

Cardiac Remodelling Following Ligation of Arteriovenous Fistula in Stable Renal Transplant Recipients: A Randomized Controlled Study

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Background

- Kidney Transplantation is the optimal long-term management of end-stage renal disease
- Cardiovascular (CV) disease is responsible for up to 40% of deaths in kidney transplant recipients
- Left Ventricular Mass (LVM) is strongly associated with CV disease and CV mortality

Background

- Arteriovenous fistulas contribute adversely to cardiac remodelling and function
- No guideline consensus on management of a redundant arteriovenous fistula following successful kidney transplantation.
- No previous randomized controlled trials have been performed that study the CV effects of ligation of arteriovenous fistulas following successful kidney transplantation

Aim

To study the effects of ligation of arteriovenous fistula on cardiovascular structure and function in stable kidney transplant recipients utilizing cardiac magnetic resonance imaging (CMR)

Primary Hypothesis:

- Ligation of arteriovenous fistulas in stable kidney transplant recipients would result in improvement in cardiac structure with a significant reduction in LVM, compared with control subjects not undergoing arteriovenous fistula ligation.

Secondary Hypothesis:

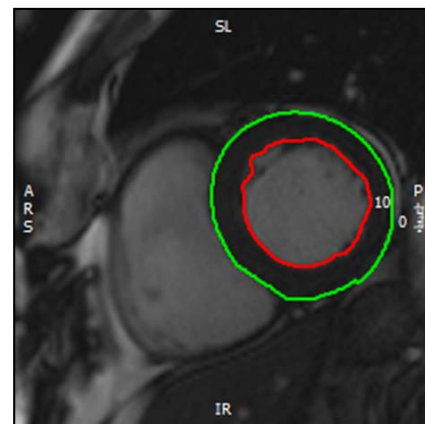
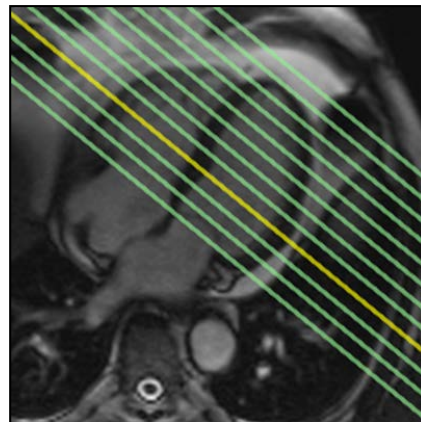
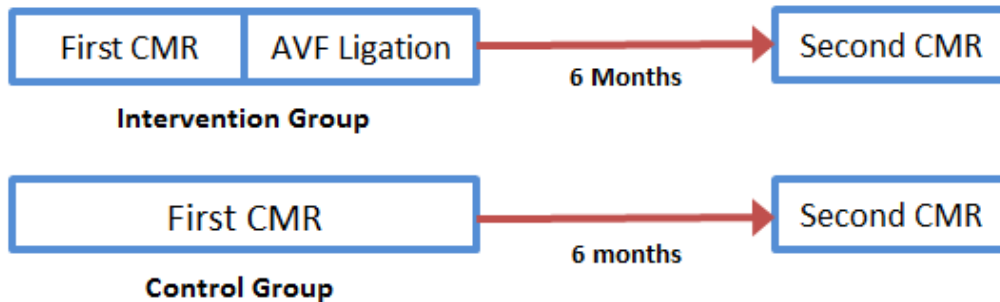
- Ligation of arteriovenous fistulas in stable kidney transplant recipients would result in reductions in both ventricular and atrial volumes, NT-pro BNP levels and pulmonary artery velocity.

