Microdissection of the Human Renal Nervous System: Implications for Performing Renal Denervation Procedures

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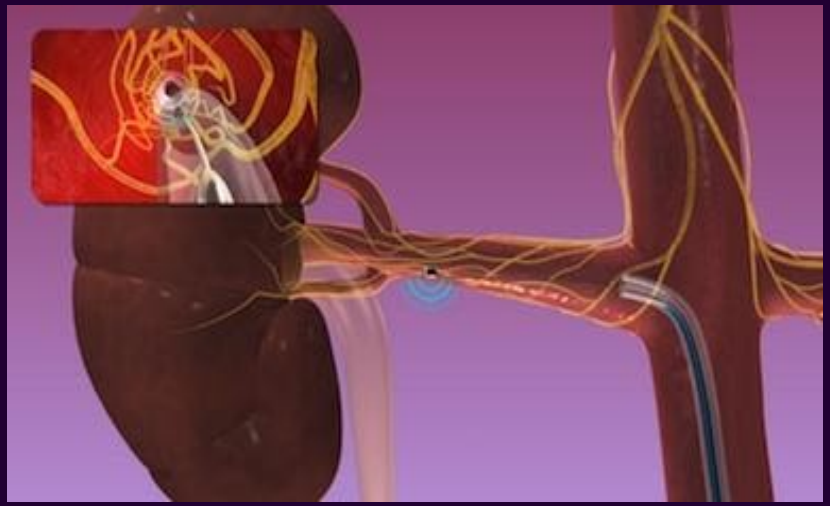
Disclosure Statement of Financial Interest

I, Dr García Touchard DO NOT have a financial interest/arrangement or affiliation with one or more organizations that could be perceived as a real or apparent conflict of interest in the context of the subject of this presentation.

Introduction



Despite the use of renal denervation to treat hypertension, the anatomy of the renal nervous system remains poorly understood

Incomplete or suboptimal renal denervation procedures due to a lack of detailed knowledge of the RNS anatomy could explain why some patients may not experience significant blood pressure drop following renal denervation

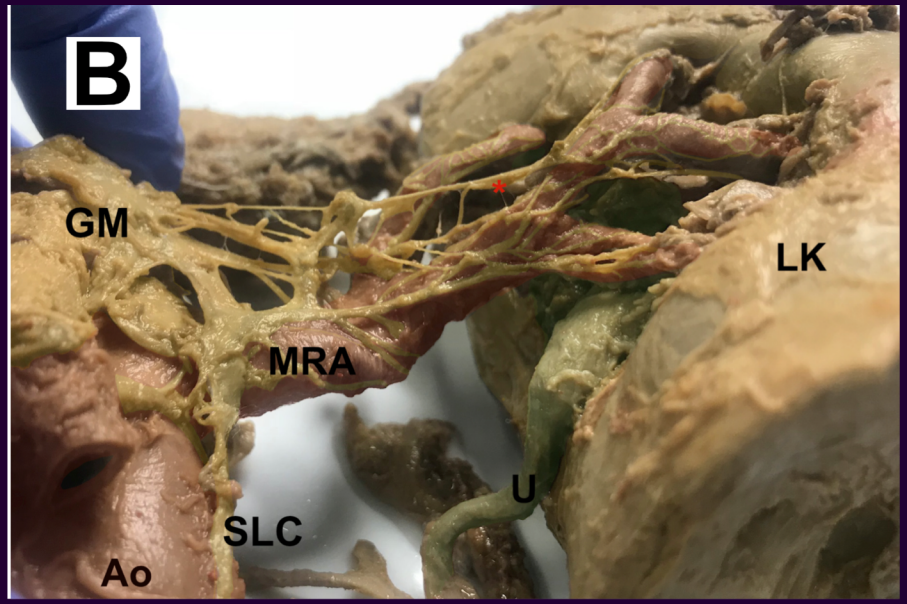
Objetives

- To performed a detailed quantitative analysis of the human renal nervous system anatomy
- With the goal of optimizing renal denervation procedural safety and efficacy

Methods

- Sixty kidneys from 30 human cadavers were systematically microdissected
- Cadavers including 60 kidneys were randomly sampled from the Center of Body Donations of the Universidad Complutense. Madrid. Spain
- Dissections were performed following standards protocols
- We quantify anatomic variations in renal nerve patterns
- A digital caliper with calibration certification was used to measure all diameters and lengths.

