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"Open or endovascular abdominal aortic aneurysm repair in patients with impaired renal function: a therapeutic dilemma"

ΜΕΤΑΠΤΥΧΙΑΚΟΣ ΦΟΙΤΗΤΗΣ: ΔΟΥΛΑΠΤΣΗΣ ΜΙΚΕΣ

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INTRODUCTION

Over the past decades, with the liberal use of cross-sectional imaging and enhanced screening efforts, abdominal aortic aneurysms (AAA) are more frequently identified in elderly patients. Approximately 1% of the general population aged over 55 years will be diagnosed with AAA, with an increasing incidence of 2% to 4% per decade thereafter [1]. In order to prevent the rupture of aneurysms, which carries a dramatic mortality rate, elective AAA repair is undertaken in our days using two alternative methods, the endovascular aneurysm repair (EVAR) and the open aneurysm repair (OAR), with good early and mid-term results in appropriate candidates for both methods. Compared with open repair, EVAR is a minimally invasive procedure eliminating the need for a laparotomy and its complications, decreases blood loss, does not require general anesthesia or intensive care unit (ICU) admission, and it is cost effective due to shorter hospitalization [2]. It has been also demonstrated that EVAR carries lower perioperative morbitity and mortality rates (25% compared with traditional open repair). Thus, one may suggest that especially high risk patients with multiple comorbidities, may be good candidates for the endovascular approach. However, EVAR is not a stable procedure, it is associated with unique complications (endoleak, migrations of the graft, collapse and limb occlusions), and requires endoluminnal manipulations and contrast administration. Additionally, a close long term follow up with serial surveillance using contrast enhanced computer tomography (CT) is essential, creating the potential for renal function deterioration, especially in patients with already impaired renal function [3].

It is widely accepted that both procedures, may affect renal function and this is an important issue when managing patients with AAA. Not surprisingly, the prevalence of baseline renal insufficiency is higher in patients with vascular disease, therefore in patients with AAA as well. It is thus essential for clinical practitioners to bear high clinical surveillance among these patients, and classify them preoperatively based on their renal function, procedure not simple due to the wide variability of definitions of renal dysfunction with lots of classifications systems [4]. Early recognition of high risk patients should prevent them from becoming dialysis dependent, with poor long term prognosis [5].

Specific guidelines upon the management of AAA patients with pre-operative renal impairment do not exist. Numerous authors have analyzed this problem, but still there are perminent questions and several issues unsolved.

1. What is the prevalence of baseline renal insufficiency in patients with AAA and which score system classification for kidney disease is the optimum?
2. What are the risk factors for declining renal function after EVAR and OAR.
3. How does OAR affect renal function in patients with preexisting renal impairment and in what manner?
4. How does EVAR affect renal function in patients with already renal impairment and in what manner? Is there a difference concerning the development of renal impairment following infrarenal or suprarenal fixation?
5. Which is the preferred method for patients with preexisting renal failure?
6. Which are the strategies in order to minimize perioperative renal impairment and preserve postoperative and long term renal failure especially in EVAR group patients?

The aim of this study is to review the current literature in order to define specific directions towards the management of patients with impairment renal function and to give answers to the above questions.

METHODS AND MATERIALS

A thorough review of the literature was performed, involving a systematic search in PubMed database for studies in English literature using terms as AAA, endovascular aneurysm repair (EVAR), open repair, renal function, renal insuffiviency, and renal impairment. References which correlate the methods of aneurysm rehabilitation with the impact on renal function status were included. From over 120 studies initially identified, 58 articles were used in this review.

1. Elective Open Abdominal Aortic Aneurysm Repair (OAR) in patients with abnormal renal function: impact on renal function and mortality rates

1.1 Patients with end-stage renal disease (ESRD)

Patients with ESRD on chronic hemodialysis, represent a challenging subgroup of candidates for elective open AAA repair due to the increased morbidity and mortality of this population. Published data are limited, only small series exist, making statistical estimation of the true population mortality rate impossible. Cohen et al. in 1986, presented a study of 251 patients undergoing elective open AAA repair. 10% of them had preoperative renal failure and only 4 patients were on hemodialysis. Among the dialysis group, perioperative mortality was 25% (1 patient died) [6].

Norwood et al. described a similar group of 13 patients with established renal failure, six of whom were receiving hemodialysis or continuous ambulatory peritoneal dialysis (CAPD). Perioperative mortality of the end renal stage subgroup was 50% (3 patients died). He also demonstrated that previously non-dialysis-dependent patients had a high risk of subsequent long-term dialysis (four of the six survivors required long-term dialysis postoperatively) [7]. In 2006, Bastounis et al. published their 10 years’ single-center experience in patients with ESRD and AAA. Eleven patients underwent open repair, with 0% perioperative mortality. The mean follow up was 11.5 months. During this period, 2 patients died from heart failure [8].

More recently, in 2014, Yuo et al. collected data from the United States Renal Data System and presented a study of 1557 hemodialysis-depended patients who underwent elective AAA repair in the United States between 2005 and 2008 (261 OAR and 1296 EVAR). As for the OAR subgroup, the 30–day mortality was 16.1 %, with a median survival of 27.4 months, with age (HR, 1.02; 95% CI, 1.01-1.03; $P < .001$) and diabetes (HR, 1.39; 95% CI, 1.13-1.71; $P = .002$) predicting increased mortality in both groups. The authors concluded that the high perioperative mortality in ESRD patients raises questions about the indications of AAA repair in this population [9].

Clearly, all these series show that OAR in patients with ESRD has a significant perioperative and overall mortality rate far in excess of that in patients with normal renal function, and higher compared to patients already with impaired renal function (Table 1). Thereafter, in this subgroup, the decision to operate may be deferred to when the aneurysms become symptomatic, while the size-threshold criteria may exceed up to 5.5 cm.

1.2 Patients with renal impairment

Open elective AAA repair is associated with a mortality rate of approximately 5% and a risk of developing renal failure between 1% and 6 % [10]. Therefore, identifying patients at increased risk is of clinical importance. For this purpose, Grant et al. conducted in 2012 a retrospective multicentric analysis of 2347 patients who underwent OAR [11]. The incidence of postoperative renal failure was 6% (140 patients), which is in accordance to previous published studies. Multivariate analysis revealed six independent risk factors for postoperative renal failure, including age over 75 years, symptomatic AAA, respiratory disease (dyspnea on exertion or at rest), treated hypertension, juxta-suprarenal AAA and serum creatinine >150mmol/L. A simple clinical renal failure score derived from this study, using the above mentioned parameters. Using this score system, patients were divided in low, medium and high risk groups for renal failure, with <3%, 3- 5.5% and >5.5% relative risk respectively.

