Contrast arterial transit time on final DSA predicts persistent type II endoleak after EVAR: a pilot study

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ABSTRACT

This study evaluates whether measuring AT on the final DSA can predict persistent T2E after EVAR.

Final DSA examinations from sixteen retrospective patients, eight with persistent T2E at one year and eight without endoleak, were analyzed, calculating the transit time from the lowest renal artery to the highest iliac artery using DICOM metadata.

Results demonstrated a significantly shorter median AT in the persistent T2E group compared to the no-endoleak group (6.08 s vs. 7.75 s, p = 0.0013) , confirming a faster rate of contrast passage through lower-resistance collateral channels.

These findings highlight final DSA AT as a potential non-invasive functional biomarker to enhance post-EVAR risk assessment and patient stratification.

INTRODUCTION

The goal of this study was to investigate whether measuring **arterial transit time (AT)** using the last digital subtraction angiography (DSA) in patients with **persistent type II endoleaks (T2E)** after repair of an abdominal aortic aneurysm (EVAR) could be a means for early detection of persistent T2E or non-persistent T2E.

The AT measured on final DSA offers **an innovative functional measure of the global aorto-iliac hemodynamics** for predicting T2E after EVAR for patient suffering Abdominal Aortic Aneurysm (AAA).

While other studies have used sac opacification methods or complex post-processing of CT attenuation values, our method uses **single-projection DSA images, routinely acquired** during the operation. By measuring AT from the lowest renal artery to the highest iliac artery, this approach is able to evaluate the low-resistance flow across collateral pathways typically associated with persistent T2E. Figure 1 and 2 illustrate contrast propagation at renal arteries and highest iliac artery bifurcations.

The innovation lies in using proximal iliac contrast arrival as a practical surrogate for sac filling dynamics, providing a **simple, reproducible metric measurable from standard DSA frames, suitable for real-time clinical use**.

METHODS AND MATERIALS

This study involved the retrospective analysis of **sixteen patients** who had undergone EVAR: **eight with persistent T2E** at one year post procedure, and **eight without endoleaks**.

AT was defined as the duration of time from when contrast material first entered the lowest renal artery until it first reached the highest iliac artery during the final DSA examination, using frame rates taken from DICOM metadata.

The median AT was compared between both groups using the Mann-Whitney U test, and a p-value of less than 0.05 indicated statistical significance.

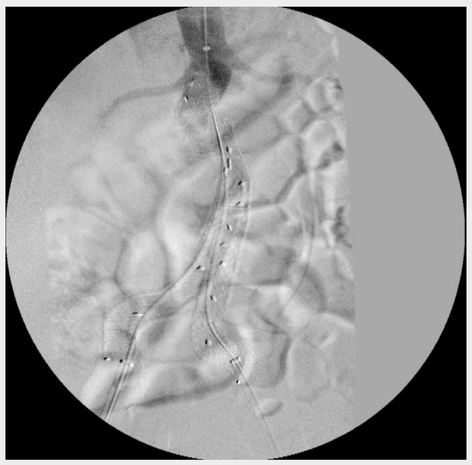

Figure 1. Contrast arrival in renal arteries during final DSA

RESULTS

The retrospective cohort evaluation revealed a clear, statistically significant distinction in regional contrast kinetics between the investigated patient groups.

Specifically, the **median AT** was **significantly shorter in the persistent T2E group**, measuring **6.08 s** with an interquartile range of 5.85–6.25 s. In contrast, the patient group without endoleaks demonstrated a noticeably **longer transit**, yielding a median AT of **7.75 s** with an interquartile range of 6.94–8.75 s. Evaluation via the Mann-Whitney U test confirmed that this operational **difference was highly significant** with a p-value of 0.0013, as reported in Figure 3

These quantitative temporal measurements provide critical insight into the macrovascular flow behaviors within the repaired aortic region. This central finding indicates that patients with persistent T2E had a faster rate of contrast passage through their arteries with respect to the no-endoleak group. From a physiological standpoint, this accelerated transit directly supports previous findings demonstrating that **persistent T2E is associated with greater amounts of collateral flow due to lower-resistance channels**.

Measuring the AT at the iliac artery can be a useful indicator of the global hemodynamics of the aorto-iliac region, even when direct measurement of the endoleak sac is not possible.

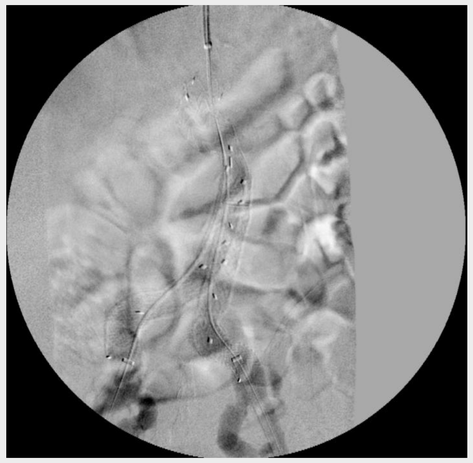

Figure 2. Contrast washout in the highest iliac artery during final DSA

Figure 3. Boxplots of arterial transit time (AT) for persistent T2E vs. no-endoleak patients; Mann-Whitney U test significance is indicated

DISCUSSION

The value of this research lies in demonstrating that **global regional hemodynamics**, evaluated through AT, accurately **reflect the pathophysiological mechanisms responsible for T2E persistence**.

Our results confirm that **faster arterial contrast transit correlates with persistence**, supporting the hypothesis of high-flow collateral circuits, according with prior literature but measured at a different vascular segment [1].

From a clinical standpoint, the distinct reduction in transit times observed in patients with long-term complications corroborates the hypothesis that the development of lower-resistance vascular channels and accelerated collateral flow actively sustains sac filling after EVAR.

Methodologically, utilizing the final DSA circumvents the complexity and computational burdens associated with traditional protocols based on CT or direct sac opacification, seamlessly integrating into the standard operative workflow without requiring any additional contrast administration or radiation exposure.

Although the pilot nature of this study **necessitates future validation in a larger cohort** , introducing AI algorithms for automated segmentation and analysis paves the way for an objective, rapid intraoperative risk assessment, ultimately optimizing post-operative follow-up pathways right at the conclusion of the procedure.

CONCLUSIONS

Final DSA **arterial transit time** is a potential **biomarker for sustained T2E** (type II endoleak).

The method is **highly feasible and reproducible**, leveraging standard angiographic frames and DICOM metadata already captured during the operation **without adding extra radiation or contrast burdens**.

This approach delivers **quantitative, actionable data** immediately at the end of the procedure, facilitating **early post-operative risk stratification** and optimizing patient selection for follow-up imaging and targeted interventions.

Future implementation of AI for automated cavity segmentation and auto-analysis will standardize evaluation, eliminate observer variability, and accelerate translation into routine clinical practice

REFERENCES

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