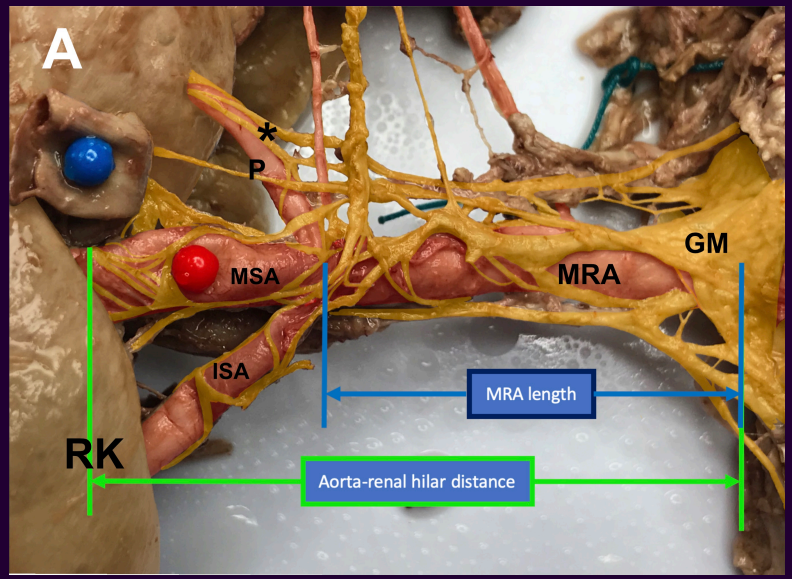
RESULTS
LATE ARRIVING NERVES



- Not all renal innervation followed the main renal artery
- Renal nerves (late arriving nerves) frequently reached the kidney bypassing the main renal artery

LANs: 73% of the right kidney and 53% of the left kidney

RESULTS



Ratio

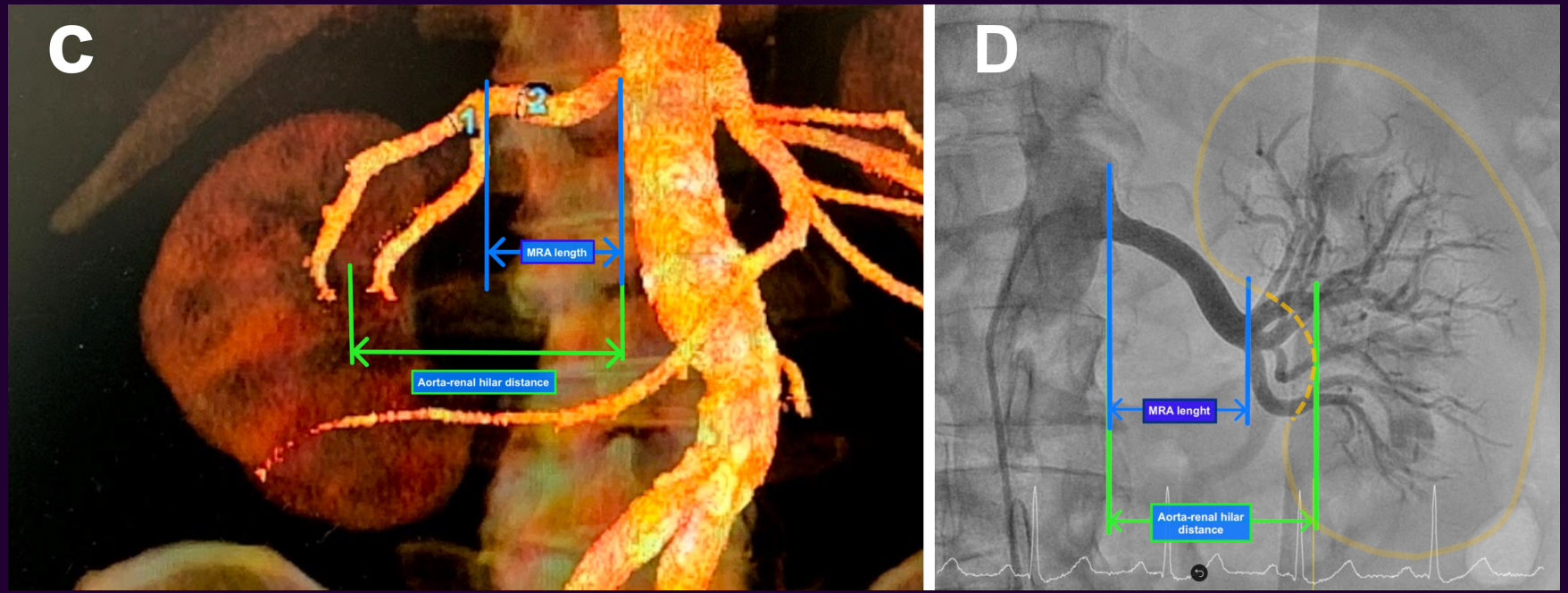
$$\frac{\text{Main renal artery length}}{\text{Aorta-renal hilar distance}}$$