Methods

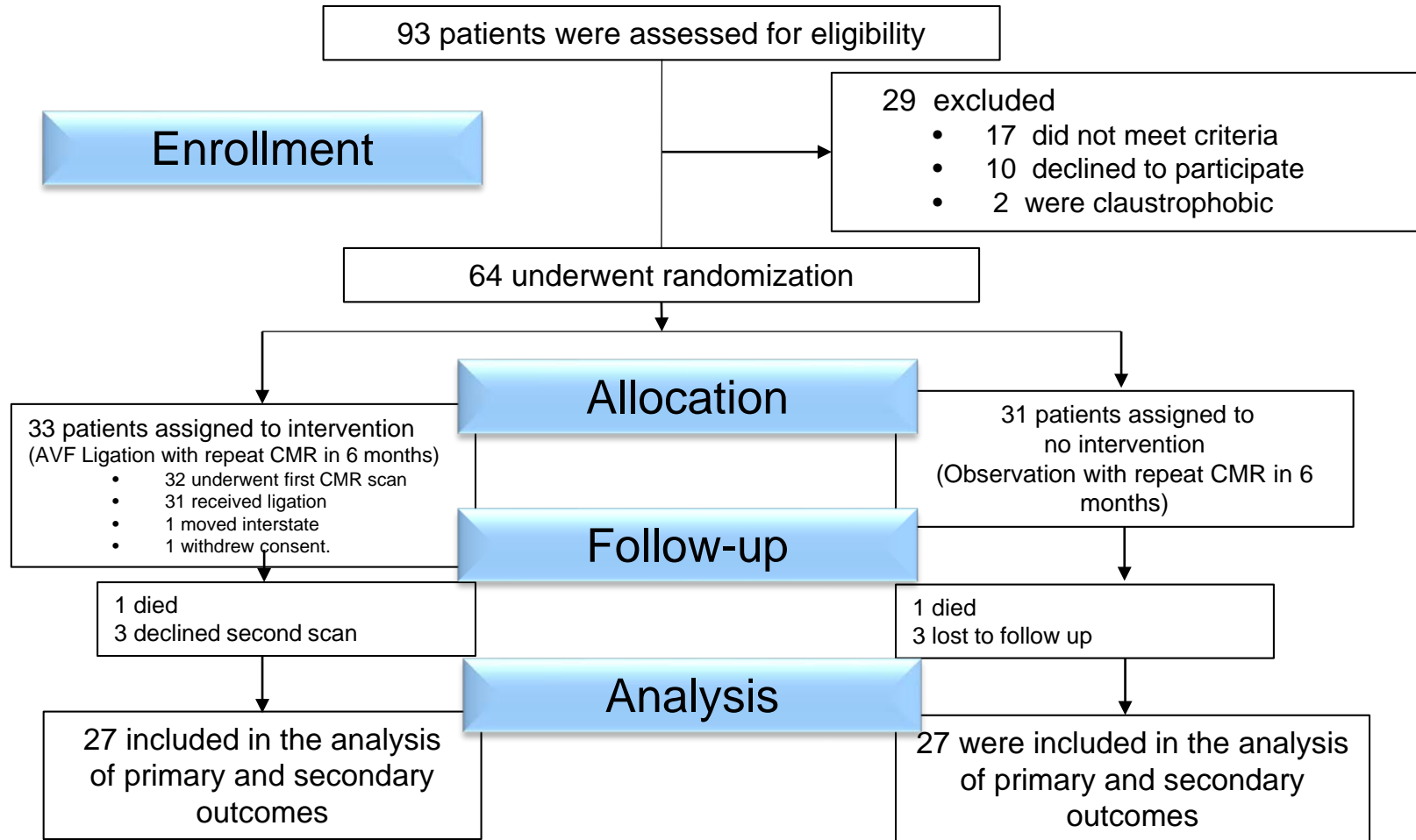
- **Study Design:** Open-label, multi-centre, two group, parallel-design, randomized controlled trial. Prospectively registered with Australian and New Zealand clinical trials registry. **ACTRN12613001302741**
- **Inclusion Criteria:** Adult (≥ 18 years) kidney transplant recipients; ≥ 12 months post successful transplant; stable kidney function; a persistent & functioning arteriovenous fistula; deemed at low risk of graft failure.
- **Exclusion Criteria:** Contraindication to MRI scan; claustrophobia; unstable or deteriorating post-transplant kidney anticipated to require re-institution of haemodialysis within 24 months.

