Summary, discussion and future studies
SUMMARY
Abdominal aortic aneurysm (AAA) is a pathological dilatation of the abdominal aorta exceeding the normal diameter by more than 50 percent. Juxtarenal aortic aneurysms (JAA), which means that the aneurysms have their origin close to the renal arteries, account for approximately 15% of AAAs. Despite advances in endovascular aneurysm repair, open surgical repair of JAA is generally the treatment of choice. Open surgical repair requires suprarenal aortic cross clamping (i.e. above the renal arteries). The latter, however, causes temporary renal artery occlusion and renal ischemia-reperfusion injury (I/R-injury), which could lead to renal dysfunction.

In the first part of the thesis we studied renal dysfunction after JAA-repair in patients. In chapter two we performed a systematic review, showing a mean perioperative mortality of 2.9% and a need for hemodialysis in 3.3% of patients. Postoperative renal dysfunction ranged from 0 to 28% (median 12.5%). In six studies selective cold renal perfusion during suprarenal clamping was performed in order to preserve renal function, whereas only one study (our study) applied routine cold renal perfusion in all patients. In chapter three and chapter four we retrospectively studied renal insufficiency after JAA repair and the possible effect of cold renal perfusion on the postoperative renal function after JAA repair in both elective and acute settings, respectively. We observed that in patients who received renal cooling during renal ischemia, postoperative acute renal insufficiency was zero in the elective setting. In the acute setting, less renal failure, multiple organ failure and mortality were seen in patients with renal cooling vs without renal cooling.

In the second part of the thesis we embarked on investigating renal cooling and the mechanisms of preservation of renal function during JAA-repair. In chapter five we simulated JAA repair in rats in a novel model and compared this to a “simple” renal ischemia-reperfusion model. During JAA-repair, a period of both supra- and infrarenal aortic-clamping is followed by infrarenal aortic-clamping (below renal arteries) in order to restore renal flow, while performing the distal anastomosis (Figure 1.3). Infrarenal aortic-clamping, despite restoring renal perfusion, provokes additional renal damage compared to suprarenal aortic-clamping alone in the “simple” renal ischemia-reperfusion model. In chapter six we tried to identify the underlying protective mechanism(s) of renal cooling and/or perfusion with saline. To this end we applied cold, warm or no renal perfusion during renal ischemia in JAA repair in rats. Cold perfusion reduced the rise in creatinine-levels as well as diminished the presence of luminal lipocalin-2 (marker for tubular damage) and brushborder damage compared to warm perfusion or no perfusion. In the group with cold perfusion also renal extraction of dimethylarginines was preserved, which resulted in high bio-availability of nitric oxide leading to preservation of renal cortical flow. Interestingly, also in the sigmoid colon, flow remained intact in rats who
received renal cold perfusion, which is described in chapter seven. Early signs of sigmoid colon injury were present after JAA repair in all rats. A creatinine-rise and renal tubular damage were positively correlated with Intestinal Fatty Acid Binding Protein expression (I-FABP; a known marker for intestinal mucosal injury). Cold perfusion during renal ischemia reduced I-FABP expression as well as leukocyte accumulation in the sigmoid colon, and resulted in high microcirculatory mucosal blood flow.

In part three of the thesis we explored new endovascular techniques to repair abdominal aortic aneurysms. In chapter eight we tested the feasibility of a direct videoscopic approach to the descending thoracic aorta for branched endograft delivery to the aortic arch and the pararenal aorta, respectively, in a human cadaver circulation model. We showed that this approach may be an alternative access technique for branched endograft delivery to the aortic arch and abdominal aorta. In chapter nine we investigated the chimney graft (CG) technique and its applicability in an in vitro juxtarenal aortic aneurysm model. One specific issue to the CG-configuration is the occurrence of so-called “gutters” in the seal zone between aortic wall and the main graft. In this in vitro study, we showed that for chimney grafting, the self expandable CG is more suitable than the balloon expandable CG.