Prognosis in patients with type 2 endoleak after endovascular repair of abdominal aortic aneurysm

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Abstract

Objective

After endovascular aneurysm repair (EVAR) of abdominal aortic aneurysm (AAA), type 2 endoleak (T2EL) is the most common complication, the significance of which is yet to be established. This study aims to analyze the clinical outcome for patients with exclusive type 2 endoleak after EVAR at a single vascular surgery center in Norway.

Methods

Since 2007, patients treated with EVAR at our institution have been prospectively registered in a local registry. Data was retrospectively analyzed. Only patients with an exclusive type 2 endoleak were included in the study. Follow-up with Computer Tomography (CT) scans were performed at 6 and 12 months postoperatively, and yearly thereafter. Study endpoints included all-cause and aneurysm related mortality (ARM), AAA sac growth, and intervention rate. We used a descriptive statistical approach to analyze and present our material.

Results

Between 2007 and 2014, 240 patients underwent EVAR for AAA at our institution. Out of 240 patients undergoing EVAR 43 (18%) developed T2EL. Mean age was 77.3 years and median follow-up time was 33.8 months. Aneurysm sac growth was seen in 22 (51.1%) patients. Spontaneous endoleak remission occurred in 21 (48.8%). Intervention was performed in six (13.9%), whereof two (33.3%) were successful. All-cause mortality was nine (20.9%), but no patients died from ARM. Four patients (9.3%) were lost to follow-up.

Conclusion

Although sac growth were seen in over half the patients, type 2 endoleak does not appear to be associated with increased risk of aneurysm related mortality. Watchful follow-up and selective intervention seems to be a reasonable strategy for managing these patients.

Keywords:

EVAR, type 2 endoleak, abdominal aortic aneurysm

Introduction

Background

Endovascular repair of abdominal aortic aneurysm (EVAR) has proven to be a safe alternative to open repair in regard to short-term mortality and morbidity, and overall aneurysm-related survival.[1-3] But endovascular repair entails its own unique set of complications, such as endoleak. An endoleak is defined as "the persistence of blood flow outside the lumen of the endoluminal graft but within an aneurysm sac or adjacent vascular segment being treated by the graft".[4] This complication may cause continued expansion of the aneurysmal sac, and rupture. Endoleak occurs in 10-27% of patients after EVAR[5-9], and can be classified as type I–V based on the source of the leak.[10] In direct, high-risk leaks, such as type I and III, imminent treatment should be sought due to the relatively high risk of rupture.[11-13] Type 2 endoleaks (T2EL) however, caused by retrograde blood flow through collateral vessels into the aneurysmal sac, is the most frequent type of endoleak, but also the most controversial when it comes to clinical significance and management.[14] Some studies argue that T2EL is a harmless complication, while others believe it can lead to serious long-term consequences.[7,15-22]

Objectives

The aim of the study was to examine the outcome in patients with isolated type 2 endoleak after endovascular repair of abdominal aortic aneurysm, in a patient population at the Department of Vascular Surgery, Oslo University Hospital.

Methods

Design

A retrospective cohort study on a prospectively collected patient material. All patients treated with EVAR for AAA at the Department of Vascular Surgery, Oslo University Hospital after 2007 were entered into a prospective database.

Material

All patients with CT confirmed exclusive type 2 endoleak after treatment with EVAR for AAA from 2007 - 2014 were included in this trial. Patient data included in this cohort study were recorded until 1st of august 2015. Our hospital functions as both a

primary, secondary and tertiary vascular center, resulting in a heterogeneous patient group.

Variables

Prospectively collected data included baseline patient characteristics (age, gender, preoperative morbidity, smoking, blood pressure, graft type) and preoperative aneurysm size. Choice of stent-graft was based on the surgeons´ preferences and anatomical suitability. Different devices used were Cook Zenith (Cook Incorporated, Bloomington, Ind), the Gore Excluder (W. L. Gore & Associates, Flagstaff, Ariz) and Medtronic Endurant grafts (Medtronic Cardiovascular, Santa Rosa, Calif). Study endpoints included all-cause and aneurysm related mortality, loss to follow-up, endoleak status, aneurysm sac size change, rate and type of intervention, and freedom from intervention.

