle with comparable ENG to normal side in auto-transplanted Sinclair mini-pig group (n=5), but a slower rate of regeneration in the allotransplanted group (n=3) (Fig 4). Histology demonstrated regenerating nerve fascicles

Conclusion

This study demonstrates proof of concept for an allotransplant large experimental animal model for research to inform post-surgical care to improve facial nerve regeneration and functional outcomes.

©2017 MFMER | slide-1