Methods

- **Procedure:**



- **Statistical power:** To obtain a 9% change in LV mass with 80% power, it was calculated that 64 study participants were required, accounting for a dropout rate of 10%



Baseline Characteristics

| Variable | AVF ligation arm (n =32) | Control arm (n = 31) | P value |
|--|-----------------------------|-------------------------|---------|
| Age (years) | 59.3 ± 11.8 | 60.4 ± 9.5 | 0.70 |
| Males, n (%) | 20 (62.5) | 22 (70.9) | 0.25 |
| AVF creation to first scan (months) | 113.3 ± 86.5 | 138.7 ± 99.4 | 0.32 |
| Transplantation until first scan (months) | 92.3 ± 71.7 | 115.0 ± 97.9 | 0.34 |
| Diabetes mellitus, n (%) | 9 (28.1) | 9 (29) | 0.83 |
| Hypertension, n (%) | 25 (78.1) | 23 (71.8) | 0.25 |
| Smoking, n (%) | 7 (21.8) | 9 (29) | 0.32 |
| Peripheral Vascular Disease, n (%) | 2 (6.2) | 2 (6.4) | 0.83 |
| Prior ischaemic heart disease, n (%) | 4 (12.5) | 2 (6.4) | 0.36 |
| Location of AVF, n (%) | | | |
| • Forearm AVF | 14 (43.7) | 16 (51.6) | 0.59 |
| • Upper arm AVF | 18 (56.2) | 15 (48.3) | |