Follow-up

After EVAR the patients were followed at the outpatient clinic at 1, 6 and 12 months postoperatively, and yearly thereafter, unless more frequent controls were medically indicated. At all outpatient control sessions clinical examination and color duplex ultrasound scan were performed. Computer tomography (CT) scans were routinely performed at the 6- and 12-month control, and additionally when ultrasound or clinical examination gave suspicion of postoperative complications. Patients registered as lost to follow-up included those who did not attend their latest outpatient clinic control within the study period, and excluded patients who were dead at the end of study period.

Intervention

Intervention was performed in patients where CT showed persistent type 2 endoleak and sac growth >5 mm, and consisted of either coiling or clipsing of branching arteries, conversion to open surgery, or a combination thereof.

Ethics

The project was approved by the Regional Committee for Medical and Health Research Ethics (REC).

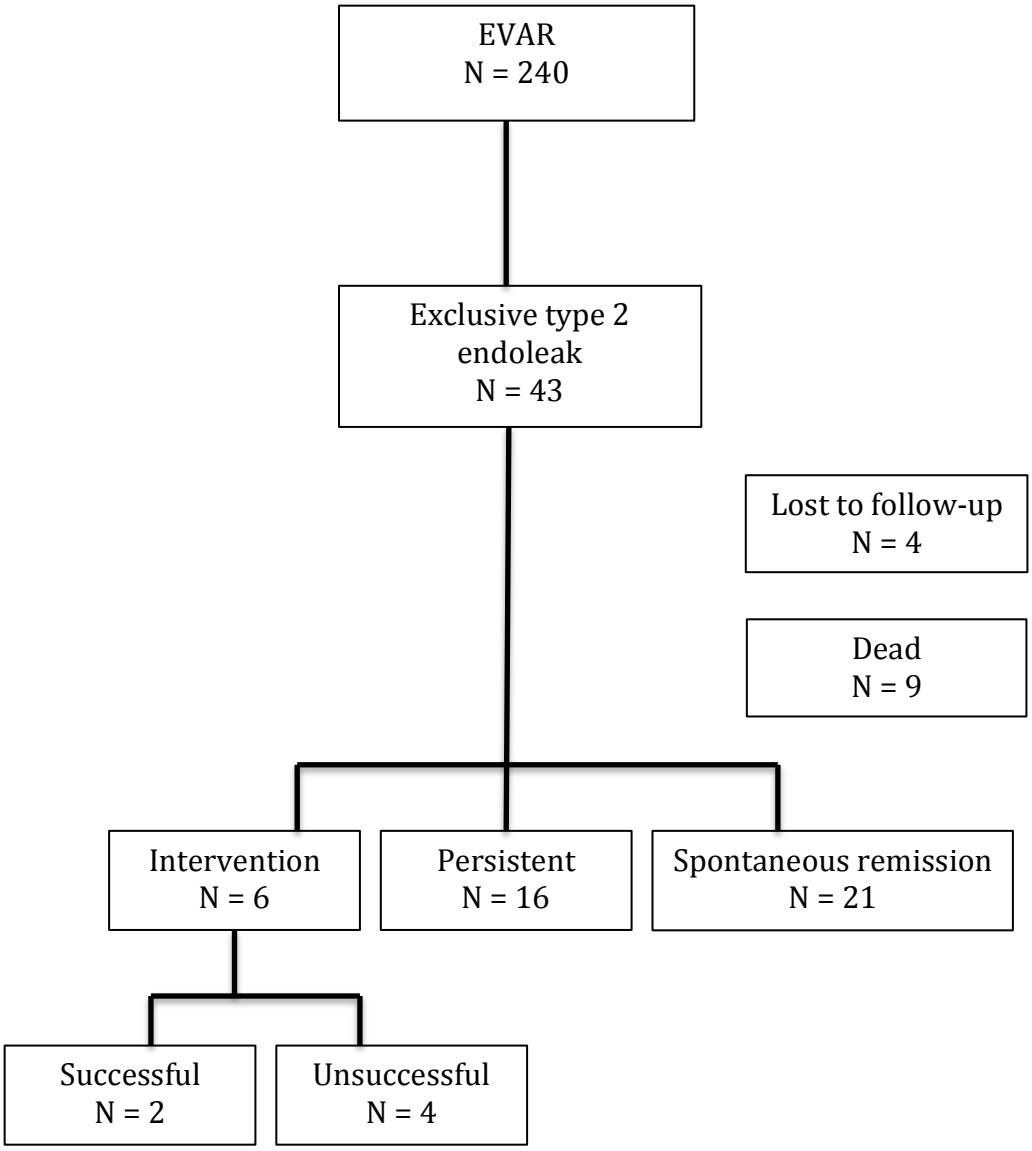
Statistical analysis

Descriptive statistics calculated using integrated mathematical functions in Microsoft Excel, version 14.5.9 (Microsoft Corporation, Redmond, Wash).

Results

Between 2007 and 2014, 240 consecutive patients underwent EVAR for AAA at the Department of Vascular Surgery, Oslo University Hospital. Our material consisted of the 43 (18%) out of 240 patients who developed an exclusive type 2 endoleak after EVAR, see flowchart (figure 1).

Figure 1. Flowchart for patients developing exclusive type 2 endoleak after treatment with EVAR for AAA



The median follow-up time was 33.8 months (interquartile range, 22 – 53 months). All patients attended at least one or more clinical control sessions following their initial operation, but four (9.3%) patients were lost to follow-up during the study period.

Baseline and clinical characteristics of patients with exclusive type 2 endoleak are presented in table 1.

