

Long term aortic remodelling outcomes for acute Type B Aortic Dissection

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Background

Strategies for the acute management of type B aortic dissection are pushing towards earlier endovascular intervention with the aim of greater aortic remodelling. This study aims to investigate aortic remodelling outcomes for Thoracic Endovascular Aortic Repair (TEVAR) and conservative management for acute TBAD.

Method

All patients presenting with acute TBAD between 2012-2022 at our centre were retrospectively identified. Computed tomography (CT) imaging at 1 year post primary admission and final surveillance scan obtained for analysis using three-dimensional reconstruction software 3mensio (Pie Medical Imaging, Maastricht, Netherlands).

Results

A total of 144 patients presenting with appropriate follow up imaging identified. 74 (52.7%) patients managed with TEVAR and 70 (48.6%) patients managed conservatively. Median time to 1 year scan 13 (9-17) months and final scan 35 months (24-57). At 1 year positive aortic remodelling identified in 47 (63.5%) patients in TEVAR group and 29 (41.4%) in conservative group ($p < 0.001$); increased false lumen thrombosis in 57 (77%) of TEVAR group and 11 (15.3%) in conservative group ($p < 0.001$). At final scan positive aortic remodelling found in 33 (62%) TEVAR patients and 9 (22%) in conservative group ($p < .001$); false lumen thrombosis 37(69%) TEVAR group and 10 (26.3%) conservative group ($p < .001$). At 1 year false lumen reduced in size in TEVAR group whereas in conservative group it increased ($p < 0.001$). At final scan maximum aortic diameter was greater in conservative group (45.2mm) than TEVAR (43.0mm) ($p = 0.25$).

Conclusion

Endovascular intervention induces favourable long term aortic remodelling in comparison with conservative management in patients presenting with acute TBAD.

Biological effects of radiation exposure in patients treated with X-ray guided endovascular aortic repair

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Background

Endovascular aortic repair (EVAR) exposes the patient to significant amounts of radiation. Studies have suggested a higher incidence of cancer in these patients compared with those who have had open aneurysm repair, but evidence is inconclusive. We investigated biological sequelae of radiation exposure, including markers of genomic instability, in patients after complex EVAR using advanced cytogenetics techniques and gene expression.

Methods

Lymphocytes were isolated from patients after (branched/fenestrated) EVAR and non-irradiated controls. Dicentric chromosomes (DC), chromosomal aberrations caused by irradiation and linked to cancer, were enumerated. γ -H2AX, a marker of acute DNA damage/repair, was measured by immunofluorescence after *in-vitro* irradiation at 0.2Gy and 1Gy. Expression of radiation-responsive genes (FDXR, CCNG1, P21 and PHPT1) was measured by qPCR following irradiation.

Results

Seventeen patients (82% male, age 73[59 – 85years]) and fifteen controls (60% male, age 68[53 – 83years]) were recruited. The mean incidence of DC was 3.782, 95% CI[3.134, 4.429] and 0.936, 95% CI[0.490, 1.382] per 1000 cells for patients and controls, respectively ($p < 0.0001$). Patients had higher background of γ -H2AX foci than controls, (0.7056, 95% CI[0.3163, 1.095] vs 0.2413, 95% CI[0.0774, 0.4051]) per cell, ($p < 0.05$). FDXR was the most radio-responsive gene ($p < 0.0001$), but no statistical significance was found between the two groups.

Conclusion

This is the first study to show a raised frequency of dicentrics in patients after complex EVAR, a biological finding that may support a propensity to developing malignancies. A higher background DNA damage/repair activity was also found in this population, evidenced by an increased baseline expression of γ -H2AX.

Interim MRI Results of patients in INTERCEPTevar trial: multicentre pilot randomised controlled trial of carbon dioxide flushing versus saline flushing of thoracic aortic stents

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Background

TEVAR carries a 3-6% stroke risk, including 'silent' brain infarction (SBI). Stent grafts retain air despite saline flushing. CO₂ can be used in addition to saline to de-air stents and reduce bubble formation. This pilot trial aims to investigate the neuroprotective benefit against SBI with the use of CO₂ flushed aortic stent grafts.

Methods

Multicentre pilot RCT taking place in the UK, USA and New Zealand. Patients will be randomised (1:1) to TEVAR- CO₂ or TEVAR-Saline, stratified according to TEVAR landing zone. This abstract will focus on the results of the first 10 participants in the UK who underwent inpatient MRI post randomisation.

Results

Seven cases were randomised to TEVAR- CO₂, with three in TEVAR-Saline. Zone 1 TEVARs showed no infarcts in the CO₂ arm. Zone 2 TEVAR mean infarct of 2.3 with CO₂ vs 4 in saline, mean volume of infarcts 22 vs 28mm². Zone 3 TEVARs mean infarcts 1 in CO₂ vs 0 in saline, mean volume of 2 vs 0mm². Zone 4 TEVARs mean infarct rate of 0.5 CO₂ vs 2 in saline, reduced volume of 3 vs 8mm². Combined mean of 0.5 infarcts in TEVAR-CO₂ vs 2 in TEVAR-Saline. Mean volume of infarcts in all zones also reduced at 3.9 in TEVAR-CO₂ vs 12 in TEVAR-Saline.

Conclusion

The results suggest that CO₂ flushing reduces the number and volume of infarcts DW-MRI infarcts. Further recruitment and analysis is necessary to discern the clinical impact of this within the trial, and is this association reaches statistical significance.

