Type II endoleaks after endovascular repair of Abdominal aortic aneurysm: A Single-Center experiance

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ABSTRACT

Objective: To determine the incidence of type II endoleaks (T2E) and the results in patients who had endovascular aortic aneurysm repair (EVAR).

Methods: A series of 234 patients who underwent EVAR consecutively at King Hussein Medical Center were retrospectively studied during five years. Analysis of medical records, computed tomography angiography and procedure angiograms was performed. Furthermore, the incidence of type II endoleaks, the number of all feeding and draining arteries, aneurysm enlargement and outcomes were analyzed.

Results: The median follow up duration was 20 months range (6-58 months). The median age was 71 years and 182 were males. We identified 46/234 (19.7%) patients with type II endoleaks, out of these 22/46 patients (47.8%) had spontaneous resolution during the follow up period and 21/46 patients (45,7%) the aneurysm sac size was unchanged. Only 3/46 patients (6.5%) developed sac enlargement needed re-intervention. 7 (15%) Patients with more than one source of Type II endoleak had significant failure rate for resolution in < 180 days (p value =0.04). Furthermore, we identified 36/46 (78%) with T2E had presence of intramural thrombus. We compared transient T2E vs persistent T2E in cases with the presence of intramural sac thrombus. There was significant difference between patients with transient T2E (61%) and patients with persistent T2E (36%) with regard to presence of thrombus P<0.01). The Overall patient mortality during the study period was 16 (7% patients), all deaths were aneurysm unrelated

Conclusion: Our data suggests that type II endoleaks are the most common endoleaks in patients who have undergone EVAR. Not all endoleaks type II are benign so continued long-term surveillance and selective intervention is necessary in this cohort of patients, particularly in patients with sac growth, absence of thrombus, multiple collaterals and persistent endoleaks.

Keywords: Endoleak type II, EVAR complications.

JRMS April 2018; 25(1):56-63/DOI:10.12816/0046996

Introduction

Endovascular therapy has become an integral part of management of abdominal aortic aneurysm due to significant advantages over open repair .However, this intervention has its own complications particularly endoleaks. The frequency of endoleaks has been reported as high as 50% [1, 2]. Endoleaks are clinically important since they can be associated with aneurysm sac enlargement leading to rupture. Type II endoleaks (T2E) occur in 10-30% of patients, and it is defined as backflow of blood from refilling collateral vessels into aneurysm sac [3, 4], typically lumber and inferior mesenteric arteries. The best treatment of T2E is controversial , some retrospective studies considered it as benign complication and the authors reported the low risk of rupture during conservative management of T2E and in most cases it does resolve spontaneously [2,3] . However, others have considered it as adverse late

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Manuscript Received Dec 21,2017,Accepted April 12,2018.

outcome, which need more frequent follow up or more aggressive interventional approach. Patients whose aneurysm sac continues to grow require treatment by embolization through the transarterial approach, direct sac puncture endoscopic ligation of the feeding vessels, aneurysm sac plication, or in extreme circumstances surgical explants [5, 6]. However, some patients will not have persistent endoleak and will undergo unnecessary intervention. Identification of patients clinical and aneurysm factors, which may be associated with T2E and aneurysm sac growth, should be useful to guide further treatment. The purpose of this relatively large series of EVAR to determine the incidence and outcomes of T2E. We also analyzed which anatomical factors might be associated with continued AAA sac growth after type II endoleaks**.**

Methods

Study design

Our hospital is a referral tertiary care center that attends a population of approximately 3 million inhabitants. We performe elective EVAR procedures using different devices. Mean age was 71 years (SD=10), 182 patients (77.7%) were males and 52 (22.2%) females. The mean aneurysm diameter was 6.7 cm range: 5.5 to 8 cm. The database included information about patient's demographics, clinical history, interventions details, and follow up records which were collected from our registry. Medical ethics board approval was obtained from our hospital for this retrospective study.

Inclusion and exclusion criteria

Inclusion criteria include all patients with elective EVAR for infrarenal AAA ≥5.5 cm. Decision for intervention and patients assessment were done by multidisciplinary team consist of vascular surgeon, interventional radiologist, anesthesiologist and cardiologist. Exclusion criteria include EVAR for patients who had rupture, inflammatory aneurysm, and cases were done outside the instruction of use, based on, suitable aneurysm morphology and anatomical criteria of infrarenal aortic neck and distal sealing zone.