Table 1. Baseline characteristics of 43 patients with type 2 endoleak after endovascular aneurysm repair (EVAR).

Age, years, mean ± SD	77.3 ± 5.9
Male gender, n (%)	40 (93.1)
Coronary disease, n (%)	18 (41.9)
Heart failure, n (%)	11 (25.6)
COPD, n (%)	13 (30.2)
Diabetes, n (%)	2 (4.7)
Hypertension, n (%)	33 (76.7)
Smoking, n (%) • Current • Ex-smoker • Never	 5 (11.6) 17 (39.5) 21 (48.8)
ASA Class, n (%) • Class II • Class III • Class IV	 11 (25.6) 29 (67.4) 3 (7)
Preoperative sac diameter • Mean ± SD • Median	 58.6 ± 9.6 55
Graft type, n (%) • Cook Zenith	 32 (74.4)

• Gore Excluder • Medtronic Endurant	2 (4.7) 9 (20.9)

T2EL = Type 2 Endoleak
SD = Standard deviation
COPD = Chronic obstructive pulmonary disease

The majority of the patients who developed T2EL were male (93.1%). The mean age at the time of initial surgery was 77.3 years.

Hypertension was the most prevalent preoperative morbidity, found in 76,.7% of the patients, followed by coronary disease in 41.2%. The majority (67.4%) were ASA class III, the rest were either class II (25.6%) or IV (7%).

The Cook Zenith graft was the most widely used endovascular device accounting for almost ¾ (74.4%) of the operations. Other devices consisted of the Medtronic Endurant and the Gore Excluder grafts.

Clinical outcomes for the 43 patients with T2EL are shown in table 2.

Table 2. Clinical outcomes in 43 patients with type 2 endoleak after EVAR.

Mortality, n (%) • All cause • ARM	 9 (20.9) 0 (0)
Lost to follow-up, n (%)	4 (9.3)
Status of T2EL at end of study • Remission • Persistent • Unknown	 23 (53.5) 18 (41.9) 2 (4.7)
AAA sac size at end of study • Increase • Decrease • Unchanged	 22 (51.1) 19 (44.1) 2 (4.7)
Mean AAA sac change, mm ± SD	-0.7 ± 10.4
Interventions for T2EL, n (%)	6 (13.9)

Type of intervention, n (%) • Coiling • Clipsing • Conversion to open surgery	 6 (13.9) 1 (2.3) 1 (2.3)
Successful interventions	2 (33.3)

ARM =Aneurysm related mortality
T2EL = Type 2 endoleak
AAA = Abdominal aortic aneurysm
SD = Standard deviation

Nine (20.9%) patients died within the follow-up period, but none from aneurysm-related mortality.