Machine learning algorithm development for longitudinal sarcopenia assessment of perioperative complex endovascular aortic aneurysm repair

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Background

Sarcopenia, characterised by muscle mass and function loss, is associated with adverse surgical outcomes. This study aims to develop a machine learning (ML) algorithm to assess sarcopenia's impact on complex endovascular aortic aneurysm repair outcomes.

Methods

Patients underwent Fenestrated Endovascular Juxtarenal (FEVAR) and Thoracoabdominal Aortic Aneurysm (TAAA) repair using thoracic and fenestrated/branched aortic repair (TEVAR+FEVAR/BEVAR) were included in the study. Peri-operative CT scans were used for radiological sarcopenia assessment at 3rd lumbar vertebra level. The ML algorithm was developed using Transfer Learning and Self-Supervised Learning for qualitative and quantitative sarcopenia assessment and validated against manual measurements.

Results

Among 229 patients, 184 underwent FEVAR and 45 underwent TAAA repair from 2007 to 2022 at Freeman Hospital, Newcastle. TAAA patients were younger (71 vs. 75years, $P=0.03$) but had shorter survival (2.8 vs. 4.8years, $P=0.03$). Lumbar artery coverage percentages were comparable (64.3% vs. 60%, $P=0.07$). Neural network accuracy ranged from 0.82 to 0.89, with a Dice coefficient of 0.64 for mask prediction. Sarcopenia deteriorated within 3 months post-intervention for both groups ($p<0.0001$, for both). Recovery took 3 years after FEVAR and one year after TAAA repair. Pre-operative sarcopenia predicted post-operative sarcopenia ($P=0.001$). Peri-operative sarcopenia did not affect post-operative complications or 2-year survival. Sarcopenia levels at 3 months, 1 year, and 2 years post-operation predicted 5-year survival ($P=0.02$).

Conclusion

The ML algorithm effectively assesses sarcopenia in complex aortic aneurysm repair. Despite being minimally invasive, interventions exacerbate sarcopenia post-operatively. Sarcopenia levels serve as robust predictors of patient survival following these procedures.

An early postoperative sac radiomic signature associates with 1-year sac non-regression on follow-up after endovascular repair of infrarenal aortic aneurysm

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Background

Endovascular repair of infrarenal aortic aneurysm (EVAR) is followed by lifetime surveillance to monitor for endoleak and sac expansion. Sac dynamics 1 year post-op have previously been binarized into 'regressors', defined by ≥ 5 mm standardised diameter reduction, and 'non-regressors', with significantly increased risk of sac expansion and re-intervention. We queried if a radiomic signature on early postoperative CT angiography associated with 1-year clinically relevant sac non-regression.

Methods

All infrarenal EVAR procedures performed at a tertiary centre between 1st Jan 2019 and 1st Oct 2023 were identified from electronic notes, and intervention and follow-up data collected retrospectively. Patients presenting with rupture, inflammatory aneurysm or who received adjunctive devices were excluded. In early (20-70 days) post-operative CT angiography, the axial slice of maximal anterior-posterior residual sac diameter was segmented and radiomic features extracted, then logistic regression performed against binarized sac dynamics.

Results

254 patients underwent infrarenal EVAR, 222 with follow-up CT angiography, 137 met 'early CT' criteria (median 44 days). 91 met follow-up criteria, binarized as sac regressors (41) or non-regressors (50). Non-regression associated with type II endoleak on CT angiography (40% non-regressors, 12% regressors). Reintervention was more frequent in non-regressors (risk ratio 3.28). Logistic regression with sac outcome as the dependent variable produced a model with area-under-curve of 0.88, with largest model coefficients associated with slice segment mean, texture complexity and first-order distribution kurtosis.

Conclusion

These data suggest an early post-operative radiomic signature of sac non-regression, a potential positive marker of endotension, and a model for prospective validation.

Sex-specific comparison of vascular morphology and thrombus burden, adjusting for relative size and concomitant cardiovascular disease burden

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Background

Women with an infrarenal abdominal aortic aneurysm (IRAAA) are less likely to meet instructions for use (IFU) criteria for endovascular repair (EVAR) and more likely to suffer technical and thromboembolic complications. Anatomical sex-differences likely contribute, but previous comparisons using IRAAA diameter do not account for the smaller aortic calibres in women. Adjustment for aortic size index and concomitant cardiovascular disease burden may provide more accurate comparison.

Methods

Multi-centre retrospective cohort study using fully automatic volume segmentation (FAVS) to examine pre-operative imaging for elective IRAAA repairs (2013-2023). Nearest-neighbour propensity score matching was used, adjusting for aortic size index (ASI), cardiovascular risk factors, medications, and repair-type. Pre-specified morphological variables, aortic wall thrombus (AWT) index and “within-IFU” criteria for neck and access were compared between sexes.

Results

From 1026 patients, 128 women were matched to 512 men. Women and matched-men had similar ASI (3.33 [2.94,3.79] vs 3.26 [2.88,3.68], $p=.300$) and no difference vessel stenosis, calcification, or tortuosity. Women had greater relative-thrombus burden (AWT index: thoracic aorta, $p=.010$; superior mesenteric artery, $p<.001$), and were less likely to be within-IFU for neck criteria (13.38% vs 12.50%, $p.002$), due to shorter, narrower, more angulated necks (39.92° [30.61,50.55] vs 34.73 [26.21,43.86], $p<.001$). Visceral and access artery diameters were smaller ($p<.001$), meaning women less often met IFU-access criteria (45.31% vs 18.95%, $p<.001$).

Conclusion

Adjustment for ASI and cardiovascular disease burden did not mitigate sex-specific differences in AWT index, neck angulation or vessel diameters. Therefore, sex-specific device design is key to reduce inequity for EVAR.