Proved to be a useful variable to identify the presence/absence of these late arriving nerves

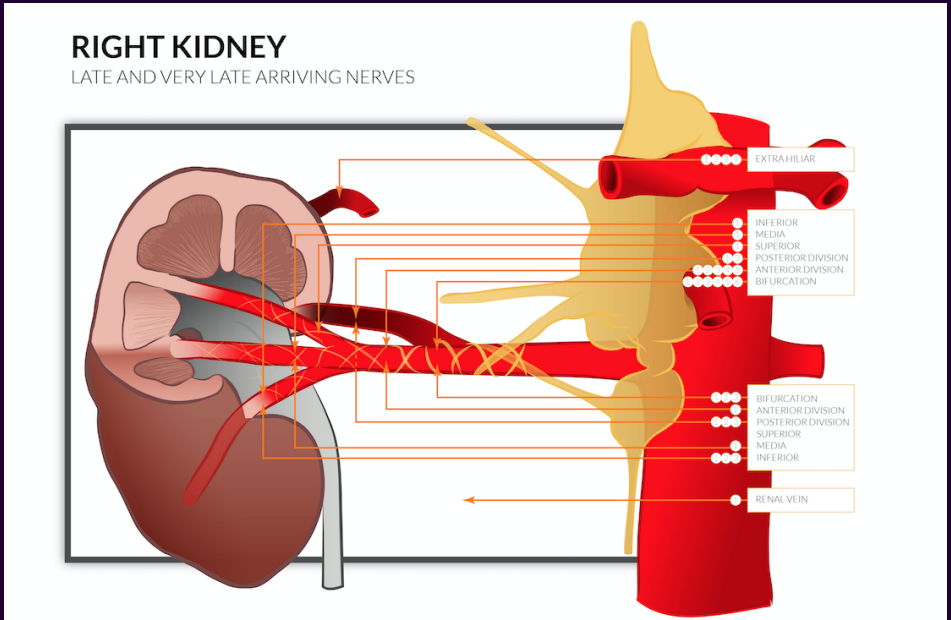
- ***Odds ratio, 0.001 (95% CI, 0.00002–0.0692; P: 0.001)***
- ***Cutoff of 0.75***
  - ***sensitivity: 0.68, specificity: 0.83, area under ROC curve at threshold: 0.76***