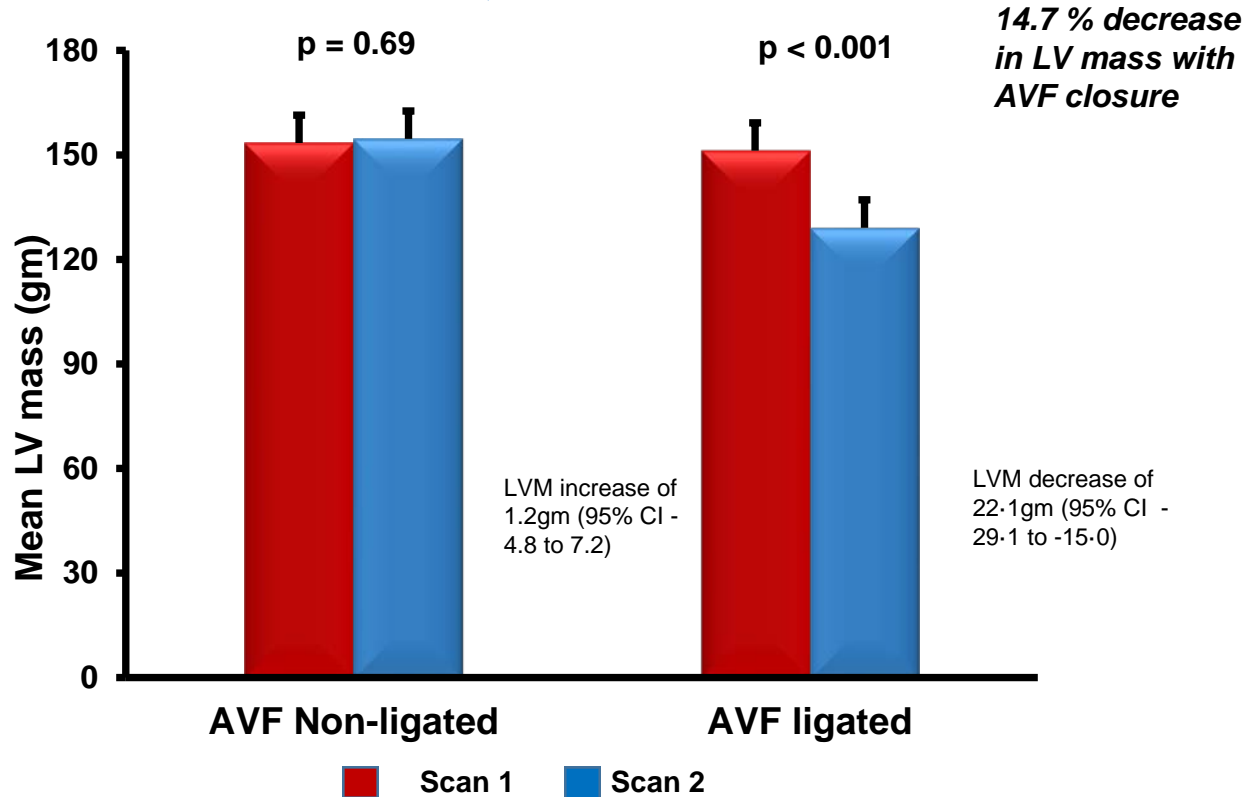
Data are mean ± SD

Baseline Cardiac Parameters

| Variable | AVF ligation arm (n=32) | Control arm (n=31) | P value |
|----------------------------|----------------------------|-----------------------|---------|
| LV Mass (gm) | 151.2 ± 36.5 | 153.4 ± 47.8 | 0.85 |
| LV EDV (ml/min) | 161.5 ± 52.3 | 171.7 ± 45.5 | 0.45 |
| LV ESV (ml/min) | 56.3 ± 25.7 | 52.4 ± 18.9 | 0.52 |
| LV EF (%) | 67.7 ± 9.9 | 69.3 ± 6.7 | 0.50 |
| RV EDV (ml/min) | 166.4 ± 53.0 | 179.8 ± 52.2 | 0.35 |
| RV ESV (ml/min) | 63.1 ± 21.1 | 65.6 ± 24.4 | 0.69 |
| RV EF (%) | 62.4 ± 6.9 | 64.0 ± 6.3 | 0.36 |
| LA Area (cm ²) | 25.2 ± 5.5 | 27.0 ± 5.2 | 0.22 |
| RA Area (cm ²) | 22.1 ± 4.8 | 23.8 ± 4.8 | 0.20 |

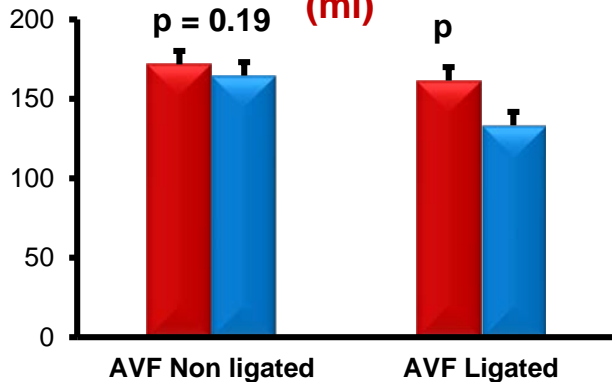
Data are mean ± SD

Primary end point

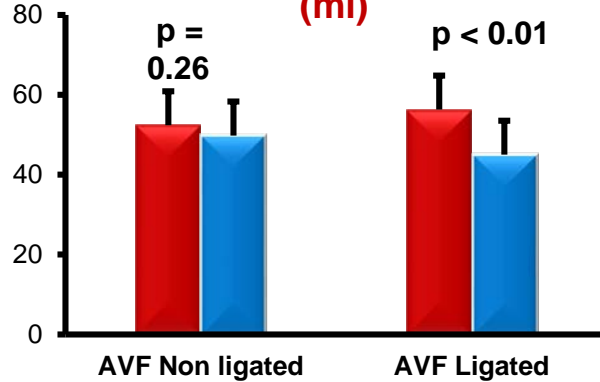


Indexed to BSA,
LVM reduction was
11.8 gm/m²
(95% CI 15.2 to 7.8);
p < 0.001

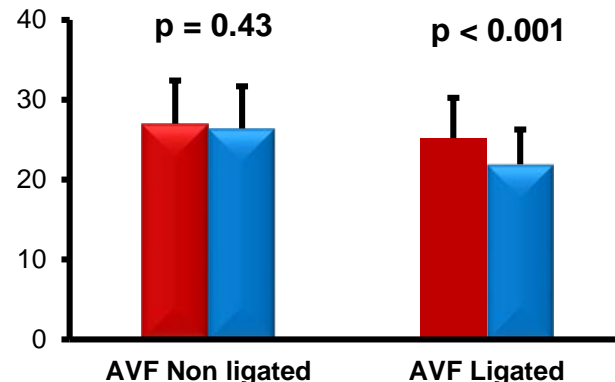
LV End Diastolic Volume (ml)



