Markers of haemolysis and renal tubular injury after catheter ablation for atrial fibrillation using pulsed field and radiofrequency energy

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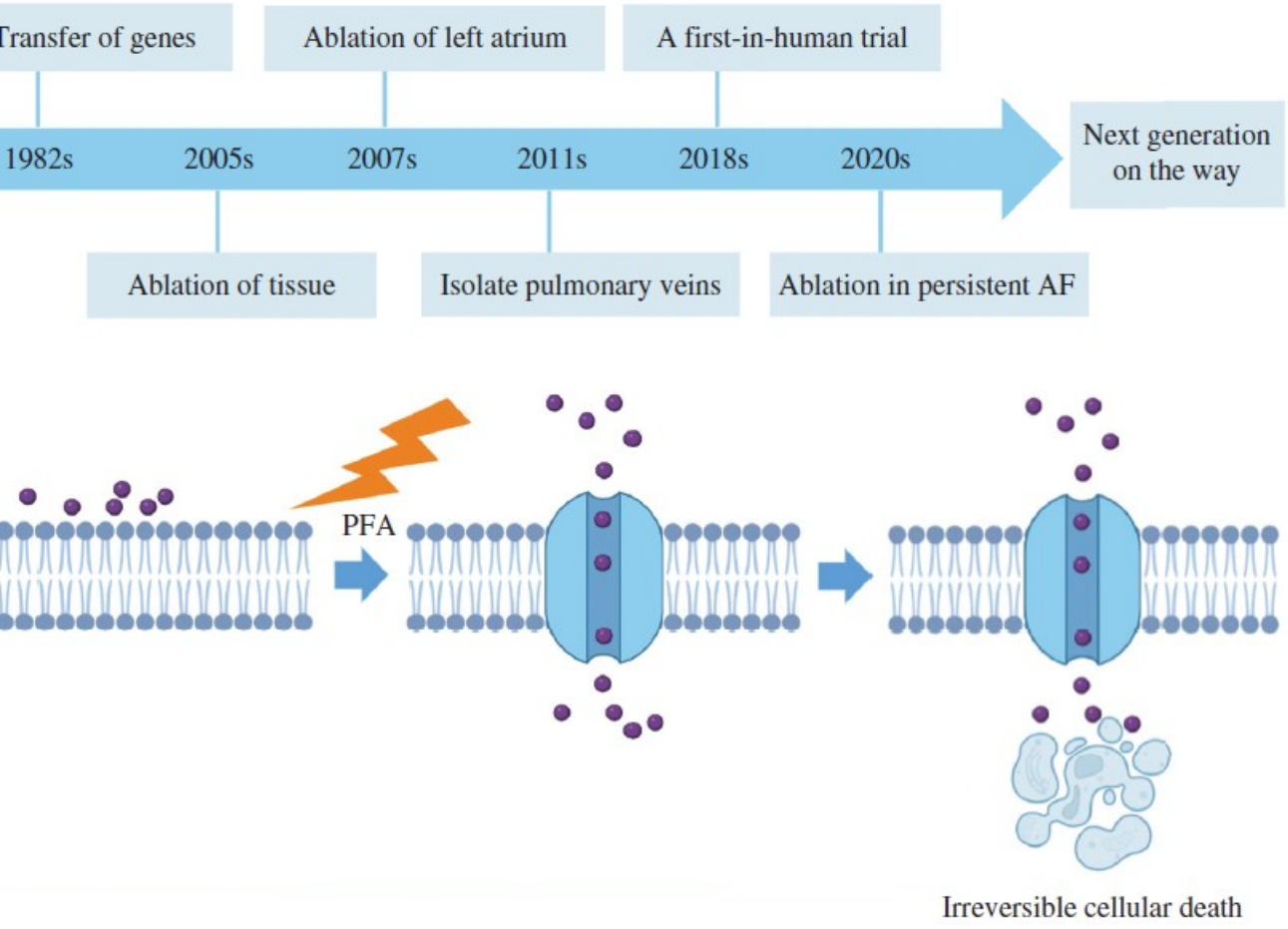
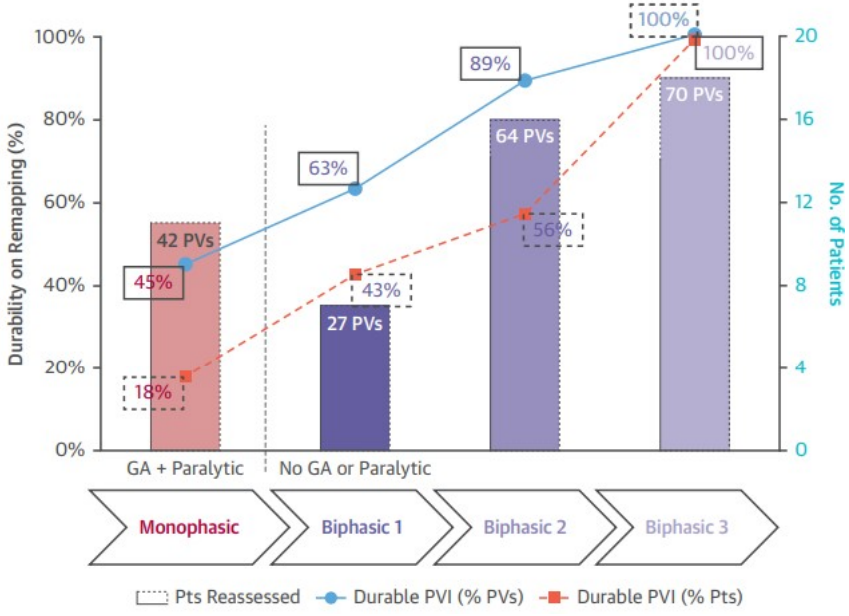
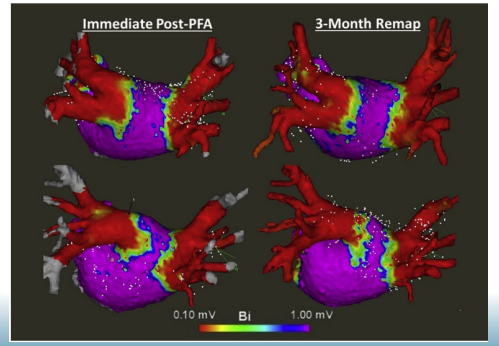
Introduction