Data from the literature concerning patients with preexisting renal failure, conclude that the risk of postoperative renal impairment is higher than in the normal baseline group [7,12]. Statistical metaanalysis is infeasible though, as the criteria used to assess renal function (mainly serum creatinine or GFR) vary between studies.

Komori et al. reported a mortality rate of 2% (one patient), in 50 patients with a mean creatinine level of 256 mmol/l (standard error 35) [13]. All patients had serum creatinine greater than 177mmol/l.

In 33 patients with a mean serum creatinine level of 221mmol/l (standard deviation 150), Sugawara et al. demonstrated a mortality rate of 9.1 % [14]. Additionally, Cohen and Norwood with their small series demonstrated mortality outcomes varying from 0% to 14.3% [6, 7]. No effect of preoperative renal impairment to mortality rate was detected from the large study by Helle et al., who examined 358.521 cases of elective open AAA repair over a 19-year period in North America, using ICD-coding to define renal failure. In this study no serum creatinine value definition was used [15]. In a single metaanalysis of four pooled studies with a total of 10.174 patients undergoing OAR, Hallin et al. examined the consequences of preoperative renal impairment on post operative mortality. It was found that the relative risk ranged from 4.2 to 9.0. Pre-operative renal impairment was also undefined in this large study [16].

Numerous large cohort studies have also previously highlighted the negative effect of renal impairment on survival after OAR. The Canadian Aneurysm Study [17], a prospective multicenter study of elective OAR, presented a total mortality rate of 4.8 % in 666 patients. A significantly increased operative mortality (9.9%) and morbidity (11.8%) demonstrated in patients with chronic renal insufficiency, which was defined as Cr > 1.25mmol/L. Katz et al reported an unexplained high operative mortality rate (41.2%) in patients with renal impairment. Moreover, he suggested that renal failure was the strongest independent predictor of death for OAR (odds ratio 9,0;95% confidence interval, p=0,001) [12].

Similarly, in a large study using database from the NSQIP between 2000 to 2008, Patel et al. demonstrated that in 2890 patients who underwent OAR and who were assigned to a CKD class (normal – mild –moderate- severe –kidney failure) based on eGFR value, the unadjusted operative mortality was 2.6% for mild, 9.1% for moderate and 10.3% for severe CKD [18].

Recently in 2013, Nguyen et al. identified 1256 patients with chronic renal insufficiency (defined as eGFR <60 Ml/min/1,73 m^2), in the NSQIP database between 2005 and 2010 who underwent open AAA repair. Among them, 1117 had moderate (30<eGFR<60 Ml/min) and 139 had severe <30 renal dysfunction. The mortality rate was 4.1% and 5.8% respectively and both groups had significant mortality and major events (cardiovascular and pulmonary) compared to the EVAR group [19] (Table 2).

1.3 Pathogenesis of renal impairment in open AAA repair

Apart from the preoperative risk factors, the surgical technique is also a major contributor to postoperative renal failure in open repair of AAAs. Hypoperfusion related to aortic clamping, perioperative hemorrhage and atheroembolism into the renal vasculature, increase the risk of acute renal failure (ARF) in open AAA repair, leading 0.5-2% of patients to dialysis [20]. While supra-renal aortic clamping has been implicated in increased renal insult in previous studies [21], when Hoshina et al compared 35 patients with juxtarenal and 26 patients with infrarenal AAA (with short <15 mm and/or large >28 mm aneurysm neck that only required infrarenal aortic clamping), no statistically significant differences in the postoperative renal function were observed, using the RIFLE (Risk, Injury, Failure, Loss of kidney function, and End-stage kidney disease) classification. These two groups in the study had similar baseline characteristics, comorbidities, and intraoperative variables [23]. In another study, Wahlberg et al. published the effect of suprarenal clamping in 43 patients with AAA. Sixteen of them had impaired preoperative renal function (Cr >1.25 mg/dl). Postoperative renal decline was statistically significant in this subgroup compared with the group of normal preoperative renal function. Univariate analysis revealed that preoperative renal failure, intraoperative hypotension and the renal ischemia time due to suprarenal clamping were the only significant risks factors for renal complications [20].

2. EVAR in patients with abnormal renal function: prevalence of postoperative Acute Renal Failure (ARF)

While the incidence of ARF in patients with normal preoperative renal function undergoing open repair of AAA is 5.4%, it is known to be increased two to three folds in patients with preexisting renal insufficiency [23]. This is attributed to aortic clamping, blood loss, cardiac output reduction, neuroendocrinic mechanisms, and extracellular fluid accumulation. All the above lead to significant hemodynamic changes during surgery while, emboli and ischemia- reperfusion injury are participants in renal injury, as well [24].

Respectively, mortality is remarkably increased in patients with chronic kidney insufficiency (CKI) (41.2% compared to 6.2% in control groups) [12].

Patients undergoing endovascular repair of AAA are considered to be in high risk of renal failure, which is a significant risk factor for mortality. The latter is increased to 47% if renal failure preexists, compared to 3% in patients with normal baseline renal function [25]. Efforts have been done in order to quantify this risk in patients with baseline normal or impaired renal function.

2.1 EVAR and ARF based on preoperative serum creatinine (SCr)

In 2001, Carpenter et al. studied 98 patients who underwent endovascular AAA repair, excluding patients requiring dialysis preoperatively [26]. In this study, 20% of patients had baseline SCr ≥1.3mg/dL, and a rise in SCr was observed in 23 patients (24%) after the repair, with permanent impairment in 16% of them. Notably, affected patients had either normal (15) and impaired (8) preoperative renal function, while 2% required permanent dialysis, 1 of them with normal previous SCr. While mortality was independent of preoperative SCr, neither complication such as access failures, arterial injuries, blood loss or endoleaks seemed to be affected by baseline SCr in this study.

Three years later, Vasquez et al presented their 5-year experience with 213 patients, divided in two groups based on preoperative SCr, group A (61%)for SCr <1.2mg/dL and group B (39%) for SCr ≥1.2mg/dL. Patients with ESRD were excluded in this study as well. Contrast- medium angiogram was performed in all patients. One patient from group A (0.8%) progressed to ESRD, compared to 5 (6%) patients in group B (p= 0.068). Mortality rate was also higher in group B (6%) compared to group A (1.6%), with statistical significance of (p=0.068) suggesting a predisposition of renal failure to postoperative mortality. Of note, patients with preoperative renal impairment were predominantly elderly, male, with history of myocardiac infarction [27].

Similar results emerged from the EUROSTAR registry which classified renal impairment as a raised SCr >1.33 mg/dL [28].