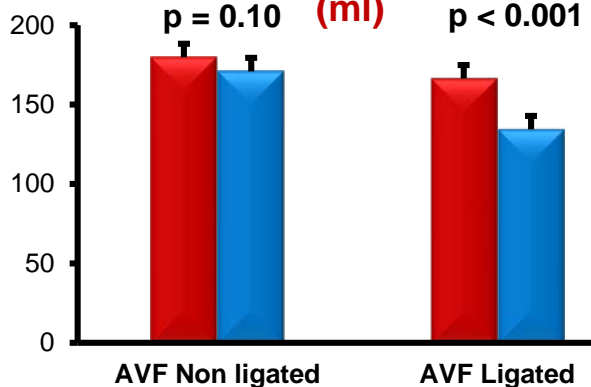
LV End Systolic Volume (ml)



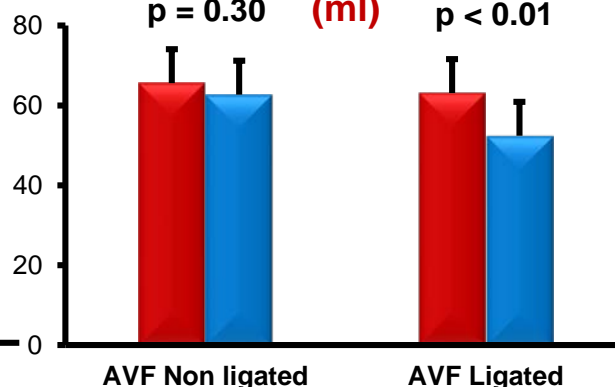
Left Atrial Area (cm²)



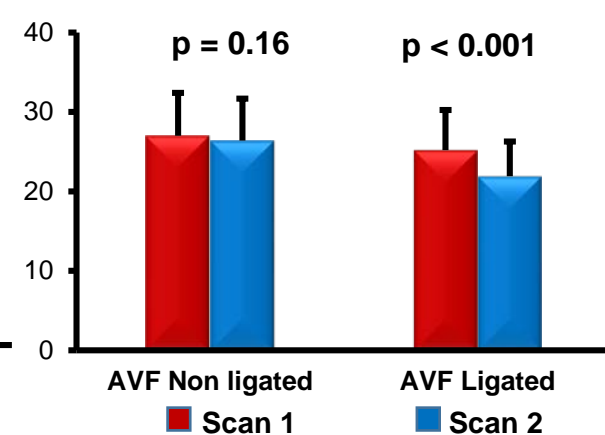
RV End Diastolic Volume (ml)



RV End Systolic Volume (ml)