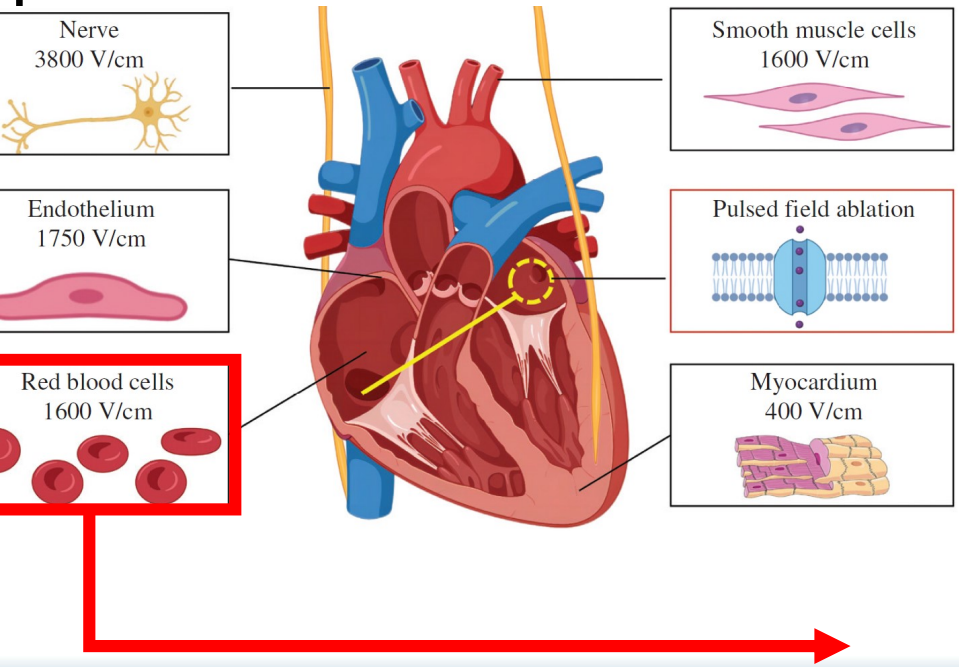


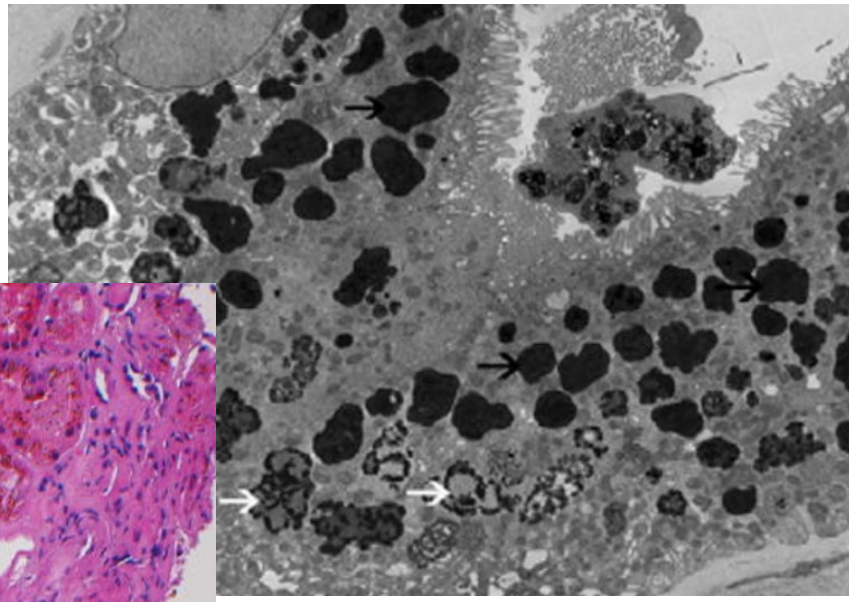


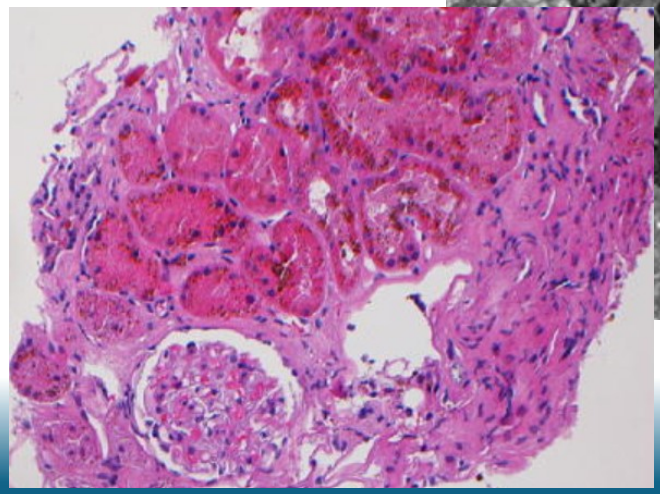
o et al., Advances in the Ablation for Arrhythmia Treatment, 2023
ddy et al., JACC, 2019

Introduction

owever, rare cases of ***acute renal failure secondary to tubular jury caused by intravascular haemolysis*** have been described ter PFA procedures with a very high number (> 100) of PF npulses