In another 5-year review by Mehta et al in 2004, 200 patients were divided in groups 1,2 and 3, based on their SCr level: <1.5, 1.5-2 and 2.1 to 3.5mg/dL respectively. Patients with ESRD were excluded. A temporary increase in SCr was observed in 2.7%, 3.1% and 7.4% in groups 1, 2 and 3 respectively. Patients requiring dialysis existed in all groups, with lower incidence in group 1 (1.9%), 3.1% in group B and 3.7% in group 3, while mortality rates were 0.9% for group 1, 3.1% for group 2 and 3.7% for group 3. Surprisingly, all patients in groups 2 and 3 who experienced renal failure, needed hemodialysis [29].

A large population of 342 patients undergoing EVAR was retrospectively studied by Park et al in 2007, divided in groups based on preoperative SCr <1.3mg/dL (250 patients) , 1.3-2.5 and ≥2.5 mg/dL (totally 92 patients with clinically significant renal insufficiency). ARF was detected in 5 of 76 patients with moderate renal failure (7%) compared to 2 in 250 patients with normal preoperative SCr (1%) (P=0.0001), while 4 of 16 patients (25%) with severe preexisting renal impairment experienced ARF. Surprisingly, need for hemodialysis occurred in two patients with previous normal renal function and recovery was not noted, while patients with SCr between 1.3 and 2.5mg/dL did not reach ESRD, considering thus that EVAR is not a contraindication for these patients. The high incidence of ESRD in patients with severe renal failure (SCr >2.5 mg/dL) warrants great caution when considering them as candidates for EVAR. Likewise, perioperative mortality in moderately raised SCr was similar to control group, while a significant raise was observed in patients with SCr >2.5mg/dL [30] (Table 3).

2.2 EVAR and ARF based on GFR levels

In 2011 Guntani et al reviewed 46 patients with preexisting chronic insufficiency, defined as GFR<50ml/min, excluding patients with ESRD. A raise in SCr was observed in 5 patients (10%), with no occurrence of ESRD. In 4 patients, intravascular ultrasound was performed intraoperatively, restricting arteriography only after the device was in place, while post-operative surveillance was performed with color flow duplex ultrasound, in order to minimize nephrotoxic effects of contrast- enhanced medium [31].

The same year, Markovic et al concluded that the overall mortality is 16-fold greater in patients with preexisting CKI, while renal impairment is more common among this group, with an odds ration 22.478, in a prospective analysis of 12.451 patients who underwent endovascular repair of AAA.

Preoperative CKI is also associated with increased risk for perioperative mortality, as Azizzadeh showed in a retrospective analysis of 398 patients. Based on Cockroft- Gault equation, GFR was calculated and used as a marker in order to divide patients in 4 groups: group I (GFR 7 to 45), group II (GFR 45 to 60), group III (GFR 61 to 79) and group IV (GFR ≥80ml/min). 4-year survival was 61.5, 70.5, 86% and 85.7% for groups I to IV respectively, while 30-day mortality was 2.2, 3.2, 0 and 0% in groups I to IV respectively. Consequently, a GFR <45mL/min was associated with increased mortality after EVAR. A high occurrence of perioperative mortality was noted when GFR is between 45 and 60 mL/min, but late survival was comparable to that of patients with GFR >60 mL/ min. In the absence of clarification of the acute renal failure rate in the patients who passed, it is suggested that the mortality raise in groups I and II is mainly due to deterioration of renal function as well [33] (Table 3).

2.3 Longterm renal impairment after EVAR

Nearly all published studies of the effect of EVAR on renal function are limited by short – follow up. Over the first 7 days post- EVAR, an improvement in SCr has been observed, yet followed by a significant deterioration over the next year [34, 35].

Longterm deterioration post-EVAR remains a speculation. While a decline in renal function occurs with increasing age, this decline can be as much as 10% per annum in EVAR patients, 5 times higher than expected [36].In numbers, Surowiek et al showed that 25-36% of 113 EVAR patients developed renal impairment 3 years after the procedure, increased in comparison to a respective 19% rate in 65 patients after open AAA repair [37].

Controversial results occurred in 2010, in a larger study of 1194 patients who underwent EVAR. No long-term difference was demonstrated between EVAR or open repair in fit patients, or between EVAR and no intervention in unfit patients [38]. Notably, the cases of rapid renal impairment were associated with graft complications and larger neck diameters.

2.4 Pathogenesis of renal failure in EVAR

The decrease of renal function after endovascular repair of AAA is attributed not only to the administration of nephrotoxic contrast, but to other factors as well. Instrument manipulations in the femoral arteries engender an amount of lower limb ischemia, accompanied by ischemia-reperfusion injury. This is suggested by the increase in base deficit, which is proportionate to the tissue hypoperfusion and anaerobic metabolism. Activated neutrophils which are observed in ischemia-reperfusion injury are also considered toxic for the renal tissue.

Renal infarction by emboli dislodged from the aneurysm wall due to guidewires manipulation is also a major factor, described in two series [39, 40]. This consequence often leads patients to hemodialysis, especially when suprarenal endograft fixation is performed. The latter method is used in order to prevent stent graft migration, but the positioned struts across the renal artery ostium may decrease the flow rate in renal arteries, despite the fact that small studies have not achieved to prove this theory [41].

Suprarenal endograft fixation may increase the risk of renal infarction, as proximal movement of the renal arteries during respiration is suspended. The increased fixity of the renal arteries may attenuate the shearing forces on the artery, enhancing the risk of dissection [42].Concerning the suprarenal fixation of stent- grafts, it is suggested that these increase the risk of renal infarction, but does not otherwise alter renal function in the absence of this complication [43].

3. Comparison of OAR vs. EVAR in patients with renal dysfunction.

Patients with intrinsic kidney disease represent a subgroup for whom elective open AAA repair or EVAR remains problematic, due to excessive perioperative risk. Moreover, these patients bear significant cardiovascular comorbidities and reduced long-term survival in proportion to the severity of renal disease independent of the AAA. While numerous single–center and retrospective cohort studies have compared the effect of each procedure on renal function and mortality, there are no randomized clinical trials comparing the effects of these procedures in patients with already impaired renal function. In the early 21th century Wijnen et al determined in a small study the difference in renal impact between open and endovascular aneurysm repair in 37 patients (22 with OAR and 15 with EVAR). They studied a time dependent ratio of urine albumin/ creatinine (A:C ratio) using urine and blood samples that were obtained pre-operatively and then 5 min, one, six, twenty-four, and fourty-eight hours after declamping the first leg. In both groups there was a significant rise in A:C ratio after declamping ($p<.001$). When comparing the two procedures they found a significantly larger renal impact in patients undergoing OR, and less renal damage to the endovascular group. One patient died on each group during the postoperative time [44].