Image review

Thin slices contrast enhanced MD-CT angiography (CTA) was the main imaging modality used in both preplanning and follow up. CTAs were performed according to standard of care at the time of acquisition and were acquired in digital image and communication in medicine (DICOM) format from PACS System. A senior surgeon and radiologist assessed the presence of any endoleak and maximum aneurysm diameter. Maximum aneurysm luminal size was determined by the shortest diagonal of the cross-sectional CT image, and the shortest and largest measurements at that point were recorded. Follow up imaging was obtained at 1 month, 6 months and 12 months and yearly thereafter. We recorded all aneurysm morphology details. The number of all feeding arteries were measured, and endoleaks were classified according to their sources into simple inferior mesenteric artery (IMA), simple lumbar artery (LA), complex LA, and complex IMA-LA type II endoleaks. In few cases we did angiogram if there was doubt about type of endoleak. The policy in our center to observe all patients with T2E with follow up visit, and to do selective intervention in those with sac expansion more than 5 mm.

Outcomes

The primary endpoint was to determine the incidence of T2E after EVAR for AAA. T2E is defined as persistent filling of the aneurysmal sac due to retrograde flow from collateral vessels at the time of the completion angiogram or when demonstrated on follow-up CTA (early T2E is observed within 30 days of EVAR procedure vs late T2E is appeared on follow up images later). Furthermore, we defined transient T2E (<180 days) and persistent T2E (>180 days). We defined the resolution of T2E as absence of aneurysmal sac enlargement and disappearance of the obvious source of T2E during consecutive CTA in one year without any kind of interventions. Secondary study outcomes included mortality, aneurysm related death, aneurysm sac enlargement, re-interventions for T2E, conversion to open repair, and abdominal aortic aneurysm (AAA) rupture. Additional measurements were performed:

demographic characteristics, tobacco use, risk factors, antiplatelet or anticoagulation medications use.

Statistical analysis

Patient's characteristics were summarized using descriptive statistics analysis. Results of continuous variables were given as mean and standard deviation. Count and percentage for categorical variables. For patients with T2E and follow-up, comparison between patients with transient and persistent T2E was conducted for aneurysm sac size, intramural sac thrombus and number of sac side branches. Continuous variables were analyzed by a Student t-test or by the Mann-Whithney U test for unparied comparisons. Qualitative variables were analyzed with a Chi-Square test or Fisher test where appropriate. Differences were considered as significant if P value $\leq$ 0.05. The statistical analyses of the data were performed using SPSS v.19 for windows statistical software (Chicago, IL, USA).

Results

We performed a retrospective and descriptive study including 234 infrarenal AAA treated consecutively with EVAR between January 2007 and March 2012. Preoperative patient demographics variables are summarized in Table I. 170 cases (73%) were American Society of Anesthesia (ASA) scale 3/4 with significant co-morbidities. Most of EVAR procedures were done under epidural and local anesthesia. Usually we expose one femoral artery through cut down while we deploy the other limb through percutaneous approach. Different endovascular devices models have been used. The selection of device depends on surgeon preference and availability of device. Configurations included; 226 (97%) aorto-bi-iliac, 6 (3%) aorto-uni-iliac with femoro-femoral crossover graft and 2(0.08%) straight tube graft. Mean hospital length of stay (LOS) was 3 days (range 2-8 days). The median follow up duration was 20 months range (6-58 months). During follow up period of all patients, a total of 60 endoleaks were seen in this cohort. 12 (5%) patients developed type l endoleak. Among them, 8(3%) patients were detected on completion angiogram and treated by ballooning. The other 4 patients (2%) were discovered during follow up of median period 12 months (6 months- 2 years) and we managed them by proximal extension. Two patients (1%) developed type lll endoleak, both were treated by iliac limb extension. Out of 60 endoleaks, 46 patients (19.7%) developed T2E. Data related to T2E were analyzed separately. The patient characteristics, associated risk factors, and comorbid conditions are shown in Table II. Patients with early T2E were 42 (91%), while 4 (9%) patients with late T2E were discovered within period from 1 to 6 months, all analyzed as one group. The source of endoleak was from inferior mesenteric artery (IMA) in 16 (35%) patients, from lumbar artery in 20 (44%) patients, and from sacral artery in 2(4%) patients. Furthermore, 8 (17%) among total patients have mixed two sources from IMA, lumbar arteries or accessory renal artery, Table III. In our study, 22(48%) T2E resolved spontaneously within median of 6 months, and 21 (46%) remain under surveillance protocol with stable aneurysm sac. Only 3/46 patients (6, 5%) developed sac enlargement needed re-intervention. Additional comparisons were performed on patients with T2E by resolution time (<180days vs ≥180days). The sub analysis of presence and number of aneurysm side branches showed 7 patients (15%) with more than one source of T2E had significant failure rate for resolution in < 180 days vs. one patient (2%) with single source of T2E (p= 0.04). However, there was no significant difference between transient and persistent T2E regarding single source of T2E. Of the 46 patients with T2E, 36/46 cases (78%) had presence of intramural thrombus. We compared transient T2E vs persistent T2E in cases with the presence of intramural sac thrombus. There was significant difference between patients with transient T2E (61%) and patients with persistent T2E (36%) with regard to presence of intramural thrombus P<0.01). Aneurysm sac size remined stable in patients with T2E, however three patients (6.5%) with T2E developed aneurysmal sac enlargement (7mm, 8 mm, 7 mm) respectively in median follow up 20 months. Sac measurement was taken by two different radiologists and by interventional radiologist.

