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Cumbria and Lancashire Vascular and Endovascular Centre

Assessment Of Carotid Plaque Ultrasonic Morphology for Predicting Ischaemic Stroke Risk In Symptomatic Carotid Artery Disease

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Background

Current recognised criteria for symptomatic carotid artery intervention focuses on the degree of internal carotid artery (ICA) stenosis. However, such symptomatic patients may have co-existing abnormal plaque morphology.

Methods

A total of 3253 abstracts were screened from Pubmed and Medline databases which included all studies evaluating;

- Carotid artery stenosis.
- TIA / Stroke.
- Carotid plaque evaluation.
- Sonographic morphology.

Results

4297 patients with 4518 carotid arteries were analysed from thirteen studies, including two review manuscripts. Plaque evaluation was based on visual ultrasonic interpretation using multiple different classification systems. Due to these variations in plaque assessment methodology, secondary parameters could not be systemically analysed. There was no clear evidence to suggest a correlation between ICA stenosis and plaque echogenicity. However, the studies suggested the importance of plaque echolucency as a possible predictive factor which should considered prior to intervention.

Conclusions

Studies have suggested that carotid plaque morphology plays an important role in the pathogenesis of symptomatic disease. However, our systematic review identified that visual ultrasonic interpretation using different classification system is subject to inter- and intra -observer variability.

Aims

A systematic review of published literature was performed to evaluate carotid plaque echogenicity as an additional independent predictor of ischemic cerebrovascular events in symptomatic carotid artery patients.

Plaque Morphology

Sonograghic classification of carotid plaque was based of the Polak classification;

Type I: Uniformaly echoleucent.
Type II: Predominantly echoleucent.
Type III: Predominantly echogenic.
Type IV: Uniformaly echogenic.
Type V: Unclassified plaques.

Studies Included

Study No.	Year	First Author	No. Of Subjects	Degree of Stenosis Assessed	Sonographic Plaque Assessment as Evaluated
1	1988	Sterpetti	214 (238 Carotids)	<50% & >50%	Heterogeneous plaque
2	1994	Geroulakos	84	> 70 - 90%	Type I
3	1995	Cave	116	N/A	Type I and Type II plaques
4	1995	Golledge	285	60 - 99%	Type I and Type II plaques
5	1997	Pedro	74 (105 Carotids)	N/A	Echogenic/GSM grading
6	2000	Liapis	332 (442 Carotids)	Varying Degree	Echolucent plaque
7	2001	Mathiesen	223	35-49%(123)/50-100%(100)	Echolucent plaque
8	2001	Tegos	150 (192 Carotids)	50 - 99%	Echolucent plaque / GSM grading
9	2001	Gronholdt	246 (135)	≥ 50%	Echolucent plaque / CA
10	2001	Tegos	113 (127 Carotids)	40 -95%	Hypoechoic plaque
11	2002	AbuRahamn	2460	< 50 - 99%	Heterogeneous plaque

Recommendations

Consideration of multicentre trials to evaluate plaque morphology using a standardised validated sonographic assessment process.

Development of computerised analytical tools may be a useful investigative modality to link any effect of plaque and the degree of stenosis to minimise assessment variability.