Five years later (2006) Wald et al in a retrospective study of 6516 patients who underwent open (3865 pt 59,3%) or endovascular (2651 pt, 40,7%) repair, found that EVAR was associated with lower odds of ARF (adjusted odds ratio 0,42 ; 95% confidence interval , 0,33 to 0,53) and ARF requiring dialysis (adjusted odds ratio 0,30 ; 95% confidence interval , 0,15 to 0,63). Mortality was higher among patients who underwent open repair (3,9 % vs. 1%) and higher among patients who developed ARF compared to those who did not . Besides, ARF was an independent risk factor for mortality and did not differ by procedure type. The authors concluded that EVAR was associated with lower risk of postoperative ARF. The limitation of this study is that data from ICD-9-CM codes were used, without clear criteria for the assignment of the ARF diagnosis [45].

Controversial results about the long term effect of EVAR have been reported by many authors as stated before. Mills et al (2008) tried to determine the impact of endovascular AAA repair on longterm renal function. Through a retrospective chart review with 223 patients receiving EVAR or OAR in a mean follow up of 48 months, he attempted to differentiate the expected serial decline in renal function opposed to procedure-related deterioration. They stratified baseline renal function (using the Chronic Kidney Disease (CKD) staging system and the glomerural filtration rate (GFR) estimated by the Cockcroft-Gault equation), as normal (stage 1 and 2: GFR > 60 ml/min/1,73m2) and abnormal (CKD >3, GFR <60). Using the same system he defined renal function decline in patients with pre-existing CKD at study entry. (stage 3: 30< GFR<60 , stage 4: GFR < 30 , stage 5: receiving dialysis), and rapid decline as a fall in GFR >4/y which was equal to a reduction in GFR >20%. He also compared patient’s CKD prevalence with the expected age-adjusted prevalence. The results were very interesting. Early postoperative renal dysfunction reflected by a lower mean GRF at 30 days, was more common after OAR than EVAR (P 0,047), but after this period there was no difference in mean GFR between the 2 groups, suggesting that this deterioration was transient. The decline in renal function (GRF >20% or > 1 CKD stage increase) was significant in both groups but did not differ between them. Freedom of renal dysfunction was also calculated according to Kaplan-Meier for short and long term differences in 2 groups (including patients with normal baseline renal function and patients with preexisting CKD). No short term differences could be detected but the long term follow up was significant higher in OR group compared with EVAR (P= 0.03), and especially in patients with preoperative renal impairment. This deterioration seems to occur 12 months earlier than those with normal baseline renal function [46].

This continuous deterioration in renal function after EVAR with respect to OAR, regardless of fixation level of endograft and independently of preexisting renal insufficiency was also observed by Antonello et al recently, in 2013. In a prospective study they compared the effect of EVAR, both with transrenal and infrarenal fixation vs. open repair in renal function. Patients with preexisting renal impairment were excluded [47]. Those results were opposed to the recent metanalysis of the DREAM STUDY GROUP by De Bruin. Using the chronic kidney disease epidemiology collaboration equation, and estimated GFR for the entire group decline, they found that renal function after OAR and EVAR was similar with no significant difference in the mean GFR after 5 years [48].

In an effort to precise the effect of CKD on outcomes after open or endovascular aneurysm repair in contemporary practice, Patel et al. studied a large series of 8701 patients who were treated for intact AAA (5811 with EVAR vs. 2890 with OAR). Those patients were grouped according to the preoperative CKD as mild (stage 1 and 2), moderate (stage 3) or severe (stage 4 and 5) renal disease. A prospective score analysis was performed to match OAR and EVAR patients with mild, and those with moderate or severe CKD. In unmatched patients undergoing EVAR or OAR, the presence of CKD increased mortality rates (1.7% for mild, 5.3 % for moderate and 7.6 % for severe renal disease). The unadjusted operative mortality for OAR was 2.6 % for mild, 9.1% for moderate and 10.3 % for severe CKD, while for EVAR was 1.3%, 3.2% and 6.2 % retrospectively. In the prospensity–matched cohorts the presence of moderate and severe CKD was associated with increased 30 day-mortality for both procedures compared with the presence of mild CKD. (EVAR : 1.9% mild vs. 3,2% moderate and 2,6% mild vs. 5,7 % severe), (OAR : 3,1% mild vs. 8,4% moderate and 4,1% mild vs. 9,9% severe) . The presence of moderate or severe CKD in patients considered for AAA repair is associated with significantly postoperative mortality in both groups with higher rates in the OAR [18].

Nguyen et al. using NSQIP database from 2005 to 2010 identified 5142 patients with chronic renal insufficiency (defined as eGFR<60 ml/min/1,73m^2) who were treated with either OAR (1256) or EVAR (3886). Among these patients approximately 90% had moderate (30< eGFR <60) and 10% had severe (eGFR< 30) renal dysfunction. The aim of this study was to compare the main postoperative outcomes (30–day mortality, renal dysfunction, cardiovascular and pulmonary complications) for open and endovascular repair in patients with moderate or severe renal function. They found that EVAR patients had significantly lower 30 day mortality (1,8% vs. 5,9%) and were less likely to have renal, pulmonary or cardiovascular postoperative events than patients treated with OAR. After correcting demographic and comorbidity variables between the 2 groups they also found a significant lower 30- day mortality in the EVAR group (odds ratio :3,74, confidence interval 2,63-5,32, p<0.001) and less complications (odds ratio of 3,0 /5,5/2,0/4,3 for renal ,pulmonary, cardiovascular and combined events respectively). Interestingly, when patients were stratified according to the severity of preoperative renal dysfunction, OAR repair had 3.6 times higher risk of postoperative renal impairment and 5.1 times higher risk of dialysis than EVAR repair. EVAR was also superior compared with OAR in primary outcomes (mortality, complications) for the group with moderate renal dysfunction (GFR 30-60ml/min). In contrast, there was no benefit of EVAR over OR in patients with severe renal dysfunction (GFR <30ml/min) because the complication rates were equally high in both procedures [19].