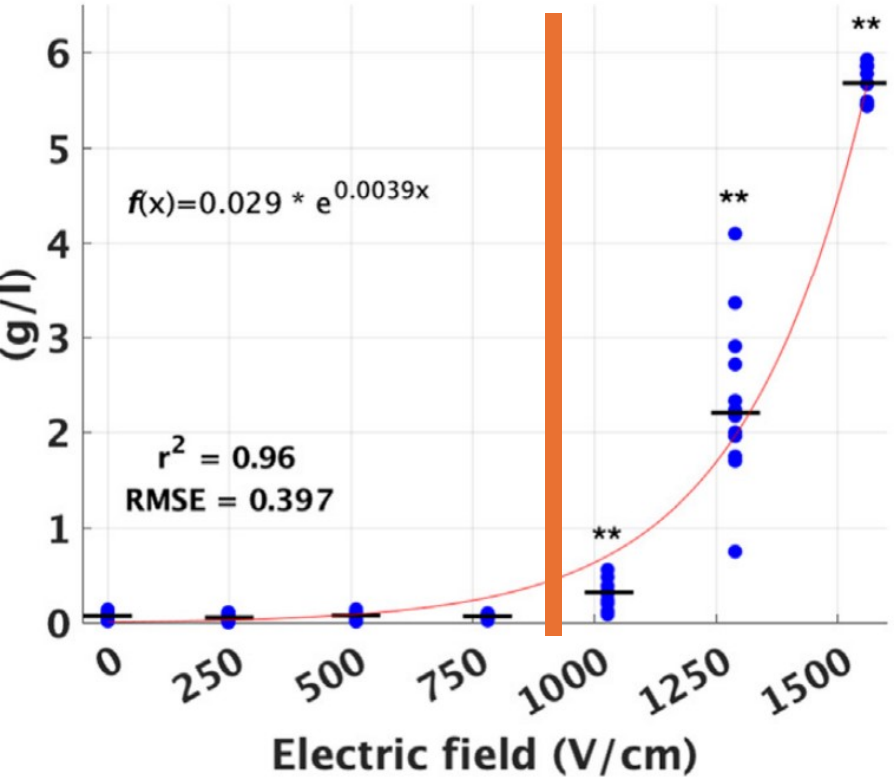


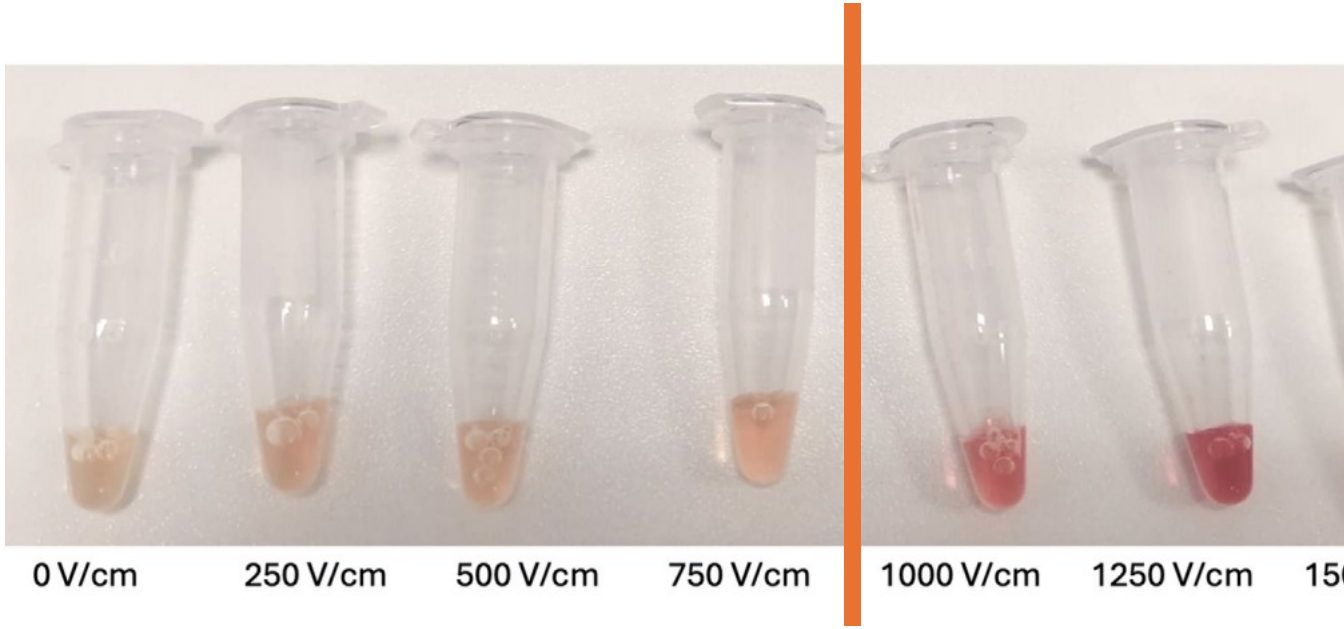




enier et al., Europace, 2023
Qian et al., Am J Kidney Dis. 2010

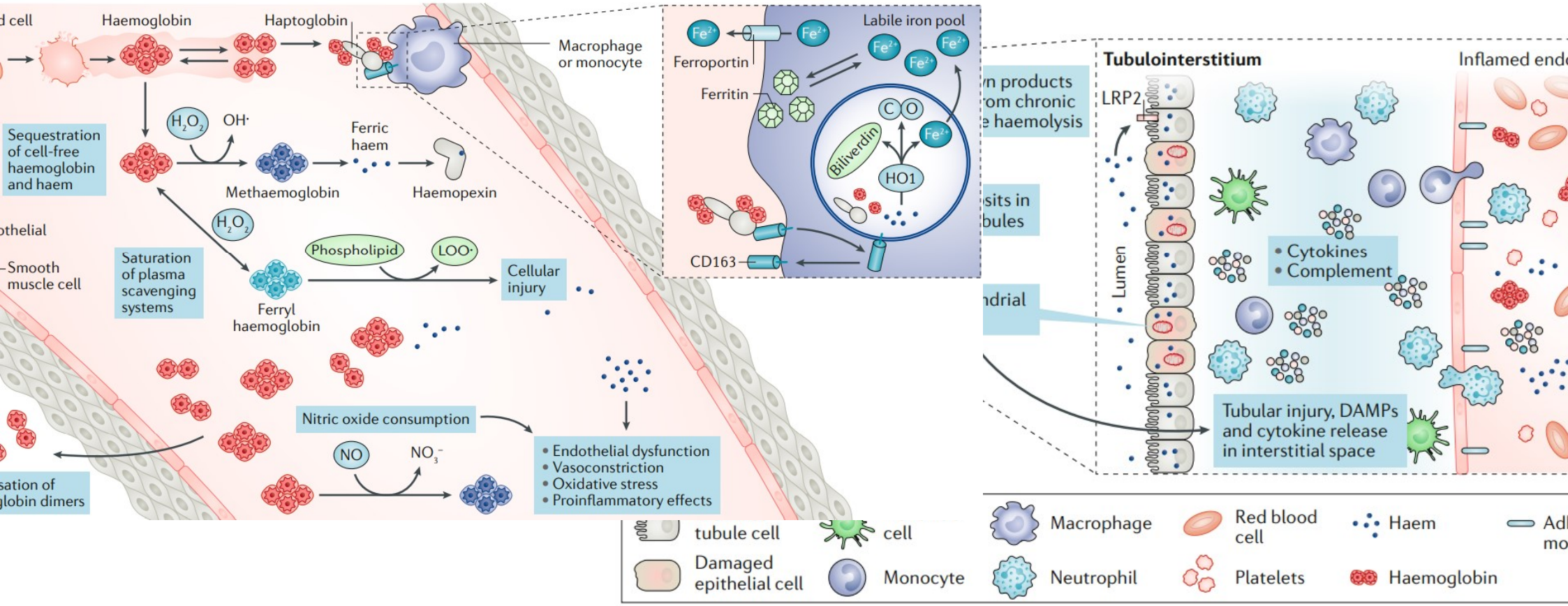
Introduction





Tiserova et al., Heart Rhythm, 2024

Introduction



Van Avondt et al., Nature Reviews Nephrology, 2019

Introduction

rrent AKI nomenclature	Description	Interpretation
Subclinical AKI	Tubular damage biomarker indicates damage, yet SCr is not elevated	• SCr is an insensitive marker of tubular damage • Elevation of SCr requires damage to >50% of ne mass. Damage to a portion of the kidney is not de
nsient versus sustaind AKI	• SCr elevatio ys versus SCr elevation >3 days[1] • SCr retu 10% of baseline versus >72 h of azotaemia • RIFLE-AKI d by 72 h versus RIFLE-AKI persisting ≥72 h	A