References

1) Ultrasonographic features of carotid plaque and the risk of subsequent neurologic deficits. Sterpetti AV, Schultz RD, Feldhaus RJ, Davenport KL, Richardson M, Farina C, Hunter WJ. *Surgery.* 1988; **104**(4): 652-60.
2) Ultrasonic carotid artery plaque structure and the risk of cerebral infarction on computed tomography. Geroulakos G, Domjan J, Nicolaides A, Stevens J, Labropoulos N, Ramaswami G, Belcaro G, Mansfield A. *J Vasc Surg.* 1994; **20**(2): 263-6.
3) Carotid artery duplex scanning: does plaque echogenicity correlate with patient symptoms? Cave EM, Pugh ND, Wilson RJ, Sissons GR, Woodcock JP. *Eur J Vasc Endovasc Surg.* 1995; **10**(1): 77-81.
4) Carotid plaque characteristics and presenting symptom. Golledge J, Cuming R, Ellis M, Davies AH, Greenhalgh RM. *Br J Surg.* 1997; **84**(12): 1697-701.
5) Computer-assisted carotid plaque analysis: characteristics of plaques associated with cerebrovascular symptoms and cerebral infarction. Pedro LM, Pedro MM, Gonçalves I, Carneiro TF, Balsinha C, Fernandes e Fernandes R, Fernandes e Fernandes J. *Eur J Vasc Endovasc Surg.* 2000; **19**(2): 118-23.
6) Carotid stenosis: factors affecting symptomatology. Liapis CD, Kakisis JD, Kostakis AG. *Stroke.* 2001; **32**(12): 2782-6.
7) Echolucent plaques are associated with high risk of ischemic cerebrovascular events in carotid stenosis: the tromsø study. Mathiesen EB, Bønaa KH, Joakimsen O. *Circulation.* 2001; **103**(17): 2171-5.
8) Significance of sonographic tissue and surface characteristics of carotid plaques. Tegos TJ, Kalomiris KJ, Sabetai MM, Kalodiki E, Nicolaides AN. *Am J Neuroradiol.* 2001; **22**(8): 1605-12.
9) Ultrasonic echolucent carotid plaques predict future strokes. Grønholdt ML, Nordestgaard BG, Schroeder TV, Vorstrup S, Sillesen H. *Circulation.* 2001; **104**(1): 68-73.
10) Determinants of carotid plaque instability: echoicity versus heterogeneity. Tegos TJ, Stavropoulos P, Sabetai MM, Khodabakhsh P, Sassano A, Nicolaides AN. *Eur J Vasc Endovasc Surg.* 2001; **22**(1): 22-30.
11) Carotid plaque ultrasonic heterogeneity and severity of stenosis. AbuRahma AF, Wulu JT Jr, Crotty B. *Stroke.* 2002; **33**(7): 1772-5.

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Evaluating the potential for a new specialist Central Vascular Access Service: Are we using too many Hickman Lines?

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Introduction

Indications for mid-to-long term central venous access include:

- Intravenous (IV) therapy lasting ≥7 days, including antibiotics
- Total Parenteral Nutrition (TPN)
- Infused Chemotherapy
- Venous Irritant IV Therapy

Our Trust utilises both Hickman Lines and Peripherally Inserted Central Catheters (PICCs) for mid-to-long-term central venous access. PICCs are associated with reduced complication rates and can be used for ≤12 months. Hickman line insertion is suggested if anticipated duration of IV therapy exceeds 12 months, or if a PICC has failed or is not suitable.

In our specialist unit, Hickman lines are inserted by vascular surgeons in the operating theatre, while PICCs are inserted in a procedure room by an Advanced Nurse Practitioner-led service. PICCs for chemotherapy are inserted and managed separately by the chemotherapy unit.

Methods

The numbers of Hickman Lines and PICCs inserted in 2015 were identified by retrospective search of theatre procedure codes and PICC service records.

Referrals to the vascular surgery department for central vascular access for the whole of 2015 were analysed to determine whether Hickman Line or PICC was most appropriate, based on stated indication.

Minimal projected annual demand for central venous access was estimated by audit of dietetics service records, patient episode diagnosis codes (for indications usually associated with long term IV therapy), and point prevalence audit of inpatients with an indication for mid-to-long term central venous access.

Vascular Theatre utilisation for Hickman line insertion was calculated from electronic theatre records, and the value of 1 hour utilisation of vascular theatre was calculated from published Tariffs.

Results

181 Hickman Lines and 61 PICCs were inserted in 2015.

Of 46 available referral records, 15 should have been for a PICC, based on stated indication. It is therefore proposed that up to 60 out of 181 patients could have had a PICC instead of a Hickman line.

This equates to an estimated 45 hours per year of vascular theatre time dedicated to inserting unnecessary Hickman lines (60 x mean insertion time of 45min/line) based on present CVAD numbers

Estimated current procedure costs are £264.30 for Hickman Line insertion and £126.09 for PICC insertion.

Minimum projected annual CVAD demand = 416.

Point-prevalence audit suggests at least a further 47 patients at that time may benefit from PICC placement. Related annual projections for this patient group are not available.

Conclusions

Lack of overlap between referral and insertion records suggests other, informal, referral mechanisms are being utilised and are not auditable.

A greater proportion of Hickman lines are placed than theatre codes and indications stated on referrals would suggest are necessary.