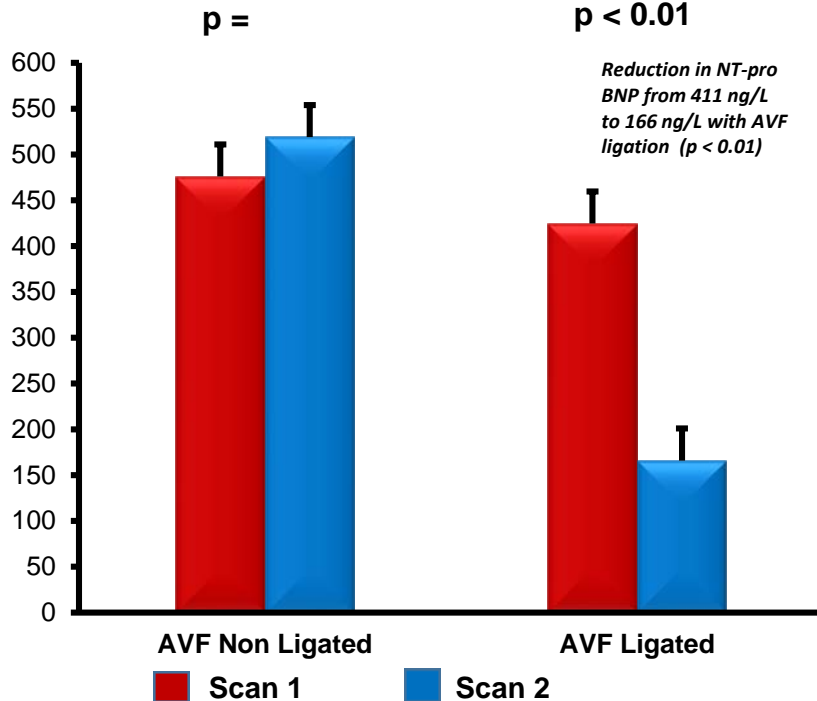


Right Atrial Area (cm²)

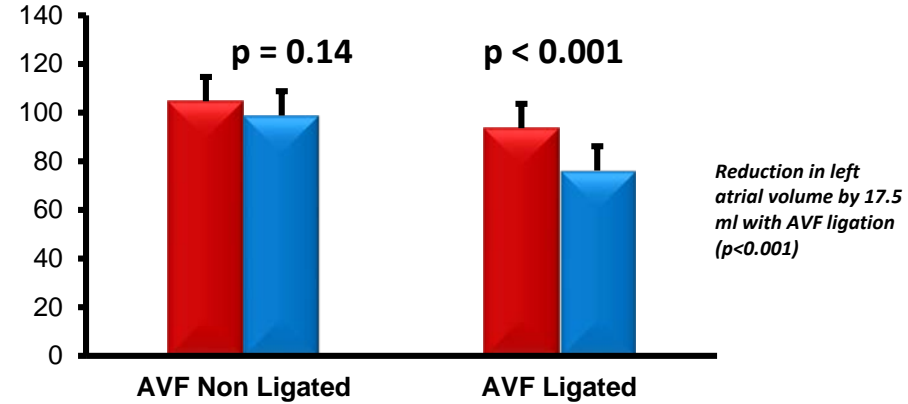


Secondary End Points:

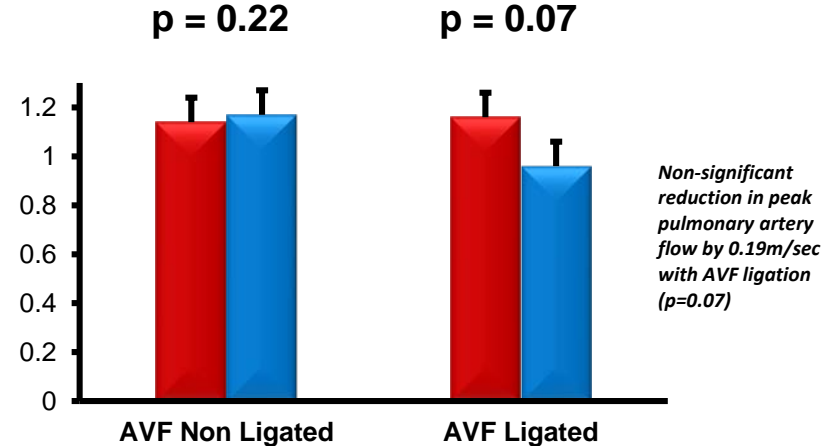
NT-pro BNP Level (ng/L)



Left Atrial Volume (ml)



Pulmonary Artery peak velocity (m/sec)



Complications of AVF Ligation

- **Thrombosis** causing pain and erythema over the proximal venous segment in 6 participants - resolved with rest and anti-inflammatory medication.
- **Infection** over the suture lines in 2 patients (managed with oral anti-microbial therapy).
- No patients required admission or surgical re-intervention
- There was **no significant change in eGFR at follow-up** comparing AVF ligation versus controls.

Summary:

Arteriovenous fistula ligation resulted in:

1. A significant reduction in LV mass
 2. A significant reduction in the volume of all four cardiac chambers
 3. A significant reduction in NT-pro BNP levels
- Control patients face persisting and substantial deleterious cardiac remodelling.
 - Further investigation would clarify the impact of AVF ligation on clinical outcomes following kidney transplantation.