

# Renal artery stenosis

## Aspects of diagnosis and endovascular treatment

### Akademisk avhandling

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av

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Avhandlingen baseras på följande delarbeten:

- I. Saeed A, Bergström G, Zachrisson K, Guron G, Nowakowska-Fortuna E, Fredriksen E, Lönn L, Jensen G, Herlitz H  
**Accuracy of colour duplex sonography in the diagnosis of renal artery stenosis**  
*Journal of Hypertension 2009;27:1690-1696*
- II. Zachrisson K, Herlitz H, Lönn L, Falkenberg M, Eklöf H  
**Duplex ultrasound for identifying renal artery stenosis: direct criteria re-evaluated**  
*Acta Radiologica 2017;58:176-182*
- III. Zachrisson K, Elverfors S, Jensen G, Hellström M, Svensson M, Herlitz H, Falkenberg M  
**Long-term outcome of stenting for atherosclerotic renal artery stenosis and the effect of angiographic restenosis**  
*Accepted for publication in Acta Radiologica 2018*
- IV. Zachrisson K, Krupic F, Svensson M, Wigelius A, Jonsson A, Dimopoulou A, Stenborg A, Jensen G, Herlitz H, Gottsäter A, Falkenberg M  
**Medium-term results of renal artery revascularization in the post-ASTRAL era**  
*Manuscript*

**SAHLGRENSKA AKADEMIN**  
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### Abstract

**Background.** Renal artery stenosis (RAS) becomes haemodynamically significant when it reduces the arterial pressure below the threshold for autoregulation of renal perfusion. Physiological responses to reduced renal perfusion include activation of hormonal cascades, causing hypertension, and reduction of glomerular plasma filtration, causing renal insufficiency. The optimal diagnostic work-up and treatment for symptomatic RAS remains to be determined.

**Methods.** Patients with hypertension and suspicion of RAS were examined with renal artery duplex ultrasound, using the indirect method of recording flow velocities in the inter-lobar arteries (paper I,  $n = 169$ ), and the direct method of recording flow velocities in the main renal artery (paper II,  $n = 58$ ). Duplex ultrasound criteria for haemodynamically significant RAS were analyzed with invasive trans-stenotic pressure gradient measurement as reference. Clinical outcomes after percutaneous transarterial renal angioplasty (PTRA) were retrospectively studied in two populations. The long-term outcome (more than one decade) was evaluated in patients with or without angiographic restenosis at one year (paper III,  $n = 57$ ), and medium-term outcome (mean 4.3 years) was studied in consecutive patients treated with contemporary indications for endovascular treatment (paper IV,  $n = 224$ ).

**Results.** The new index for indirect renal duplex ultrasound, maximal acceleration index ( $AI_{max}$ ), did not outperform the established early systolic pulse acceleration ( $ACC_{max}$ ) in detecting haemodynamically significant RAS (paper I). For direct renal duplex ultrasound, a renal-aortic ratio (RAR) of  $\geq 2.6$  as a sole criterion for significant RAS had advantages compared to the established combined criteria of peak systolic velocity (PSV)  $\geq 180$  cm/s and  $RAR \geq 3.5$  (paper II). The long-term prognosis after PTRA was dismal, with high mortality and morbidity and reduced renal function, despite maintained hypertension control. Restenosis did not affect late outcome (paper III). The number of PTRA procedures decreased over time. Patients treated in 2010–2013 had a significant and persistent reduction in systolic and diastolic blood pressures and in anti-hypertensive medication compared to before the intervention ( $p$ -values  $< 0.01$ ). In contrast, renal function increased only transiently following PTRA, without sustained improvement later during follow-up (paper IV).

**Conclusions.** Ultrasound duplex criteria for haemodynamically significant RAS affects the diagnostic accuracy. With contemporary indications and techniques, PTRA appears to have a beneficial effect on blood pressure control.

**Keywords:** hypertension, renal artery stenosis, duplex ultrasound, trans-stenotic pressure measurement, percutaneous transarterial renal angioplasty