

# Ex Vivo Lung Perfusion

## - Experimental and Clinical Studies

Akademisk avhandling

som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien,  
Göteborgs universitet kommer att offentligen försvaras  
i hörsalen Arvid Carlsson, Academicum, Medicinargatan 3,  
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av  
**Tobias Nilsson**  
Leg. läkare

Fakultetsopponent:  
Professor Richard Ingemansson  
Thoraxkliniken, Skånes universitetssjukhus, Lunds universitet, Sverige

Avhandlingen baseras på följande delarbeten

- I. **Hemofiltration in ex vivo lung perfusion - a study in experimentally induced pulmonary edema.**  
T. Nilsson, C. Hansson, A. Wallinder, C-J Malm, M. Silverborn, S-E Ricksten, G. Dellgren.  
*The Journal of Thoracic and Cardiovascular Surgery.* 2016;151(2):570-575.
- II. **Comparison of two strategies for ex vivo lung perfusion.**  
T. Nilsson, J. F. Gielis, A. Slama, C. Hansson, A. Wallinder, S-E. Ricksten, G. Dellgren.  
*The Journal of Heart and Lung Transplantation.* 2018;37(2):292-298.
- III. **Lung transplantation after ex-vivo lung perfusion in two Scandinavian centres.**  
T. Nilsson, A. Wallinder, I. Henriksen, J. C. Nilsson, S-E. Ricksten, H. Møller-Sørensen, G. Riise, M. Perch, G. Dellgren  
*Submitted manuscript.*
- IV. **Correlation of factors during ex vivo lung perfusion with short-term outcome post transplantation.**  
T. Nilsson, A. Wallinder, I. Henriksen, J. C. Nilsson, S-E. Ricksten, H. Møller-Sørensen, G. Riise, M. Perch, G. Dellgren  
*Manuscript.*

**SAHLGRENKA AKADEMIN**  
**INSTITUTIONEN FÖR KLINISKA VETENSKAPER**



# Ex Vivo Lung Perfusion - Experimental and Clinical Studies

Tobias Nilsson

Department of Anaesthesiology and Intensive Care, Institute of Clinical Sciences,  
Sahlgrenska Academy, University of Gothenburg, Sweden

**Background:** Ex vivo lung perfusion (EVLP) has since its introduction in clinical practice experienced a rapid expansion and made more organs available for transplantation. Different protocols and strategies have been implemented at transplantation centres around the world.

**Aims:** In an experimental setup in pigs, the effect of haemofiltration during EVLP on lung function, perfusate oncotic pressure and lung weight (paper I), was evaluated, and two clinically used strategies for EVLP were compared, with respect to lung function, metabolism, inflammatory response, oxidative stress, and cell viability (paper II). To assess the clinical outcome of patients in Gothenburg and Copenhagen undergoing lung transplantation after EVLP they were compared to a contemporary control group (paper III). Correlations between lung physiologic variables during EVLP and short-term clinical outcome in lung transplant recipients were assessed, with the intention to identify variables during EVLP predicting post-transplantation outcome.

**Methods:** In paper I, pulmonary oedema was induced in pigs, and lungs randomized to EVLP with or without haemofiltration. Oncotic pressure, lung performance and weight were measured before and after EVLP. In paper II porcine lungs were harvested and randomized to EVLP according to either of two clinically used protocols. The groups were compared before and after four hours of EVLP. In paper III lungs not accepted for donation, but with potential for improvement, underwent EVLP and were transplanted if predefined criteria were met. Outcome was compared to a control group of patients transplanted with conventional donor lungs. Variables during EVLP were examined for correlation with short-term outcome after lung transplantation in paper IV.

**Results:** Haemofiltration during EVLP increased oncotic pressure and decreased lung weight compared to EVLP without haemofiltration, but without effect on lung oxygenation capacity in either group (paper I). There was a trend towards more lung oedema formation in the acellular, open left atrium group, but otherwise there were no differences between groups (paper II). Patients receiving lungs after EVLP had a lower PaO<sub>2</sub>/FiO<sub>2</sub> ratio at arrival in the intensive care unit (ICU), longer time to extubation and spent longer time in ICU, however without difference in lung function at one year or survival at intermediate follow-up (paper III). No correlations could be found between variables measured during clinical EVLP and short-term outcome in lung transplant recipients (paper IV).

**Conclusions:** Haemofiltration during EVLP may decrease pulmonary oedema. No major differences in effect could be established between the two clinically most used methods for EVLP. Outcome in patients transplanted with lungs after EVLP was comparable to patients receiving conventional lungs at intermediate-term follow-up. There were no clear correlations between commonly measured variables during EVLP and short-term outcome.

**Keywords:**

Ex vivo lung perfusion, EVLP, lung transplantation