In 2006 Parmer et al. [34] in a single centre study compared the effects of both procedures on renal function in patients with already baseline renal insufficiency (Cr:1,5 mg /dl). Patients with AAA and preoperative renal impairment, underwent EVAR (52) or OAR (46). They compared the preoperative, postoperative and follow up level of SCr and creatinine clearance. Postoperative renal impairment was defined as an increase in SCr >30%. During postoperative and follow up period, no significant differences were observed between the two groups for SCr changes. However, with regard to changes within each group, the open group had a significant increase in serum creatinine postoperatively (2.43 ± 1.20 vs 2.04 ± 0.64, *P* = 0.012), which returned to baseline during follow-up (1.96 ± 0.94, *P* =0 .504). Although SCr levels in the EVAR group increased, compared with preoperative values of 2.04 ± 0.55 (postoperative, 2.27 ± 1.04; follow-up, 2.40 ± 1.37), failed to reach statistically significant for the postoperative (*P* =0 .092) or follow-up (*P* =0 .081) period. A similar pattern was noted in creatinine clearance. Postoperative renal impairment was noted in 13 OAR (28%) and 15 EVAR patients (29%) and was not statistically significant. Overall, two patients (4.3%) from the OAR and four (7.7%) from the EVAR group required hemodialysis. One in the EVAR group required permanent dialysis. This difference was not statistically significant (*P* _ .681).

4. Strategies in order to minimize renal impairment during and after EVAR

Contrast-induced nephropathy (CIN) is considered highly responsible for renal failure after EVAR. It is defined as impairment in renal function that occurs in 48-72 hours post-administration and characterized by a ≥0.5mg/dL increase in SCr, or 25% above baseline. SCr tends to return to normal values within two weeks. Respectively, a baseline GFR <60mL/min is considered as a risk factor for CIN [31].

Several strategies have been used in patients undergoing endovascular AAA repair, in order to minimize renal toxicity. The use of low osmolar, non-ionic contrast medium is preferred [31]. The use of MRA, rather than contrast-CT pre and postoperatively, and the use of gadolinium rather than iodinated contrast during intraoperative arteriography, have been suggested by Carpenter et al in 2001 [26]. Moreover, intravascular ultrasound imaging is considered an alternative tool. Especially concerning follow-up, Sandford et al. showed that no type I leaks or endoleaks requiring intervention were missed by duplex ultrasound [50].Carbon dioxide has been also used as a contrast material [51].

Preoperative administration of saline is crucial in order to ensure adequate renal perfusion. Mannitol, an osmotic diuretic, reduces renal damage during AAA, and although it is suggested that it could increase clearance of contrast, other data support an increase in complications with concomitant administration of contrast medium [52].

Acetylcysteine [53] and intravenous bicarbonate [54] intraoperatively have been also used with uncertain benefits. Another technique, involving systemic intravenous administration of the short-acting selective renal arteriolar vasodilator fenoldopam in order to avoid contrast induced nephropathy (CIN), has been applied by cardiologists [55]. The direct infusion of this substance into renal arteries during EVAR has been shown to induce renal arteriolar vasodilatation and increase GFR. This has been shown effective in 10 patients with SCr>1.5 mg/dL or GFR<60 ml/min who underwent EVAR. Patients with suprarenal fixation were excluded, though, in this study [3].

Likewise, avoidance of concomitant use of nephrotoxic agents is suggested, such as metformin, non-steroidal anti-inflammatory drugs, aminoglycosides and vancomycin, while rarely rhabdomyolysis has been encountered with the concomitant use of statins.

A reduction in contrast medium load would be preferred for some researchers [55], while others found no statistical significance between low or large contrast volumes.

Regarding the technique, guidewire and sheath manipulation should be minimized in order to reduce the risk of embolization, whereas the time of lower limb ischemy should be eliminated to as minimum as possible.

DISCUSSION

Chronic renal insufficiency is common in patients with AAA, as aproximately 36% of them already have renal dysfunction. Many authors suggest that this incidence is higher than in the general population, despite the fact that the definition of renal dynsfuction and laboratory markers that are used varies widely, rendering safe statistical conclusions impossible. Nakamura et al, compared baseline renal function in AAA patients with a cohort in hypertension (HTN) and showed by multiple methods including renal scintigraphy, that moderate or severe renal dysfunction was present in 81% of AAA compared with 58% of the HTN group [56].

Outcomes for patients with renal insufficiency are known to be significantly worse compared with patients with normal renal function, therefore it is critical that the approach we offer to that already disadvantaged group, should provide the best possible treatment. This is crucial because it is already known from the EUROSTAT STUDY (2006) that renal dysfunction also affects mortality after endovascular aneurysm repair and is a significant and independent risk factor for death [28].

Our review of over 50 reports aims to solve the clinical dilemma which vascular surgeons frequently face, when coping with a patient with CKD who has an aneurysm with anatomy suitable for both EVAR and OAR. This review reveals major issues from existing literature.

1. A worldwide classification system for baseline renal dysfunction is lacking.

2. In the same manner, there is no standard definition of postoperative renal dysfunction.

3. When comparing OAR to EVAR, there is a lack of information about the anatomy of AAA in candidates for the 2 groups.

4. The kind of endograft which is used in the EVAR group patients (supra or infrarenal fixation) should be determined.

5. With rare exceptions, the follow–up of the patients is short, as only few studies have focused on the long term results with the impact of repeated contrast CT scans in renal function , especially in EVAR patients.

The primary reason for the **disparate** and confusing results in the literature regarding the effect of both procedures on postoperative and long term renal function is attributed to the lack of standardized definitions. In many series [32, 45] renal impairment is not defined at all. Some of them use a variety of definitions, most commonly using SCr levels. Definition of renal deterioration as increased values of SCr is also used by many authors. Others use a 20% rise in SCr as a definition, but some include a >20% or at least 30% increase in SCr as a definition of postoperative renal impairment.

Many authors suggest the use of CKD staging, based on GFR measurement as the validate standard for the evaluation and management of chronic renal disease. It is believed that Scr is an insensitive indicator of renal dysfunction compared to the GFR, because it is influenced by a host of factors other than GFR, including tubular secretion and generation and extrarenal creatinine excretion. In addition to this, Scr does not begin to rise above the upper normal limits, until at least half of glomerular filtration has been lost. GFR is accepted as the best overall index of kidney function. Normal values of GFR vary by age, gender and body size, but a decrease in GFR <60 is a specific indicator of CKD and applies regardless of age, thus preceding the onset of kidney failure. Patients can also be assigned to a CKD class based on eGFR values according to National Kidney Foundation clinical guidelines . CKD stage 1 (normal): eGFR >90, CKD stage 2 (mild): eGFR 60 to 80, CKD stage 3 (moderate): eGFR 30 to 59, CKD stage 4(severe):eGFR 15 to 29 and CKD stage 5(kidney failure): eGFR<15. Using

CKD eGFR, the severity of renal failure can be categorized to mild (CKD class 1 or 2), moderate (CKD class 3) and severe (CKD class 4 or 5).