single measurement of SCr at the time of patien encounter does not provide prospective informatio the kinetics of SCr; transient AKI includes volume al azotaemia), whereas sustaine
Severe AKI		ntitative tool only in steady state studies have demonstrated that ate with biomarkers of tubular inj
Subacute AKI		uscle, accumulates slowly in se tients cannot be diagnosed at the patient encounter using SCr criteria
Late onset AKI	• AKI occurring >7 days after birth • AKI occurring ≥5 days from admission • AKI occurring 48 h after admission	Optimal use of SCr requires correlating its values clinical cours

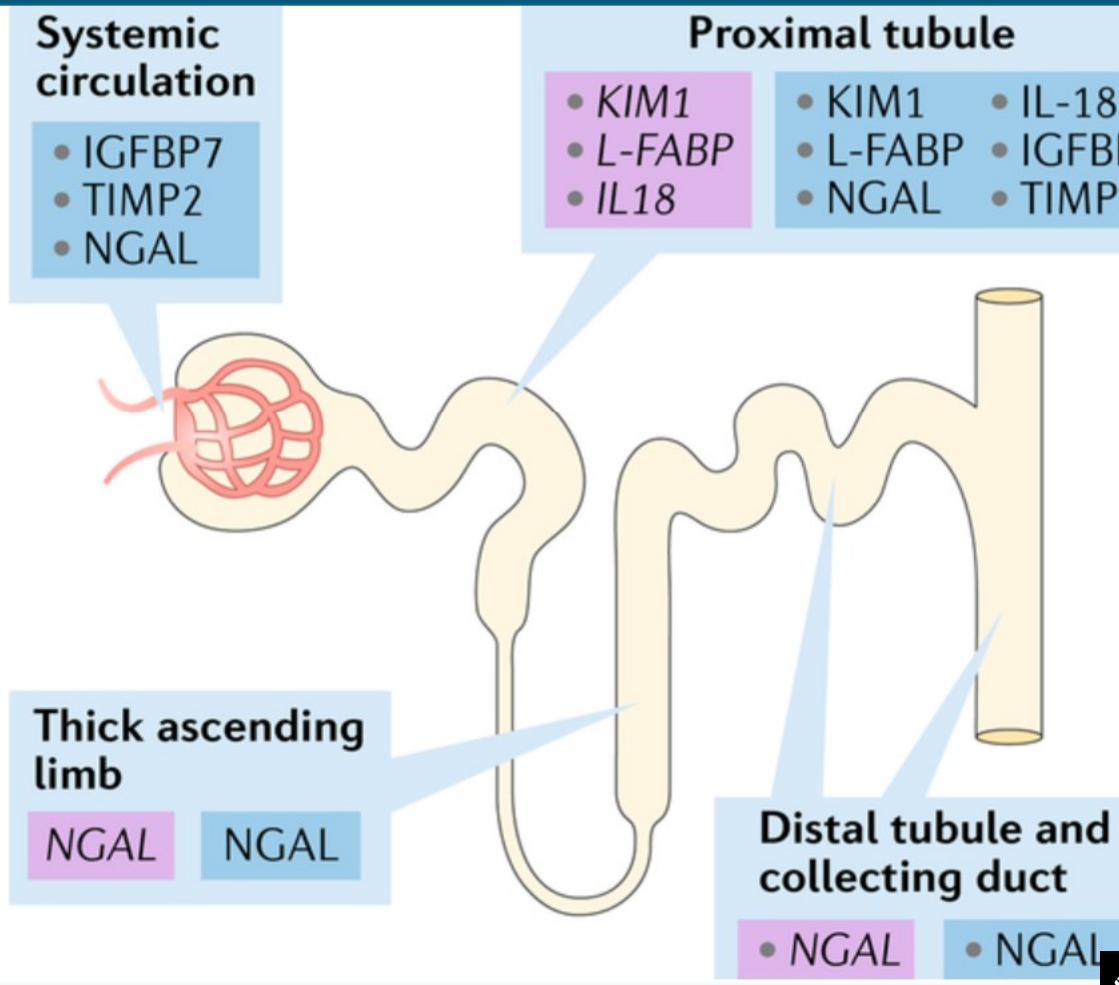
Alpha Glutathione S-Transferase, Kidney Injury Molecule 1, Clusterin, Cystatin C, Neutrophil Gelatinase-Associated Lipocalin, Osteopontin, (Micro)albumin