Two of those patients were clinically fit for secondary intervention; the primary aneurysm sac size was (7.2, 7cm). Both patients did not have intramural thrombus. The source of endoleak was from IMA and lumbar artery, were treated successfully through super selective catheterization via superior mesenteric artery and coil embolization. No endoleak and sac enlargement were found during next follow up scan. The third patient had source from lumbar artery and was unfit for our selection criteria due to significant co-morbidity; he died from acute myocardial infarction after 7 months. Overall patient mortality during the study period was 16/234 patients (7%). Mortality rate among patients with T2E was 3/46 (7%) and 13/188 (7%) in non T2E group. All causes of deaths were aneurysm unrelated. No rupture aneurysm neither conversion to open repair were needed. Causes of death were cardiac (6 patients), stroke (4 patients), malignancy (1 patient), respiratory failure (2 patients), renal failure (1 patient) unknown (2 patients).

Table I: Demographic characteristics.

	Patients with EVAR (N)	**%**
Patients	234	-
Age in years (mean ±SD)	71±10	-
Tobacco users	162	69.2%
Hypertension	161	68.8%
Ischaemic heart disease	131	56%
Diabetes mellitus	148	63.2%
CVA\TIA	42	17.9%
Renal impairment	8	3.4%
COPD	56	23.9%
Anticoagulation\Antiplatelet	22	9.4%
Aneurysm diameter	5.5-8 cm	-
Stent Graft		
Endurant[a]	104	44.4%
Zenith[b]	22	9.4%
Talent[a]	104	4.4%
Excluder[c]	4	1.7%

Table II: Demographic characteristics in patients with Type II Endoleaks.

	Patients with type 2 endoleak	**%**
	46	19.7%
Aneurysm diameter	5.6-7.6	-
Age in years (mean ±SD)	67± 10	-
Tobacco users	32	69.7%
Hypertension	22	47.8%
Ischaemic heart disease	17	37%
Diabetes mellitus	12	26%
CVA\TIA	6	13%
Renal impairment	1	2.2%
COPD	8	17.4%
Anticoagulation\Antiplatelet	4	8.7%

Table III: CTA features of Type II Endoleak**.**

	Transient Type II Endoleak	Persistent Type II Endoleak	P- Value[a]
Patients	22	24	
Inferior mesenteric artery (IMA)	9 (41%)	7(29.1%)	>0.05
Lumber artery	11 (50%)	9 (37.5%)	>0.05
Sacral artery	1 (4.5%)	1(4.1)	>0.05
Mixed source of endoleak 2: arteries either IMA & lumber, or accessory renal arteries and lumber	1(4.5%)	7(29.1%)	P=0.04
Presence of intramural thrombus= 36	22/36(61.1%)	14/36(38.8%)	P=0.0005