The majority of the published studies in the literate comparing OAR and EVAR in patients with preexisting renal impairment are focused on short term results, such as 30-day mortality and morbidity due to the incidence of ARF. Results from the studies are controversial and outcomes vary in each group. In general, EVAR in these studies shows no inferiority than OAR and is associated with lower 30 –day mortality, pulmonary and cardiovascular events and renal dysfunction in patients with GFR of less than 60 ml/min. Some authors, show good results with the EVAR procedure in those patients, with 30-day mortality rates of 1,8% almost the same as reported in the EVAR -1 trial [56], while the 30–day mortality rate for OPEN group (5,6%) is slightly higher than the quoted (4,7% in the EVAR -1 trial). Thus it seems that the advantage of EVAR over OPEN for patients with moderate renal insufficiency (GFR<60) is even more profound than the general aneurysm population. Therefore it is not surprising that the NSQIP database demonstrates that 75% in patients with preoperative renal insufficiency, were operated using EVAR compared to only 25% who were elected for OAR. This ratio is exact the same for all AAAs with and without renal dysfunction.

As for the subgroup of patients with severe preoperative renal dysfunction, which is the minority (approximately 10%), operative outcomes regardless of the repair approach are the worst. Even the minimally invasive EVAR, could not mitigate the high all-combined mortality / morbidity (17%) and complications rate (17-43%) in patients with eGFR <30. Postoperative dialysis may be needed for 6-10% of these patients. Mortality and complication rates in patients with severe renal preoperative function are not significantly different between open and EVAR . Other authors have reported higher morbidity and mortality rates for each group, which depends on the preoperative CKD class (mild vs moderate vs severe). In propensity–matched cohorts, moderate CKD increased the risk of 30-day mortality for EVAR (1.9% mild vs. 3.2% moderate) and OAR (3.1 % mild vs. 8.4% moderate) and was also associated with increased morbidity. Severe CKD increased the risk of 30 day mortality for EVAR (2,6 % mild vs 5,7 % severe ;P=0,0081) and OAR (4,1 % mild vs 9,9% severe ;P= 0,057) and increased dramatically the morbidity rates in both groups.

Thus regarding the short term results, many authors suggest that in term of kidney function both OR and EVAR are safe in population with mainly stage 2 CKD. In patients with moderate renal dysfunction EVAR is superior to OPEN at 30-day for all outcomes, especially in deteriorating renal function and thus should be considered as first- line therapy for patients with appropriate anatomy.

As for patients with severe renal function, the increased 30-day mortality rates of approximately up to 9% in some series [19] for both procedures are similar to those at EVAR-2 TRIAL by Greenlaugh and coauthors, who identified patients unfit for open repair and randomized them to EVAR versus medical treatment. In those patients, a higher threshold for repair using either approach should be applied, with an increase to 6-6,9 cm regarding the aneurysm diameter, as in these levels, the probable annual rupture rate approaches operative mortality risk . Therefore high risk patients (severe CKD), with symptomatic or rapidly growing aneurysms may be considered for repair after risk-benefit analysis.

Endovascular repair is less invasive but requires the use of contrast intraoperatively and especially during follow up (CT scan), in order to identify its procedure-specific complications such as endoleak, stent graft migration, collapse and endograft limb occlusion. This issue is critical in order to compare long-term effect of both procedures, in renal function especially in patients with preoperative renal impairment. Only few studies and subgroup analysis from randomized trial analyze this issue. Davey et al in their study, compared 24 EVAR patients with suprarenal fixation and 28 OAR patients, including a randomized trial (EVAR -1). There was no difference in CrCl and cystatin C during 12 months; however, CrCl differed by 7 ml/min at baseline, favoring EVAR (45). A retrospective study using eGFR as a measure of renal function examined 120 OARs and 103 EVARs. Again, there were no differences at 23 months. A similar study, which represented a post hoc analysis of renal function of patients recruited to the EVAR -1 and EVAR -2 trials, used the MDRD formula to compare patients managed with open or endovascular repair or no intervention. For EVAR trial 1 (open vs EVAR), the mean rate of change in eGFR was -1.13 and -1.00 unit per year (P = 0 .208). Even though the data came from randomized controlled trial (EVAR-1), the groups were unmatched and imbalanced. The authors from OVER trial (open vs. endovascular repair), reported only dialysis-related renal outcomes; the incidence of renal failure requiring dialysis in those undergoing EVAR within 1 year was 1.1% and did not differ from that in OAR group (P= .73) [44]. As for the reports from the DREAM (Dutch Randomized Endovascular Aneurysm Management) trial, mean absolute changes from preoperative to 5 years-after eGFR were -0.8 and -0.9 unit per year (P = .480) for OAR and EVAR, respectively [48]. Finally Nquyen et al analyzed 9877 patients undergoing EVAR and 3314 OAR, all of whom had moderate or severe renal dysfunction preoperatively; in patients with an eGFR between 30 and 60, the risk of dialysis was 5.2 higher in the open group. In those with an EGFR <30, outcomes were similar in both EVAR and OAR (43).

The issue of the influence of the type of fixation (suprarenal fixation, SRF or infrarenal fixation, IRF), on renal function is also unresolved. The results for the studies are also controversial and several investigations have reported that SRF is associated with a significant increased risk of renal function decline, compared with IRF or OAR patients. Recently Greenberg et al reported in a prospective study that coverage of an accessory renal artery during EVAR is well tolerated based upon preservation of renal function. No significant deterioration in long term GFR was detected, compared with the control EVAR group [24]. Zarins et al compared the impact of late postoperative renal function (using the CrCl) in 277 patients subgrouping them as IRF vs. SRF. He reported a 10 % decrease in CrCl in the first year for all patients regardless of the type of endograft . He concluded that suprarenal fixation does not seem to increase the like hood of postoperative renal impairment [36]. Kouvelos et al also reported the same conclusion in a prospective non randomized trial with 100 patients undergoing EVAR with supra or infrarenal fixation endografts. Deterioration in renal function was observed 12 months after EVAR in patients with SRF, even though this did not seem to increase the likelihood of postoperative renal impairment [57]. It is also known by Macierewicz et al, using postoperative Tc-DTPA scan that coverage of renal ostria by bare struts does not affect renal function [41].

Comparing these subgroups of EVAR (supra–infrarenal fixation) with OAR, Surowiec et al reported that renal impairment at 36 months was seen in 36% of patients in IRF group, 25% in SRF group and 19% in OAR ($p<0,04$ for IR fixation vs OAR) thus giving different results with the above authors [37]. In a recently published study by Saratzis et al (2014), comparing those 3 groups in a case control study with a total of 225 patients, he reported that OAR and suprarenal fixation EVAR was associated with significant declines in renal function during 2 years, in contrast to infrarenal EVAR fixation [58]. What is widely accepted by all these studies is that different and probably multifactorial causal mechanisms are responsible for the renal deterioration for each group.