Aneurysm sac growth was seen in 22 of the patients at the end of study, while 19 had diminished, and two remained unchanged. Overall mean change in aneurysm sac diameter was a decrease of 0.7 mm (SD, 10.4) Intervention were performed in six (13.9%) patients. Coiling was performed in all intervention cases, while two patients also underwent a secondary intervention consisting of clipsing or conversion to open surgery, respectively. Two patients (33.3%) had successful interventions.

At the end of the study period 21 (48.8%) of the type 2 endoleaks had resolved spontaneously within an average of 19.3 months (median 14.5 months). 18 patients had persistent endoleaks, while two were unknown due to being lost to follow-up.

Discussion

Key results

43 (18%) of the patients treated with EVAR between 2007 – 2014 developed type 2 endoleak. All-cause mortality rate was nine (20.9%), but no one died from aneurysm related mortality. Aneurysm sac growth was seen in 22 (51.1%), and intervention performed in six (13.9%). At the end of the study period 48.8% of the type 2 endoleaks had resolved spontaneously.

Interpretation

There are some similar previously published studies, but none based on Norwegian materials. A non-systematic search on PubMed with different keywords and mesh

terms for "endoleak" and "EVAR" was performed. Between 2004 and today fourteen relevant, similar studies were found.[7,15-27]

Other relevant reports include guidelines such as the “Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II)” [28],’’ "The care of patients with an abdominal aortic aneurysm: The Society for Vascular Surgery practice guidelines" [29], the European society for vascular surgery´s "Management of abdominal aortic aneurysms clinical practice guidelines".[30]

The incidence of T2EL in our study seems in range with what has been reported in earlier research.[5-9,22] Some studies argue that T2EL is not associated with an increased risk of rupture or ARM, and can therefore be managed conservatively, while others suggest that T2EL is a potentially dangerous condition that can increase the risk of serious complications. [7,16-22]

Although aneurysm sac growth was seen in over half the patients, we did not find any aneurysm related deaths in our study.

The mean age of the patients with type 2 endoleak was quite high, 77.3 years old (SD 5.86). Recent studies like Walker et al.[22] and Sidloff et al.[7] also found that the mean age was higher for patients who developed T2EL, compared to those who did not, possibly suggesting these patients suffering from more co-morbidity in general. This is also supported by the fact that the majority of patients being ASA class III (67.4%) or IV (7%) preoperatively.

Surprisingly few of the patients with T2EL were current or ex-smokers. This correlation has also been demonstrated previously[7], indicating that smokers may have increased general coagulability, reducing the possibility of back-flow from lumbar arteries.

There are reports of harmful complications after interventions for T2EL.[31,32] Thus, since aneurysm sac growth does not appear to be associated with ARM, and the success rate for interventions was quite low (33.3%) in our study, it further signifies the importance of being restrictive and selective in this matter so that not more harm than good is done.

Limitations

Our material is fairly small, including only 43 patients with exclusive T2EL from a single center, and there is no control group. The generalizability of such a small study is uncertain. But so far there has not been published any other Norwegian studies

regarding the outcomes for patients with type 2 endoleak after EVAR. There might be a selection bias due to our clinics' status as a primary, secondary and tertiary vascular center and the procedure for referral changed during the study period, as more and more local hospitals now perform EVAR. The size of our study did not permit distinguishing between early and late endoleaks.

Conclusion

In this small single center cohort study, type 2 endoleak after EVAR does not seem to be associated with any aneurysm related mortality, suggesting that a watchful approach with selective intervention may be a safe follow-up method for these patients.

An aim for further research could be a randomized controlled trial comparing intervention versus watchful approach in patients with type 2 endoleak after EVAR.

Conflict of interest or external funding

None

Acknowledgements

Thanks to Lars Erik Staxrud and Thomas Nyheim for all their work on the EVAR-database, and allowing us to use it in our study.