CVADs are almost certainly underused amongst inpatients with appropriate indications. Potential CVAD demand cannot be met by the existing Hickman Line-based, vascular surgeon-led service, and can be provided at less cost with a PICC-based nurse-led service.

We are as yet unable to quantify other benefits and costs of a fully implemented comprehensive, PICC-based nurse-led central venous access service.

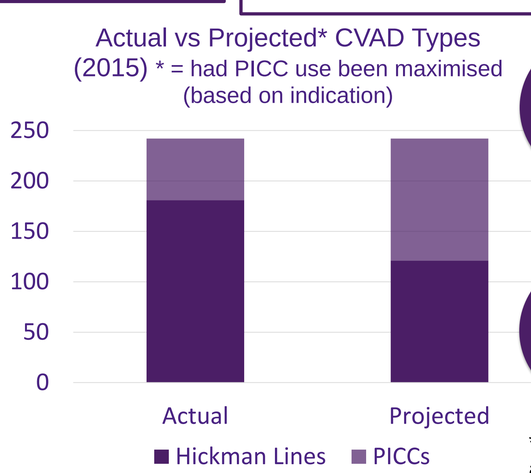
Aims

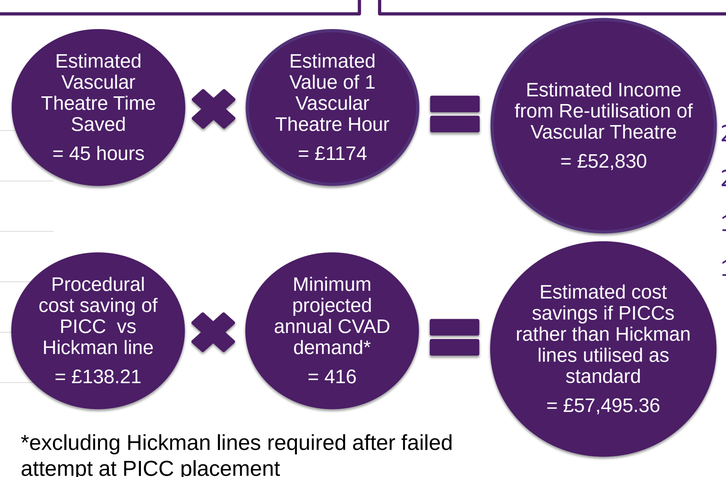
To determine the number of Hickman Lines & PICCs inserted annually in our Trust.

To estimate potential cost & efficiency savings from increased use of PICCs and decreased use of Hickman lines, based on 2015 data.

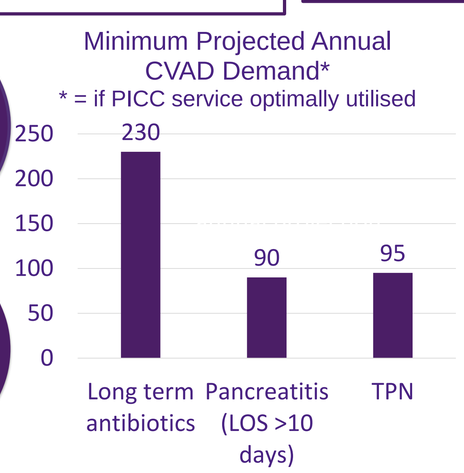
To estimate the potential number of Central Venous Access Devices (CVADs) required annually in the Trust.

To determine whether potential demand for central vascular access exceeds present service capacity.





*excluding Hickman lines required after failed attempt at PICC placement



Recommendations

Serial point-prevalence audit to accurately quantify CVAD demand.

Establish nurse-led central vascular access device (CVAD) team to optimise use of PICCs.

Single point of referral to CVAD team via electronic referral system.

Robust audit mechanisms for referrals, insertions and complications.

