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Evaluation of Lung Sealants as Suture Replacements in an Ex Vivo Pig Model

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Abstract

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PURPOSE: Postoperative airleak may occur following 30-50% of lung resections, with up to 15% being classified as prolonged. Patients with prolonged airleak are at increased risk for infectious and other complications, increased hospital costs and lengths of stay. Efforts to reduce airleak have led to development of various sealants which have been used as an adjunct to standard closure techniques with sutures or staples. This study aims to test the performance of different sealants without sutures in mechanically ventilated explanted pig lungs with standardized pleural defects.

METHODS: Explanted pig lungs were evaluated for airleak after creation of 1 cm circular defects in the visceral pleura. Airleak was confirmed by submerging in PBS. Pleural defects were sealed using Evicel (fibrin-based), Biogluue (two-part hydrogel glue consisting of bovine serum albumin and glutaraldehyde), Progel (two-part hydrogel glue consisting of human serum albumin and polyethylene glycol), or sutures (2 layered running horizontal mattress and simple closure). Lobes were then selectively ventilated for 2 minutes at an airway pressure of 10 cmH$_2$O, PEEP of 0, and respiratory rate of 12. Airway pressure was increased by 5 cmH$_2$O at 2-minutes intervals. Lungs were submerged in a water bath containing PBS at 37˚C to test for airleak at each interval. This process was continued till airleak was observed or a maximum airway pressure of 50 cmH$_2$O was reached. Our primary endpoint was bursting pressure (BP), defined as the minimal peak pressure at which gas bubbles were observed. One-way ANOVA and post-hoc Tukey tests were used to compare groups.

RESULTS: A total of 12 lungs were evaluated and 20 lobes were selected. Biogluue demonstrated the highest sealing efficacy, with no bursting in any samples after reaching peak pressures of 50 cmH$_2$O (n=3, p<0.0001). There were no significant differences in BP between sutures, Progel and Evicel.

CONCLUSIONS: Our study suggests that Biogluue had the highest sealing efficacy, although it is not currently approved as a pleural sealant. Progel, the only approved pleural sealant on market, had similar sealing efficacy to sutures.

CLINICAL IMPLICATIONS: To our knowledge, this is the first study to evaluate the performance of lung sealants as alternatives to sutures in an _ex vivo_ airleak model. _In vivo_ animal models are needed to further explore these findings.

DISCLOSURE: The following authors have nothing to disclose: Sebastian Ochoa, Bijan Dehghani, George Cheng, Jennifer Wilson, Adnan Majid, Nasim Annabi, Ali Khademhosseini, Sidhu Ganghadaran

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