Rasi G Letter of support for drug-induced renal tubular injury biomarker(s). European Medicines Agency https://www.ema.europa.eu/en/documents/other/letter-support-drug-induced-renal-tubular-injury-biomarkers_en.pdf (2016).

esanti et al., Nature Reviews Nephrology, 2019

Introduction

e	Description	Serum levels elevated after injury
L	Expressed in renal tubular epithelial cells and released in case of cell damage.	After 2 hours
1	Not detectable in normal kidney tissue but expressed at high levels in proximal tubule epithelial cells after injury.	Within 12 hours



nti et al., Nature Reviews Nephrology, 2019
a et al., Lancet, 2005
Han et al., Kidney International, 2002

Aims of the study

To investigate the impact of ablation energy (**PFA vs. radiofrequency ablation (RFA)**) on the plasma concentration of:

(1) cell-free haemoglobin (CFH)
(2) and **markers of renal tubular injury: neutrophil gelatinase associated lipocalin and kidney injur molecule 1** (NGAL and KIM-1).

Methods

A prospective nonrandomized study that included a consecutive cohort of patients who underwent AF ablation (PFA of RFA) in one centre.

PFA procedures:

- Deep sedation / GA (LMA): propofol + sufentanil / remimazolam + ketamine
- A pentaspline Farawave catheter (Boston Scientific)
- Paroxysmal AF = PVI
- Non-paroxysmal AF = PVI + PW + Mi

RFA procedures:

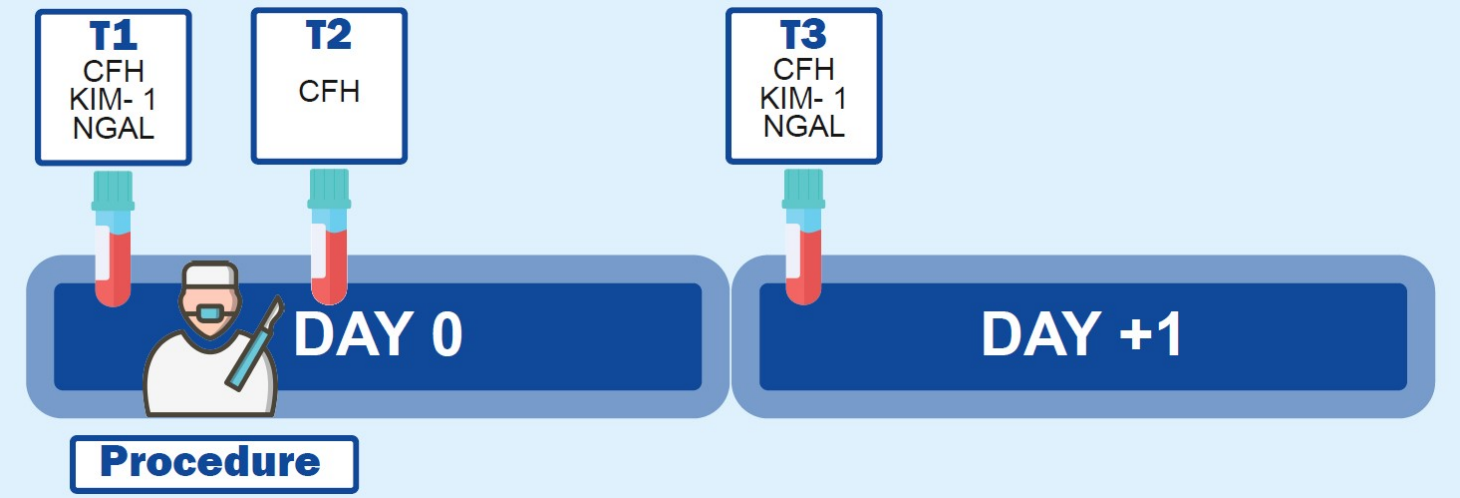
- CARTO 3 mapping system (JaJ Medtech)
- Ablation catheter SMARTTOUCH / QDOT (JaJ Medtech)
  - Ablation index 400 – 450 on the anterior wall, 300 – 350 on the posterior wall; high-power short-duration applications were avoided
- Paroxysmal AF = PVI
- Non-paroxysmal AF = additive lesions at the discretion of the operater

Methods

Blood samples:

- **T1**: CFH, NGAL, and KIM-1
- **T2**: CFH
- **T3**: CFH, NGAL, and KIM-1

The concentrations of CFH, NGAL and KIM-1were determined using the ELISA technique.



Results: Baseline characteristics

Characteristics	RFA group (N = 23)	PFA group (N = 47)	P - value
Paroxysmal AF, N (%)	14 (60.9)	27 (57.4)	0.99
Female gender, N (%)	9 (39.1)	19 (40.4)	1.00
Age, mean (SD), years	67.4 (10.2)	62.9 (9.70)	0.08
BMI, mean (SD), kg/m2	28.4 (4.0)	29.9 (5.1)	0.19
LA (PLAX), mean (SD), mm	43.3 (4.9)	41.8 (5.9)	0.30
LVEF, mean (SD), %	56.2 (12.1)	58.1 (6.0)	0.54
Hypertension, N (%)	13 (56.5)	35 (74.4)	0.21
Diabetes mellitus, N (%)	1 (4.3)	10 (21.3)	0.09
Coronary artery disease, N (%)	1 (4.3)	4 (8.5)	1.00
Baseline creatinine, mean (SD), µmol/L	91.7 (22.1)	88.8 (22.1)	0.44