Thanks to Anne Helene Krog for all the help and guidance.

REFERENCES

1. Schermerhorn ML, O'Malley AJ, Jhaveri A, Cotterill P, Pomposelli F, Landon BE. Endovascular vs. open repair of abdominal aortic aneurysms in the Medicare population. *N. Engl. J. Med.*;358(5):464-474.
2. Blankensteijn JD, de Jong SE, Prinssen M, et al. Two-year outcomes after conventional or endovascular repair of abdominal aortic aneurysms. *N. Engl. J. Med.* 2005;352(23):2398-2405.
3. Drury D, Michaels JA, Jones L, Ayiku L. Systematic review of recent evidence for the safety and efficacy of elective endovascular repair in the management of infrarenal abdominal aortic aneurysm. *British Journal of Surgery.* 2005;92(8):937-946.
4. White GH, Yu W, May J, Chaufour X, Stephen MS. Endoleak as a complication of endoluminal grafting of abdominal aortic aneurysms: classification, incidence, diagnosis, and management. *J. Endovasc. Surg.* 1997;4(2):152-168.
5. Sheehan MK, Ouriel K, Greenberg R, et al. Are type II endoleaks after endovascular aneurysm repair endograft dependent? *Journal of Vascular Surgery.* 2006;43(4):657-661.
6. Sidloff DA, Stather PW, Choke E, Bown MJ, Sayers RD. Type II endoleak after endovascular aneurysm repair. *British Journal of Surgery.* 2013;100(10):1262-1270.
7. Sidloff DA, Gokani V, Stather PW, Choke E, Bown MJ, Sayers RD. Editor's Choice - Type II Endoleak: Conservative Management Is a Safe Strategy. *European Journal of Vascular & Endovascular Surgery.* 2014;48(4):391-399.
8. Hobo R, Buth J, collaborators E. Secondary interventions following endovascular abdominal aortic aneurysm repair using current endografts. A EUROSTAR report. *Journal of Vascular Surgery.* 2006;43(5):896-902.
9. Gelfand DV, White GH, Wilson SE. Clinical significance of type II endoleak after endovascular repair of abdominal aortic aneurysm. *Annals of Vascular Surgery.* 2006;20(1):69-74.
10. White GH, May J, Waugh RC, Chaufour X, Yu W. Type III and type IV endoleak: toward a complete definition of blood flow in the sac after endoluminal AAA repair. *J. Endovasc. Surg.* 1998;5(4):305-309.
11. Fransen GA, Vallabhaneni SR, Sr., van Marrewijk CJ, et al. Rupture of infra-renal aortic aneurysm after endovascular repair: a series from EUROSTAR registry. *European Journal of Vascular & Endovascular Surgery.* 2003;26(5):487-493.
12. Buth J, Harris PL, van Marrewijk C, Fransen G. The significance and management of different types of endoleaks. *Seminars in Vascular Surgery.* 2003;16(2):95-102.
13. Harris PL, Vallabhaneni SR, Desgranges P, Becquemin JP, van Marrewijk C, Laheij RJ. Incidence and risk factors of late rupture, conversion, and death after endovascular repair of infrarenal aortic aneurysms: the EUROSTAR experience. European Collaborators on Stent/graft techniques for aortic aneurysm repair. *Journal of Vascular Surgery.* 2000;32(4):739-749.
14. Karthikesalingam A, Thrumurthy SG, Jackson D, et al. Current evidence is insufficient to define an optimal threshold for intervention in isolated type II endoleak after endovascular aneurysm repair. *Journal of Endovascular Therapy.* 2012;19(2):200-208.

