

# Renal function in cardiac surgery

## Clinical and experimental studies

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien,  
Göteborgs universitet kommer att offentligens försvaras i Hjärtats aula, Sahlgrenska  
Universitetssjukhuset, Göteborg

Fredagen den 1 juni, klockan 09.00

av

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Leg.läkare

Fakultetsopponent:

Professor Tomas Gudbjartsson, Islands universitet

### Avhandlingen baseras på följande delarbeten:

- I. Kolsrud O, Ricksten SE, Holmberg E, Felldin M, Karason K, Hammarsten O, Samuelsson O, Dellgren G. **Measured and not estimated glomerular filtration rate should be used to assess renal function in heart transplant recipients.** Nephrol Dial Transplant. 2016 Jul;31(7):1182-9.
- II. Kolsrud O, Karason K, Holmberg E, Ricksten SE, Felldin M, Samuelsson O, Dellgren G. **Renal function and outcome after heart transplantation.** J Thorac Cardiovasc Surg. 2018 Apr;155(4):1593-1604
- III. Kolsrud O, Damén T, Nygren A, Ricksten SE, Tholén M, Hjärpe A, Laffin A, Dellgren G. **The effects of atrial natriuretic peptide on renal function during cardiopulmonary bypass: A randomized blinded study in a pig model.** In manuscript.
- IV. Kolsrud O, Barbu M, Dellgren G, Sigvardsson AL, Björk K, Corderfeldt A, Jeppsson A, Ricksten SE. **Renal effects of dextran-based versus crystalloid-based priming solution in cardiopulmonary bypass: A randomized controlled study in adult cardiac surgery patients.** In manuscript.

# Renal function in cardiac surgery clinical and experimental studies

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## Abstract

**Background:** Impaired renal function (measured as glomerular filtration rate (GFR)) is a well-known problem after heart surgery and heart transplantation (HTx), affecting both short-term and long-term survival. The reason for this is multifactorial, but the use of heart-lung machine and cardiopulmonary bypass (CPB) is thought to be one of the causes. Whatever the cause, impaired kidney function after heart surgery is an important clinical problem.

**Aims:** We wanted to investigate whether estimated GFR could replace measured GFR in the follow-up of HTx recipients and to assess the renal and survival outcome in our entire cohort of HTx patients. Also, we wanted to investigate the potential renoprotective effects of ANP in an experimental model of CPB, and to compare the renal effects of a colloid-based CPB-prime versus a crystalloid-based prime in adult patients undergoing heart surgery.

**Methods:** Retrospective registry studies were performed to evaluate the agreement of three major estimation formulas for GFR to the measured values in about 400 HTx recipients. An animal study on 20 pigs was designed to compare the renal effects of ANP during CPB. A randomized controlled trial with 80 adult patients undergoing cardiac surgery was performed to compare the renal effects of a dextran 40-based fluid to a conventional crystalloid-based fluid (Ringer-Acetate and mannitol) when used as priming solutions in the CPB circuit.

**Results:** The agreement between estimated and measured GFR was very low, with a percentage error around 100%. Moreover, pre-HTx GFR did not predict mortality in our cohort. In our pig model, ANP increased GFR during CPB ( $p < 0.0001$ ) without increasing renal oxygen consumption. The patients receiving dextran 40-based priming solution in the heart-lung machine had lower levels of the tubular injury marker NAG in their urine than the patients receiving crystalloid prime ( $p = 0.045$ ).

**Conclusions:** Measured, not estimated, GFR should be used when assessing kidney function in HTx-patients. A GFR  $< 30$  ml/min/1.73m<sup>2</sup> should not automatically exclude heart failure patients from HTx-evaluation. ANP is a drug with potential renoprotective properties that should be investigated further. A dextran 40-based priming solution seems to induce less renal tubular damage than crystalloid-based prime, and should be investigated further, specifically in patients with a preoperatively impaired kidney function.

**Keywords:** Cardiopulmonary bypass, kidney function, acute kidney injury