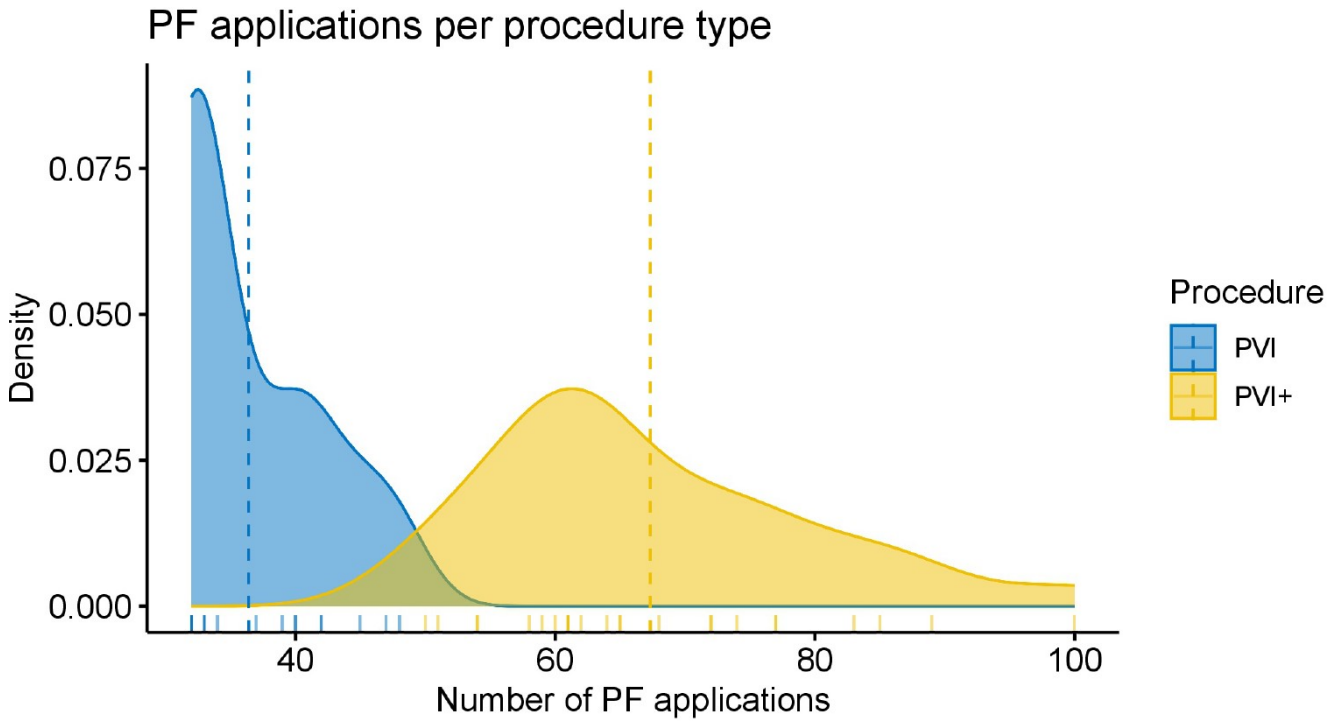
Calculated glomerular filtration rate:

PFA group: 5 (10.6%) stage 2 and 2 (4.3%) stage 3 (chronic kidney disease (CKD))

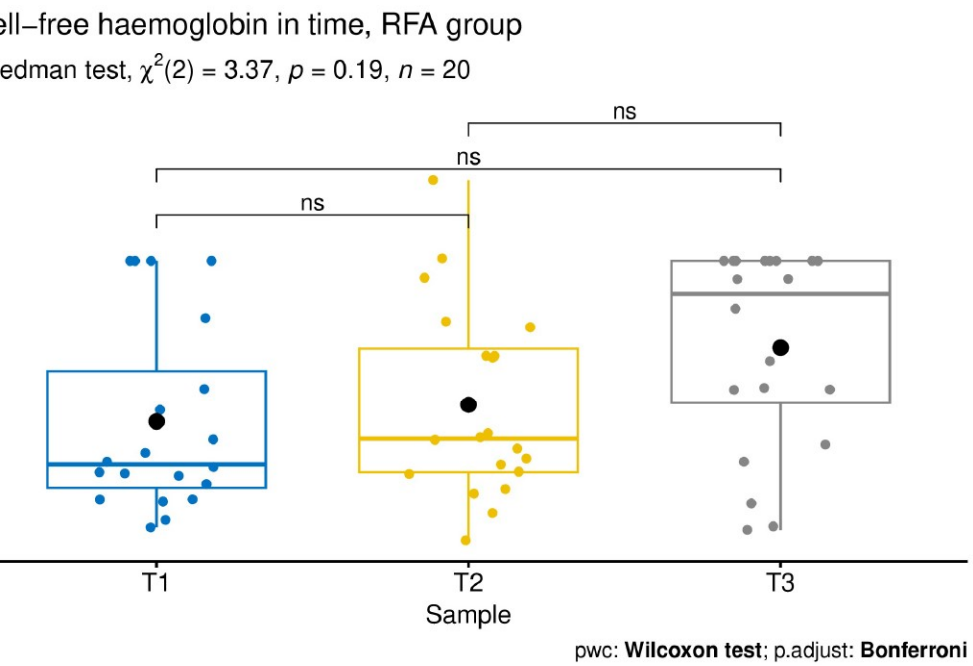
RFA group: 1 (4.3%) stage 2 and 2 (8.7%) stage 3 (CKD)