Re-evaluate procurement of PICC lines and equipment to reduce procedure costs

References

- Chopra, V., O'Horo, J.C., Rogers, M.A., Maki, D.G., Safdar, N.; 'The risk of bloodstream infection associated with peripherally inserted central catheters compared with central venous catheters in adults: a systematic review and meta-analysis.' *Infect Control Hosp Epidemiol. 2013 Sep;34(9):908-18.*
- Chopra, V., Ratz, D., Kuhn, L., Lopus, T., Chenoweth, C., Krein, S.; 'PICC-associated bloodstream infections: prevalence, patterns, and predictors'. *Am J Med. 2014 Apr;127(4):319-28.*
- Christensen, L.D., Holst, M., Bech, L.F., Drustrup, L., Nygaard, L., Skallerup, A., Rasmussen, H.H., Vinter-Jensen, L.; 'Comparison of complications associated with peripherally inserted central catheters and Hickman™ catheters in patients with intestinal failure receiving home parenteral nutrition. Six-year follow up study'. *Clin Nutr. 2015 Jul 28.*
- Gunst, M., Matsushima, K., Vanek, S., Gunst, R., Shafi, S., Frankel, H.; 'Peripherally inserted central catheters may lower the incidence of catheter-related blood stream infections in patients in surgical intensive care units'. *Surg Infect (Larchmt). 2011 Aug;12(4):279-82.*
- Maki, D.G., Kluger, D.M., Crnich, C.J.; 'The risk of bloodstream infection in adults with different intravascular devices: a systematic review of 200 published prospective studies'. *Mayo Clin Proc. 2006 Sep;81(9):1159-71.*
- Safdar, N., Maki, D.G.; 'Risk of catheter-related bloodstream infection with peripherally inserted central venous catheters used in hospitalized patients'. *Chest. 2005 Aug;128(2):489-95.*

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Rescue Management of Vascular Graft Infections using Sartorius Muscle Flaps

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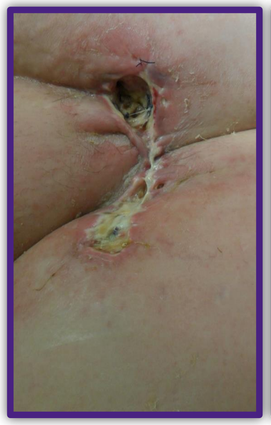
Background

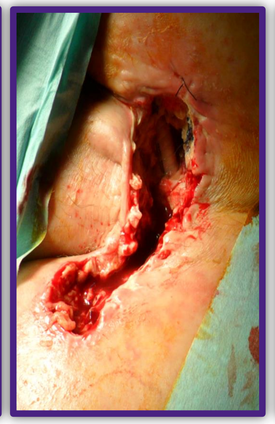
Prosthetic graft wounds in vascular patients can be notoriously difficult to manage, with infection and dehiscence rates of between 5-10%.[1] This can lead to major morbidity which includes amputation and can even preclude death. Rescue therapy aims to treat the infection whilst preserving the graft and enabling wound healing. Muscle flaps have successfully been used by limb salvage surgeons in a variety of conditions, including chronic osteomyelitis and vascular graft infection.[2] We describe the technique of using Sartorius Muscle Flaps as rescue management of vascular prosthetic graft wound dehiscence and present a case series of patients from our centre who have been successfully treated in this way.

The Technique

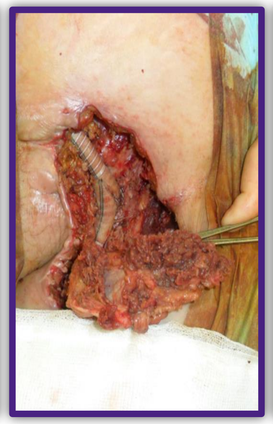
As with any infected wound the first principle, after adequately preparing the patient, is to perform a thorough washout and debridement of necrotic, infected and non-viable tissue. The Sartorius muscle is then detached from its origin at the Anterior Superior Iliac Spine and transposed medially covering the prosthetic graft. The subcutaneous tissues and skin can then be closed primarily. In our experience a long term course of antibiotics (up to 3 months) is needed as an adjunct to reduce re-infection rates and aid optimal wound healing.