[a]Chi-square or Fisher´s Exact Tes

Discussion

Careful planning to EVAR guidelines effectively treats abdominal aortic Aneurysm. With the growing number of use of EVAR as primary treatment for AAA, it is expected that an increasing number of patients with T2E will happen. There is no level 1 or 2 evidence supporting a specific threshold for intervention of T2E [11]. The results of this study confirm the high incidence of T2E after EVAR and that they most often have a benign clinical course. The incidence of T2E in our study was similar to others. Currently, there is some disagreement regarding the natural history of T2E and the best treatment. Available options for most institutions depend on physician preference and patients clinical situation; with conservative approach management [2,3,15] and intervention in persistence endoleak > 6 months or more than 5mm sac expansion in 6 months [6,7,12]. Currently, at our center, the criteria for secondary intervention are: age less than 75 years, fair life expectancy, late T2E association with other type of endoleaks , documented progressive expansion of aneurysmal sac more than 5 mm , patient unwilling to continue on surveillance protocol , and patients with the presence of more one source of T2E and absence of thrombus. According to the mortality, there is no difference between mortality rate in our group with T2E and others studies. Furthermore, we found that T2E was not associated with aneurysm rupture conversion to open repair and no increase in mortality related aneurysm. In our study, 47% patients with T2E resolved spontaneously within 6 months and 45% patients had not developed any complications with stable aneurysmal sac. Also, in our study, the need for secondary intervention was low (4%). In EUROSTAR experience [15], graft-related endoleaks (type I, type III, or a combination) are associated with a significantly greater risk of rupture than T2E. Also, the secondary outcome of this study concluded that intervention in T2E should only be performed in case of increase of aneurysm size. Leah Candell [16] described 10 years experience in rupture after EVAR. The results showed no rupture in study group attributed to isolated T2E, however he found that the cause of rupture was from type l or lll endoleak rather than T2E. The percentage of spontaneous resolution of T2E is widely variable in certain time, in one study it is 52% resolved within 7 months [3] , 80% in 6 months [6] while in other study reported 48% resolution in 4 years [2] . In our study 47% resolved within a mean time of 6 months. This data support the safety of conservative approach to treat T2E. In fact , T2E is low pressure leak and the chance for further resolution by thrombosis would be higher, few reported case series of rupture after EVAR have been published [8,16] because rupture is very rare after EVAR this confirms the non malignant nature of T2E and supports the watchful observation approach . In our series, three patients (7%) developed aneurysmal sac enlargement more than 5 mm, two patients have been successfully treated. There is inadequate evidence to guide the threshold for intervention. Some institutions empirically treat T2E if persisted more than 6 months and some do prophylactic embolization or thrombin injection into the aneurysm sac. These interventions are not always safe and carry risk of procedure complications and mortality, Also, it did not show aggregate late promising outcome [13,17,18 ,19,20]. Sarac et al. [5] showed that the freedom of AAA sac expansion is only 47% at 5 years in patients with early prophylactic embolization to T2E source to prevent aneurysm sac growth and long term surveillance is necessary. Hence no guarantee in prophylactic intervention to prevent aneurysm rupture. The effect of the presence of intramural thrombus with aneurysmal sac on resolution was studied. Lowenthal [21] found that anatomical and thrombus specific parameters were unsuitable as predictors for T2E resolution. Other studies showed that lower prevalence of mural thrombus associated with sac expansion [22, 25, 26]. our data support this finding, it showed that the presence of intramural sac thrombus predicts significant resolution in T2E 61 % vs. 36% (P= 0.0005) which gave us new parameter to guide future T2E in favor of resolution. Interestingly, patients with more than one source of endoleak significantly affect on T2E resolution rate. Although, being small group

we observed through aneurysm morphology analysis that patients with more than one source of endoleak had significant failure rate for resolution within one year 2% vs. 15% (p= 0.049). This is theoretically logic because the aneurysm has inflow and outflow source which makes the possibility for branch thrombosis significantly low [20, 23, 24, 25, 26]. Marchiori et al [27] showed in his study that patent hypogastric and lumbar arteries are significantly associated with a higher risk of developing T2E. Larger diameter lumbar arteries tend to be associated with persistent T2E while lumbar arteries <2 mm would more likely be seen with a transient T2E. These criteria may guide treatment of T2E; however, we need further studies to analyze the role of side branches on aneurysm resolution. This study does have limitations; it is retrospective in nature, single-center study and small number of patients and events. With regard to the aneurysm measurements, we could not measure aneurysm sac volume and the size of the feeding vessel and flow in relation to success of therapy. Despite these limitations, the results of this study are similar with others studies demonstrating the high occurrence and benign course of T2E. We think that more prospective trials are needed to determine the best management strategies for T2E and further innovation in the generation of endografts should be directed at eliminating T2E.

Conclusions

The results of this study confirm the common occurrence of T2E. The management of T2E is highly debatable issue, a lot of controversies. In the absence of randomized control trials to show the ideal time for intervention we found that the conservative approach is safe strategy for management of patients under surveillance program due the fact that, it has benign behavior that was shown in our result. On the basis of the data from this report we are more likely to use the conservative approach to mange patients with T2E and selective intervention in patients who have sac growth more than 5 mm, patients with presence of more than one source of T2E and absence of thrombus in sac. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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