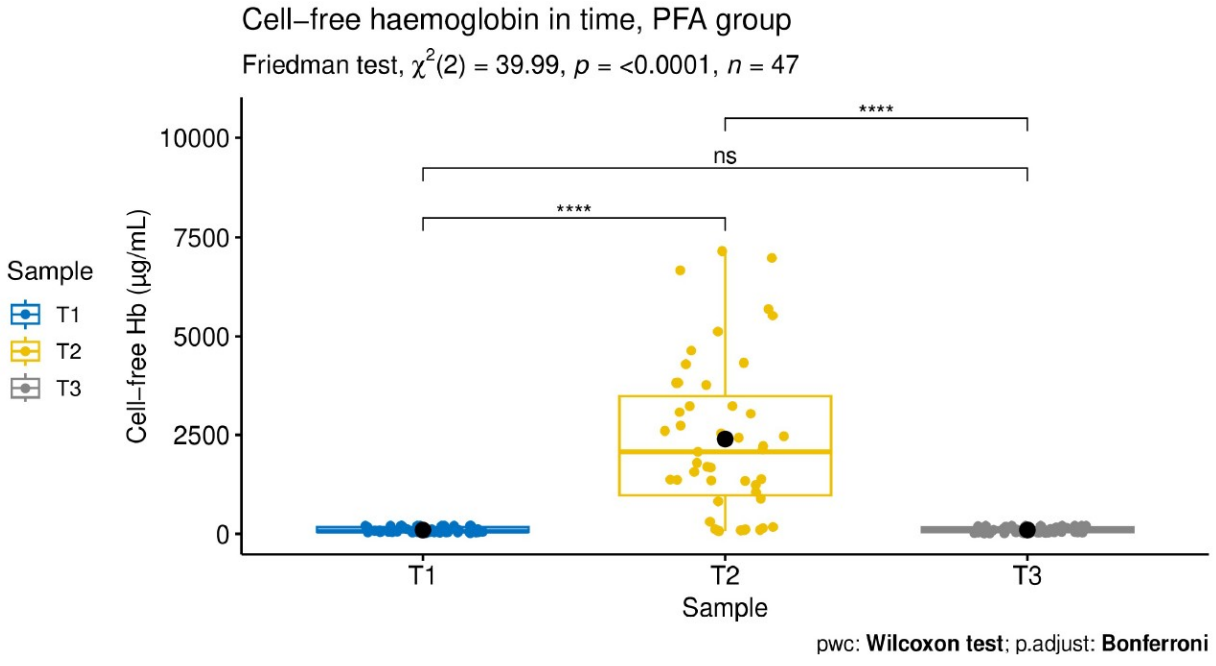
Results

23 subjects underwent RFA and 47 PFA (***mean number of PF impulses 52.85 ± 18.37, range 32-100***).