15. Timaran CH, Ohki T, Rhee SJ, et al. Predicting aneurysm enlargement in patients with persistent type II endoleaks. *Journal of Vascular Surgery.* 2004;39(6):1157-1162.
16. Rayt HS, Sandford RM, Salem M, Bown MJ, London NJ, Sayers RD. Conservative management of type 2 endoleaks is not associated with increased risk of aneurysm rupture. *European Journal of Vascular & Endovascular Surgery.* 2009;38(6):718-723.
17. Cieri E, De Rango P, Isernia G, et al. Type II endoleak is an enigmatic and unpredictable marker of worse outcome after endovascular aneurysm repair. *Journal of Vascular Surgery.* 2014;59(4):930-937.
18. El Batti S, Cochennec F, Roudot-Thoraval F, Becquemin JP. Type II endoleaks after endovascular repair of abdominal aortic aneurysm are not always a benign condition. *Journal of Vascular Surgery.* 2013;57(5):1291-1297.
19. Jones JE, Atkins MD, Brewster DC, et al. Persistent type 2 endoleak after endovascular repair of abdominal aortic aneurysm is associated with adverse late outcomes. *Journal of Vascular Surgery.* 2007;46(1):1-8.
20. Nolz R, Teufelsbauer H, Asenbaum U, et al. Type II endoleaks after endovascular repair of abdominal aortic aneurysms: fate of the aneurysm sac and neck changes during long-term follow-up. *Journal of Endovascular Therapy.* 2012;19(2):193-199.
21. Zhou W, Blay E, Jr., Varu V, et al. Outcome and clinical significance of delayed endoleaks after endovascular aneurysm repair. *Journal of Vascular Surgery.* 2014;59(4):915-920.
22. Walker J, Tucker L-Y, Goodney P, et al. Type II endoleak with or without intervention after endovascular aortic aneurysm repair does not change aneurysm-related outcomes despite sac growth. *Journal of Vascular Surgery.* 2015;62(3):551-561.
23. Higashiura W, Greenberg RK, Katz E, Geiger L, Bathurst S. Predictive factors, morphologic effects, and proposed treatment paradigm for type II endoleaks after repair of infrarenal abdominal aortic aneurysms. *Journal of Vascular & interventional Radiology.* 2007;18(8):975-981.
24. Mandziak DM, Stanley BM, Foreman RK, Walsh JA, Burnett JR. Outcome of endoleak following endoluminal abdominal aortic aneurysm repair. *ANZ Journal of Surgery.* 2004;74(12):1039-1042.
25. Silverberg D, Baril DT, Ellozy SH, et al. An 8-year experience with type II endoleaks: natural history suggests selective intervention is a safe approach. *Journal of Vascular Surgery.* 2006;44(3):453-459.
26. Steinmetz E, Rubin BG, Sanchez LA, et al. Type II endoleak after endovascular abdominal aortic aneurysm repair: a conservative approach with selective intervention is safe and cost-effective. *Journal of Vascular Surgery.* 2004;39(2):306-313.
27. Tolia AJ, Landis R, Lamparello P, Rosen R, Macari M. Type II endoleaks after endovascular repair of abdominal aortic aneurysms: natural history. *Radiology.* 2005;235(2):683-686.
28. Norgren L, Hiatt WR, Dormandy JA, et al. Inter-Society Consensus for the Management of Peripheral Arterial Disease (TASC II). *Eur. J. Vasc. Endovasc. Surg.* 2007;33 Suppl 1:S1-75.
29. Chaikof EL, Brewster DC, Dalman RL, et al. The care of patients with an abdominal aortic aneurysm: The Society for Vascular Surgery practice guidelines. *Journal of Vascular Surgery.* 2009;50(4, Supplement):S2-S49.

30. Moll FL, Powell JT, Fraedrich G, et al. Management of abdominal aortic aneurysms clinical practice guidelines of the European society for vascular surgery. *Eur. J. Vasc. Endovasc. Surg.* 2011;41 Suppl 1:S1-s58.
31. Haulon S, Tyazi A, Willoteaux S, Koussa M, Lions C, Beregi J-P. Embolization of type II endoleaks after aortic stent-graft implantation: Technique and immediate results. *Journal of Vascular Surgery.*34(4):600-605.
32. Uthoff H, Katzen BT, Gandhi R, Peña CS, Benenati JF, Geisbüsch P. Direct percutaneous sac injection for postoperative endoleak treatment after endovascular aortic aneurysm repair. *Journal of Vascular Surgery.*56(4):965-972.