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DEVELOPMENT OF A FAST GROWING ANIMAL MODEL FOR DIAPHRAGMATIC HERNIA

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Aim: Congenital Diaphragmatic Hernia (DH) survivors undergoing patch repair (50%) suffer significant patch related complications. Our current growing rabbit DH model (30-50% defect) was modified to make it more representative with increased defect size (>50%) and re-herniation rates.

Methods: 6-week-old male rabbits were weighed, intubated fibro-optically and ventilated. Initially a left subcostal laparotomy with complete left hemi-diaphragmatic excision (1cm rim) and primary closure (goretex patch) was performed (n=13). Then modified with a reduced defect: 3x3cm (>50%) (n=21). Finally (n=7) a laryngeal mask airway (LMA) (V-gel, Millpledge) was tested. 90 day survival and hernia recurrence were documented, alongside transdiaphragmatic pressure and uni-axial tensiometry.

Results: 1.57kg (0.8-2.3) rabbits surviving 90days doubled their weight. Initially 6/13 (46%) with a complete defect survived >48 hours post defect closure, yet 4/6 (67%) developed respiratory failure by 30days and two survivors at 90days had recurrence. The reduced defect group (n=21) had improved survival at 48 hours (95%), yet 13/20 (65%) died (13-30days) later with respiratory failure. Post-mortem revealed no hernia recurrence but pulmonary respiratory distress syndrome (i.e. ARDS) with tracheal mucosal thickening, stricture formation and fibrotic inflammation on histology. Of the 7/21 survivors at 90days, 5/7 (71%) had recurrence. Tensiometry (n=5) showed reduction in disruption stress at patch interface compared to untouched right hemidiaphragm ($p<0.05$). Patch (n=4) vs. control (n=1) animals had higher transdiaphragmatic pressure (13,9 vs. 3,8 cmH20) and tube occlusion increased pressures. The final (LMA) group had 100% survival at 30 days.

Conclusions: The immature rabbit airway is easily traumatised: 65% developed late respiratory failure secondary to tracheal injury following endotracheal intubation. Rabbits with a 3x3cm left postero-lateral defect had 33% survival at 90days, weight more than doubled with a 71% recurrence rate. Modified intubation technique will improve 90day survival, providing a clinically relevant growing animal model for further testing of new tissue engineered matrices.