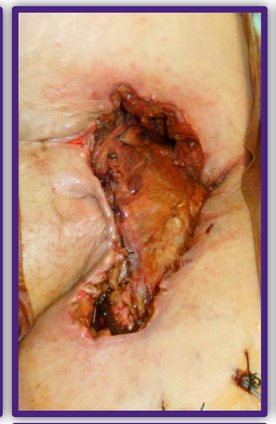
Dehisced pre-operative prosthetic graft wound



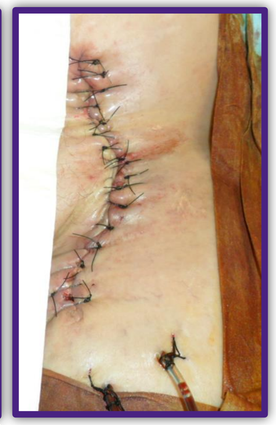
After debridement of non-viable and infected tissue



Preparation of the Sartorius Muscle Flap



Flap transposition and placement to cover the prosthetic graft



Post-operative subcutaneous tissue and skin closure

Case Series

We treated 3 patients in our centre (2 male and one female, mean age of 66) with the Sartorius Muscle Flap technique. All had a wound dehiscence within 35 days of femoral endarterectomy and patch angioplasty (n=2) or femoral to above knee popliteal bypass (n=1). The technique was performed as described with the bovine patch replaced with autologous vein in 2 of the patients but in the other patient the femoro-popliteal and femoro-femoro prosthetic grafts were left in situ. Microbiological cultures identified different causative organisms for each patient (enterobacter, β-haemolytic streptococcus and a mixture of Serratia marcescens, Acinetobacter baumannii and Stenotrophomonas maltophilia). All three patients were commenced on long-term antibiotics for 3 months as per microbiology advice. Mean admission duration was 35.7 days. All patients without prosthetic graft material remain well with healed wounds at mean follow-up of 131 days. The other patient is currently awaiting further wound evaluation for consideration of free-flap transfer.

Discussion

The use of sartorius muscle flaps is a viable option for rescue management of dehisced vascular wounds though it is not without its own potential complications. This may arise from ischaemia of the flap itself; its' blood supply enters postero-medially and so can be threatened during transposition. This can be potentially avoided by modifying the technique and mobilising just the lateral margin of sartorius and twisting the flap back on its medial axis, limiting interference with blood flow.[3]

Conclusion

Graft coverage with sartorius muscle flaps, in combination with long-term antibiotics, remains a viable rescue management for patients with groin wound infection and dehiscence around prosthetic grafts and can reduce what remains a major cause of ongoing morbidity and mortality in patients with Vascular prosthetic grafts.

References

1. Dosluoglu, Hasan H. et al. Management of early (<30 day) vascular groin infections using vacuum-assisted closure alone without muscle flap coverage in a consecutive patient series. *Journal of Vascular Surgery.* 2009;51(5):1160 – 1166.
2. Klebuc M, Menn Z. Muscle Flaps and Their Role in Limb Salvage. *Methodist DeBakey Cardiovascular Journal*. 2013;9(2):95-99.
3. Williams, I.M. et al. Vascularised muscular flaps and arterial graft infection in the groin. *European Journal of Vascular and Endovascular Surgery*. 2003;25(5):390-395.

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The Successful Treatment of a Proximal Type I Endoleak using the Aptus HeliFX EndoAnchor System – A Useful adjunct in EVAR Re-intervention.

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Objective

We report the successful use of the Aptus HeliFX EndoAnchor System for treatment of a proximal type I endoleak after elective endovascular aneurysm repair (EVAR) of an infra-renal abdominal aortic aneurysm (AAA).

Case Report

An 84-year-old male presented in August 2015 with acute ischaemia of his left lower extremity. Radiological imaging confirmed a mobile thrombus at the femoral bifurcation and an incidental 6.8cm infrarenal AAA. Lower limb perfusion was restored with embolectomy and the patient was anticoagulated.

He proceeded to EVAR in October 2015 which was completed without complication. One-month post-EVAR CT angiogram identified a posterior type-1 endoleak with associated proximal neck morphological changes **(Figure 1A)**.

Endovascular Procedure

The patient proceeded to redo-endo-intervention in January 2016 via an open cut-down of the right femoral artery. Intra-operative angiogram confirmed the alteration in proximal neck anatomy. However, the type 1 endoleak was difficult to identify.

Based on pre-operative CT imaging concerns, a decision was made to proceed to endovascular repair of his type-1 endoleak.

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Endovascular Procedure

After systemic heparinisation, an 18F sheath facilitated proximal neck moulding with a Reliant balloon for 2-minutes followed by an additional 5-minutes. We then inserted circumferential Aptus endoanchors **(Figure 2)** (n=8) concentrating on the site of endoleak where the stent graft was not fully opposed to the aortic wall **(Figure 1B)**.