CONCLUSION

Preoperative renal dysfunction in patients with AAA poses a major problem. It is well known that aortic aneurysm repair in this group of patients has a higher mortality / morbidity rate than among those with normal renal function. Both EVAR and OAR, may lead to a deterioration of renal impairment with different and specific procedure-related mechanisms. No straightforward guidelines have been published in order to give specific direction about the optimum therapy in those patients. A direct classification system of renal dysfunction using GFR is essential, in order to subgroup patients with preoperative renal impairment. Results from small series and post hoc analysis from randomized trial shows that EVAR is superior than OAR at 30 day for all outcomes, in patients with moderate renal dysfunction and should be considered as the first line therapy if the anatomy is appropriate. For patients with severe renal impairment, mortality and morbidity rates are even worse, thus a higher threshold for repair using either approach should be applied because the operative risks could outweigh the medical benefits in this patient population. Strategies in order to minimize the effect of EVAR in renal deterioration intraoperative and during follow up period are crucial. Preoperative administration of agents, the use of intravascular ultrasound during operation, minimization of guidewires and sheaths manipulation, selection of a suitable endograft and the use of duplex ultrasound in follow up period may improve the outcomes of EVAR in this group of patients. Further prospective randomized trials with long term results are essential to clarify this issue.

TABLE 1. Outcomes of OAR in patients with end stage renal disease

STUDY	OPEN	ELECTIVE /RUPTURE	SELECTION CRITERIA(μmol/l)	N	30 d-MORTALITY	
Cohen et al (6) 1986	OPEN	ELECTIVE	ESRF	4	1	25%
Norwood et al (7) 2004	OPEN	ELECTIVE	ESRF	5	3	60%
Bastounis et al (8) 2006	OPEN	ELECTIVE	ESRF	11	0	0%
Yuo et al (9)	OPEN	ELECTIVE	ESRF	261	42	16,1%

(ESRF=End Stage Renal Failure)

TABLE 2. Outcomes of OAR in patients with renal impairment.

STUDY	OPEN/ ELECTIVE	SELECTION CRITERIA	N patients	MORTALITY %
Cohen et al (6) 1986	O/E	SCr >177 µmol/L.	16	0%
Norwood et al (7) 2004	O/E	SCr >177 µmol/L.	7	14.3%
Komori et al (13) 1997	O/E	SCr >177 µmol/L.	50	2%
Sugawara et al (14) 1997	O/E	SCr >133 µmol/L.	33	9.1%
Katz et al (12) 1994				41.2%
Patel et al (18) 2012	O/E	GFR	2890	
		mild.		2.6%
		moderate.		9.1%
		severe.		10.3%

Nguyen et al (19)	O/E	GFR<60Ml/min.	1256	
2013		30<GFR<60 Ml/min.	1117	4.1%
		GFR<30 Ml/min.	139	5.5%

(SCr= Serum Creatine levels, GFR= Glomerural Filtration rate,)

TABLE 3. Outcomes of EVAR based on selection criteria in patients with impaired renal function

STUDY	EVAR	SELECTION CRITERIA	N patients	OUTCOMES
Walker et al. (25) 1998	EVAR	SCr>1.30 mmol/L	15	47% 30-d- mortality
EUROSTAR et al. (28) 2007	EVAR	SCr>1.33 mmol/L	969	6.2% 30-d- mortality
Markovic et al. (32) 2010	EVAR	Based on ICD-9-CM	254	16-fold greater risk of mortality than group without RI.
Azizzadeh et al. (33) 2006	EVAR	1.GFR=45-60 ml/min 2. GFR=7-45 ml/min	95 93	2.2% 30-d-mortality 3.2% 30-d-mortality
Guntani et al. (31) 2012	EVAR	GRF<50ml/min	46	10% ARF
Carpenter et al. (26) 2001	EVAR	SCr>1.3 mmol/L	20	↑SCr in 8 pts. 1 pts permanent dialysis.
Vasquez et al. (27) 2004	EVAR	SCr>1.2 mmol/L	83	6% 30-d- mortality
Mehta et al. (29) 2004	EVAR	1. SCr>1.5-2.0 mmol/L 2. SCr>2.0 mmol/L	65 27	3.1% 30-d- mortality 3.7% 30-d-mortality
Park et al (22) 2006	EVAR	1.SCr>1.3-2.5 mmol/L 2.SCr>2.5 mmol/L	76 16	7% ARF 25% ARF

(SCr= Serum Creatine levels, GFR= Glomerural Filtration rate, ARF= Acute Renal Failure, EVAR= Endovascular Aneurysm Repair, ICD-9-CM=International Classification of Diseases, 9th Revision, Clinical Modification)

TABLE 4. Outcomes of EVAR vs OAR in patients with impaired renal function.

STUDY	EVAR-OAR N patients	SELECTION /STUDY CRITERIA	OUTCOMES /MORTALITY EVAR - OPEN
Wijnen et al 2001 (44)	15 vs 22	urine albumin/ creatinine. (AC ratio)	6.6% VS 4.5% mortality. Less renal damage to EVAR group.
Wald et al 2006 (45)	2651 vs 3865	Based on ICD-9-CM	1.0% vs 3.9% ungrouped mortality. Lower odds ARF for EVAR.
Parmer et al 2006 (34)	52 vs 46	SCr< 1.5 mg/dl.	N/S post operative renal function deterioration between two groups.
Mills et al 2008 (46)	103 vs 120	CKD stage system. GFR deterioration.	Perioperative renal dysfunction more common for OAR. Transient deterioration.
Patel et al 2012 (18)	5811 vs 2890	CKD stage system. CKD 1,2 mild. CKD 3 moderate. CKD 4,5 severe.	30 day - mortality. 1.3% vs 2.6% 3.2% vs 9.1% 6.2% vs 10.3%
Nguyen et al 2013 (19)	3886 vs 1256	GFR< 60 ML/min.	30 day - mortality. 1.8% vs 5.9%

(SCr= Serum Creatine levels, GFR= Glomerural Filtration rate, ARF= Acute Renal Failure, EVAR= Endovascular Aneurysm Repair, CKD =Chronic Kidney Disease, ICD-9-CM=International Classification of Diseases, 9th Revision, Clinical Modification)