Results: CFH

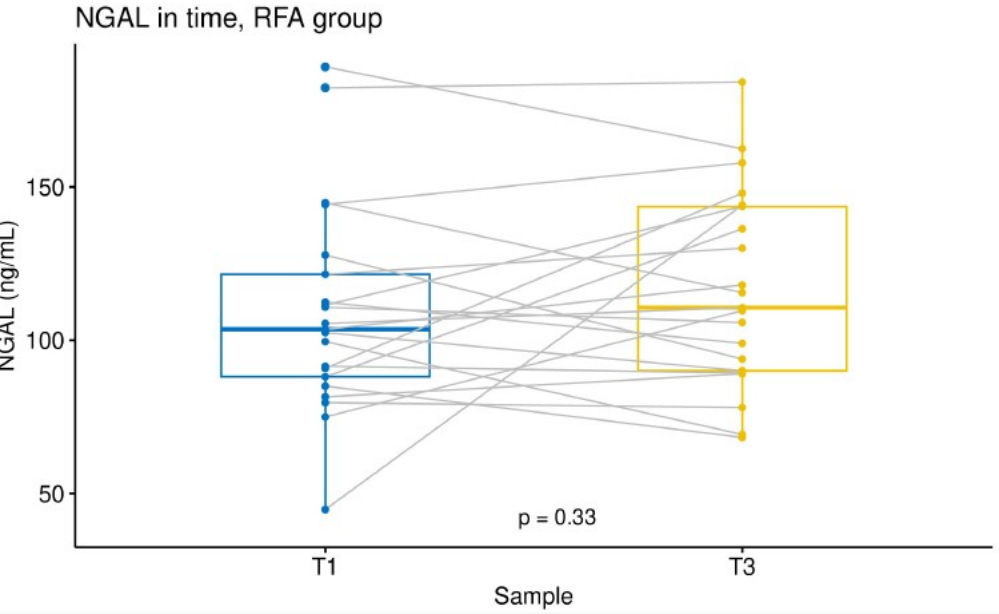


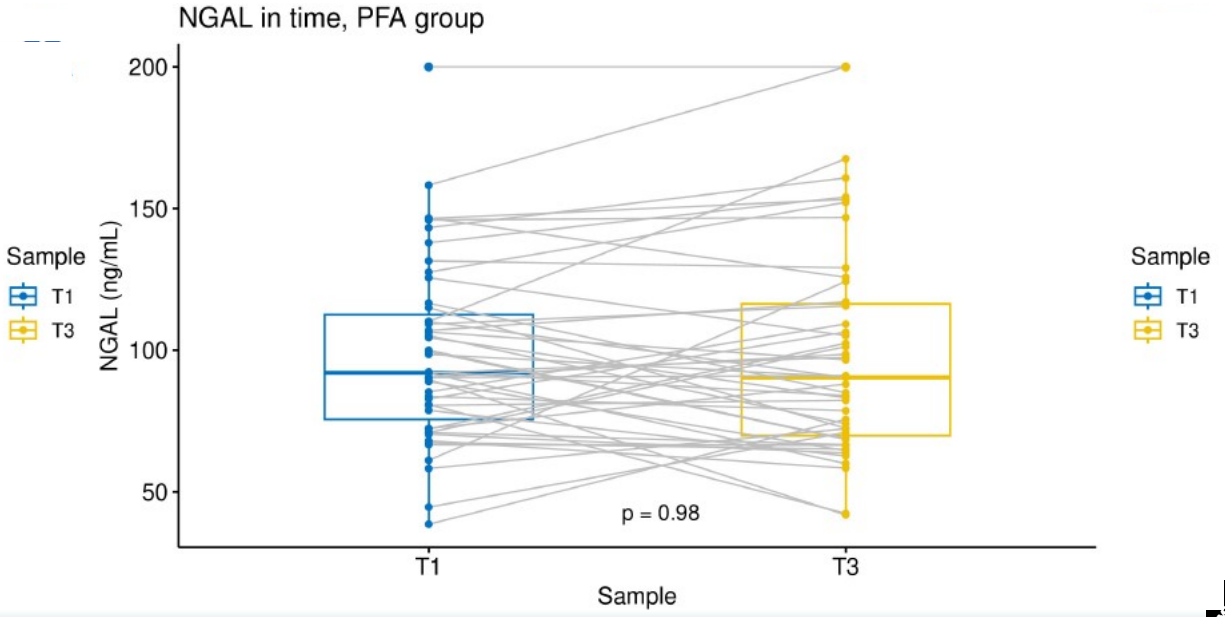


e PFA cohort, a significant increase in CFH concentration was observed immediately after ablation w
oid decline to baseline values one day after the procedure (93.4 ± 65.1 µg/mL vs. 2394.9 ± 1966.1 µg/mL v
± 68.5 µg/mL P < 0.001).
ignificant periprocedural increase in CFH concentrations was observed in the RFA cohort.

Results: NGAL

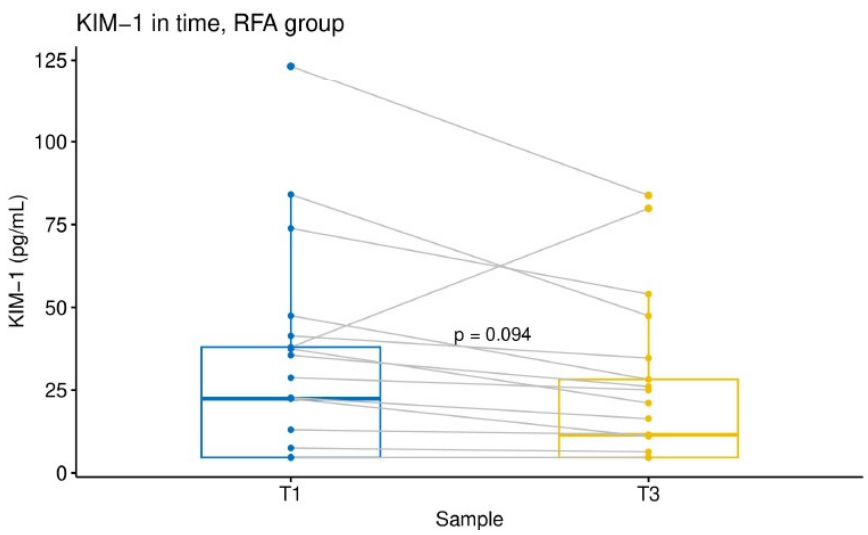
Biomarker	RFA group (N = 21)		P - value	PFA group (N = 47)		P - value
	T1	T3		T1	T3	
NGAL, mean (SD), ng/mL	108.3 ± 33.8	116.3 ± 32.2	0.49	98.6 ± 31.7	98.5 ± 38.1	0.78

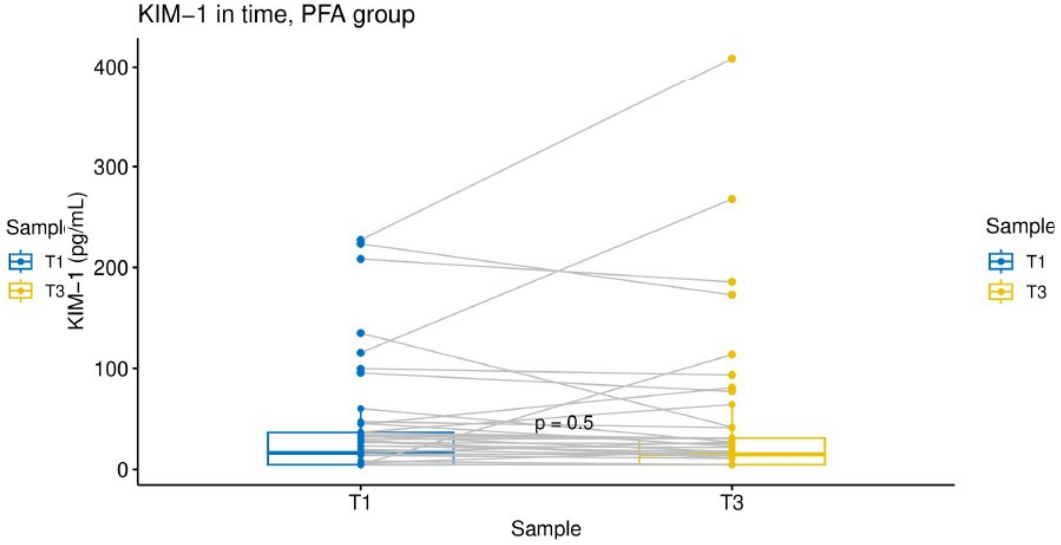




Results: KIM-1

Biomarker	RFA group (N = 21)		P - value	PFA group (N = 47)		P - value
	T1	T3		T1	T3	
NGAL, mean (SD), ng/mL	108.3 ± 33.8	116.3 ± 32.2	0.49	98.6 ± 31.7	98.5 ± 38.1	0.78
KIM- 1, mean (SD), pg/mL	29.2 ± 31.7	23.0 ± 24.4	0.09	38.4 ± 56.8	42.6 ± 76.4	0.50





mpared to baseline, **neither the PFA nor the RFA group showed a significant increase in NGAL or KIM** centrations postoperatively.

Study limitations

imitations:

1. Serum concentration of biomarkers analysed

   Urine analysis more sensitive

2. Nonrandomised study
3. Lower mean number of PF applications

   More than 70 applications seem to have better sensitivity and specificity to predict haemolysis

4. Long-term follow-up data missing

Conclusions

ompared to RFA, PFA leads to significant periprocedural haemolysis.

owever, no increase in markers of renal tubular injury was observed i
cohort in which the total number of PF applications was less than 10