All endoanchors were deployed without difficulty. For reassurance the proximal neck was further scaffolded with a 32mm x 80mm uncovered stent (Optimed sinus XL). The patient was discharged the following day. One month surveillance CT scan remains satisfactory with no evidence of endoleak (**Figure 1C**).

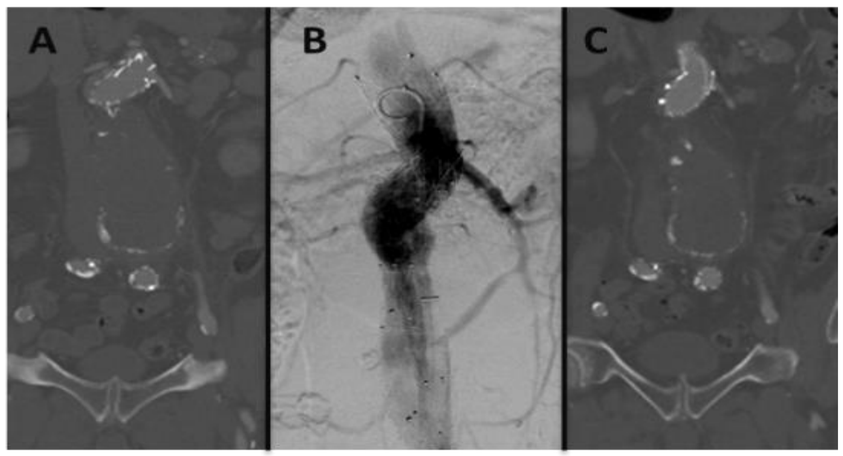

Figure 1:
A) One month CTA demonstrating type-1 endoleak.
B) Completion angiogram following Aptus Endoanchor deployment and uncovered stent scaffolding with no evidence of endoleak.
C) One-month follow-up CTA demonstrating resolution of endoleak.

Aptus HeliFX Endonchor System

The HeliFX EndoAnchor System[1] is a mechanical fastening device that involves the deployment of small helical anchors to essentially screw the endograft to the aorta. Endoanchors may be considered as an adjunct during primary EVAR procedures or for the treatment of endoleaks as shown in this case.

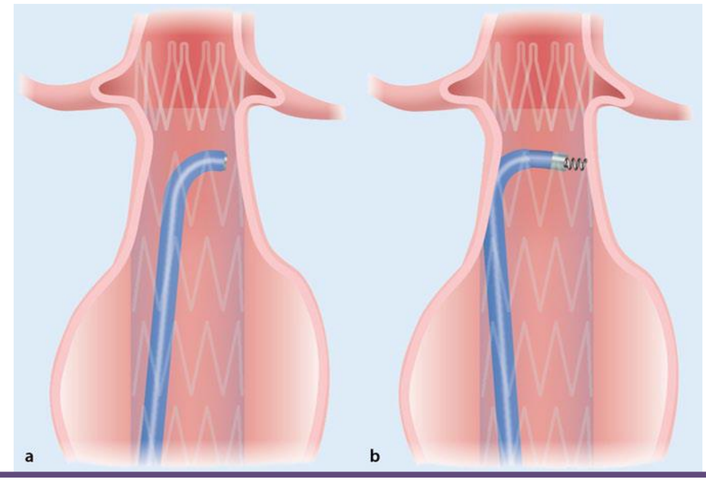

Figure 2:
A) Device positioning at the proximal neck. B) Endoanchor deployment.[2]

Conclusion

Our case reports the use of multiple adjunct manoeuvres to successfully treat a type-1 endoleak in a high risk patient.

Endoleaks remain a continuing complication of EVAR. Specialist vascular units need to possess the relevant skill sets to offer a range of interventional modalities for each type of endoleak.

References:
1.Aptus, 2016. Aptus Heli-FX EndoAnchor System. http://www.aptusendo.com/products/heli-fx [Accessed April 2016]
2. De Vries J et al. Improved fixation of abdominal and thoracic endografts with use of EndoAnchors to overcome sealing issues. Gefässchirurgie 2014, 19:212–219.