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Ανοιχτή ή ενδαγγειακή αποκατάσταση ανευρύσματος κοιλιακής αορτής σε ασθενείς με επηρεασμένη νεφρική λειτουργία: ένα θεραπευτικό δίλημμα

ΠΕΡΙΛΗΨΗ

ΣΚΟΠΟΣ ΤΗΣ ΕΡΓΑΣΙΑΣ

Είναι ευρέως γνωστό ότι η αποκατάσταση των αορτικών ανευρυσμάτων σε ασθενείς με προεγχειρητική νεφρική ανεπάρκεια έχει υψηλότερα ποσοστά θνητότητας/ θνησιμότητας σε σύγκριση με τους ασθενείς χωρίς νεφρική δυσλειτουργία προεγχειρητικά, και ότι αποτελεί έναν ανεξάρτητο παράγοντα κινδύνου για απογοητευτική έκβαση. Τόσο η ενδαγγειακή (EVAR) όσο και η ανοιχτή αποκατάσταση μπορούν να οδηγήσουν σε επιδείνωση της νεφρικής λειτουργίας με διαφορετικούς μηχανισμούς, συχνά εξαρτώμενους από την εκάστοτε τεχνική. Επιπλέον, η υποχρεωτική χρήση σκιαγραφικού μέσου για την παρακολούθηση των ασθενών αυτών με αξονική τομογραφία, αποτελεί ένα μείζον ζήτημα στην αντιμετώπιση αυτών των ασθενών. Από τις πολλαπλές υπάρχουσες μελέτες σχετικά με την επίδραση αυτών των μεθόδων σε ασθενείς με νεφροπάθεια προκύπτουν αντικρουόμενα αποτελέσματα. Ο αντικειμενικός σκοπός της παρούσας εργασίας είναι, μέσω μιας συστηματικής μελέτης της τρέχουσας βιβλιογραφίας, να οριστούν συγκεκριμένες οδηγίες για το βέλτιστο χειρισμό αυτών των ασθενών, τους οποίους συχνά αντιμετωπίζει ένας αγγειοχειρουργός.

ΥΛΙΚΑ ΚΑΙ ΜΕΘΟΔΟΣ

Διενεργήθηκε συστηματική ανασκόπηση της βιβλιογραφίας, με αναζήτηση στη βάση δεδομένων PubMed μελετών στην αγγλική βιβλιογραφία με τους όρους: Abdominal Aortic Aneurysm (AAA, ανεύρυσμα κοιλιακής αορτής), endovascular aneurysm repair (EVAR, ενδαγγειακή αποκατάσταση ανευρύσματος), open repair (ανοιχτή αποκατάσταση), renal function (νεφρική λειτουργία) , renal impairment (νεφρική δυσλειτουργία). Στη μελέτη περιλήφθηκαν μόνο αναφορές οι οποίες συσχετίζουν τις μεθόδους αποκατάστασης των ανευρυσμάτων με τη νεφρική λειτουργία και της επίδρασή τους σε αυτή. Από περισσότερες από 120 μελέτες, 58 άρθρα χρησιμοποιήθηκαν σε αυτή την ανασκόπηση.

ΣΥΜΠΕΡΑΣΜΑ

Σε ασθενείς με μέτρια νεφρική ανεπάρκεια, όπως αυτή υπολογίζεται από το ρυθμό σπειραματικής διήθησης (GFR 30-60 mL/ min), η ενδαγγειακή αποκατάσταση είναι πιθανώς ασφαλέστερη, ενώ σε ασθενείς με σοβαρή νεφρική νόσο (GFr <30mL/min) οι επιπλοκές και η θνητότητα είναι απογοητευτικές και με τις δύο μεθόδους, σε βαθμό τέτοιο, ώστε να δικαιολογείται η αναβολή της επέμβασης μέχρι ο κίνδυνος ρήξης να είναι ανεπίτρεπτα υψηλός. Ωστόσο, οι διαθέσιμες μελέτες χρησιμοποιούν ποικίλους δείκτες εκτίμησης της νεφρικής λειτουργίας, καθιστώντας τη στατιστική ανάλυση και τα ανωτέρω συμπεράσματα επισφαλή, μέχρι να προκύψουν προοπτικές τυχαιοποιημένες μελέτες με σαφή ορισμό της προ και περι-εγχειρητικής νεφρικής λειτουργίας. Η βέλτιστη χρήση φαρμάκων προ και περι- εγχειρητικά σε συνδυασμό με εναλλακτικές απεικονιστικές μεθόδους οι οποίες αντικαθιστούν την συμβατική αξονική τομογραφία και αγγειογραφία, είναι δυνατό να καταστήσουν στο μέλλον το EVAR τη μέθοδο εκλογής σε ασθενείς υψηλού κινδύνου.

Open or endovascular abdominal aortic aneurysm repair in patients with impaired renal function: a therapeutic dilemma

ABSTRACT

BACKGROUND - AIM

It is well known that aortic aneurysm repair in patients with preoperative renal dysfunction has a higher mortality / morbidity rates than among those with normal renal function and is an independent risk factor for dissapointing outcomes. Both endovascular aneurysm repair (EVAR) and open aneurysm repair (OAR), may lead to a deterioration of renal impairment in different and specific procedure-related mechanisms. Furthermore, the obligatory serial use of contrast enhanced CT during follow up poses a major problem when treating this group of patients. Various studies have examined the effect of both procedures in patients with a preexisting renal impairment, reporting conflicting results. The objective of the present study was to provide a contemporary literature review, in order to define specific directions towards the management of patients with renal impairment.

METHODS AND MATERIALS

A thorough review of the literature was performed. Systematic search in PubMed for studies (in English literature) using terms as abdominal aortic aneurysm (AAA), endovascular aneurysm repair (EVAR), open repair, renal function, renal impairment, was done. Only references which correlated the methods of aneurysm rehabilitation with the status of renal function and how it is affected were included. From over 120 studies initially identified, 58 articles were used in this review.

CONCLUSION

In patients with moderate renal insufficiency, as it is estimated by Glomerular Filtration Rate (GFR 30-60mL/min), EVAR is probably safer, while in patients with severe renal insufficiency (GFR <30 mL/min) the complications and mortality rated are disappointing for both methods,

rendering justifiable the deferral of the operation until the rupture risk is too high. However, the existing studies use variable indices for renal function, making statistical analysis infeasible, and thus the preceding conclusions are only a suggestion, until further prospective randomized studies with precise definitions of preoperative and postoperative renal function and with longterm follow up, arise. The optimal use of pre and intraopertaive medical agents in combination with alternative imaging methods replacing conventional CT and angiography may render EVAR the gold standar method for this high-risk group of patients.