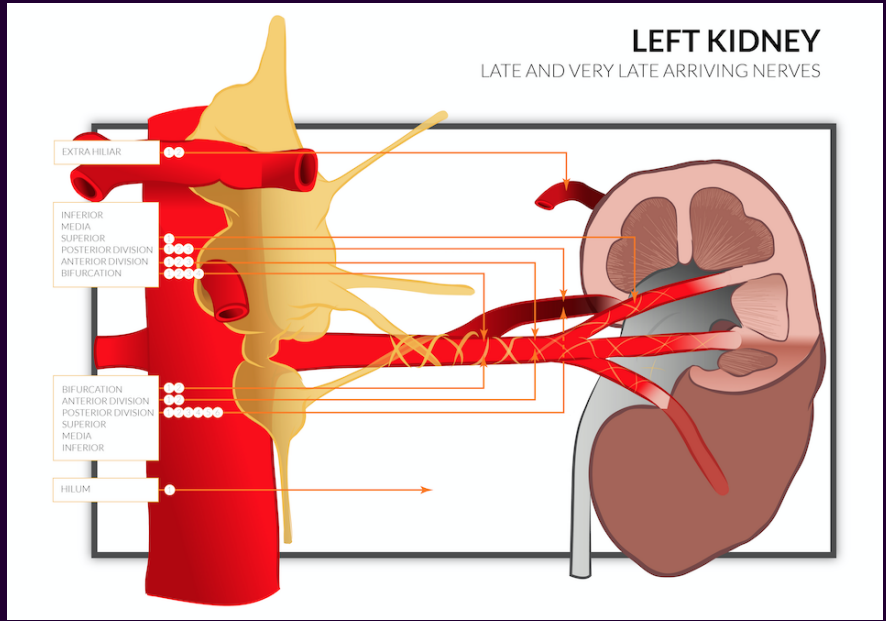
RESULTS

Ratio of the main renal artery length/aorta-renal hilar distance

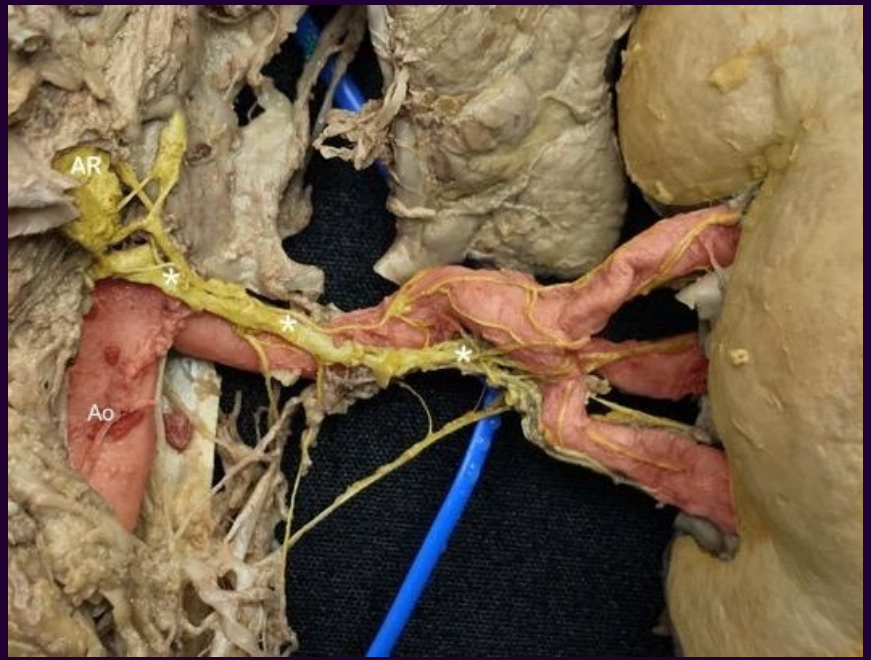


RESULTS
LATE ARRIVING NERVES



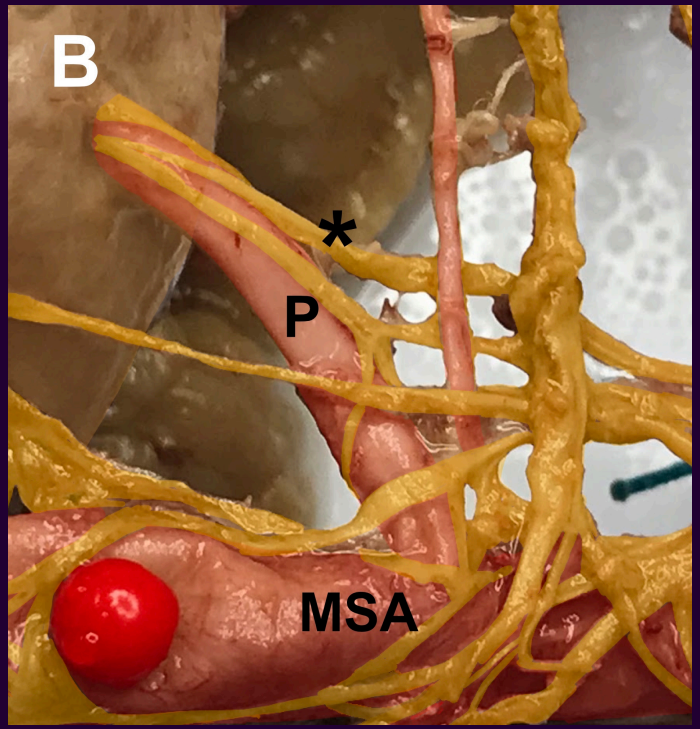


RESULTS
Renal innervation



- Renal nerves conforming the classical “basket” type arrangement from the MRA origin in only 16.6% of the cases
- Large nerve bundles instead of (or in addition to) the classical renal nerve plexus in all cases

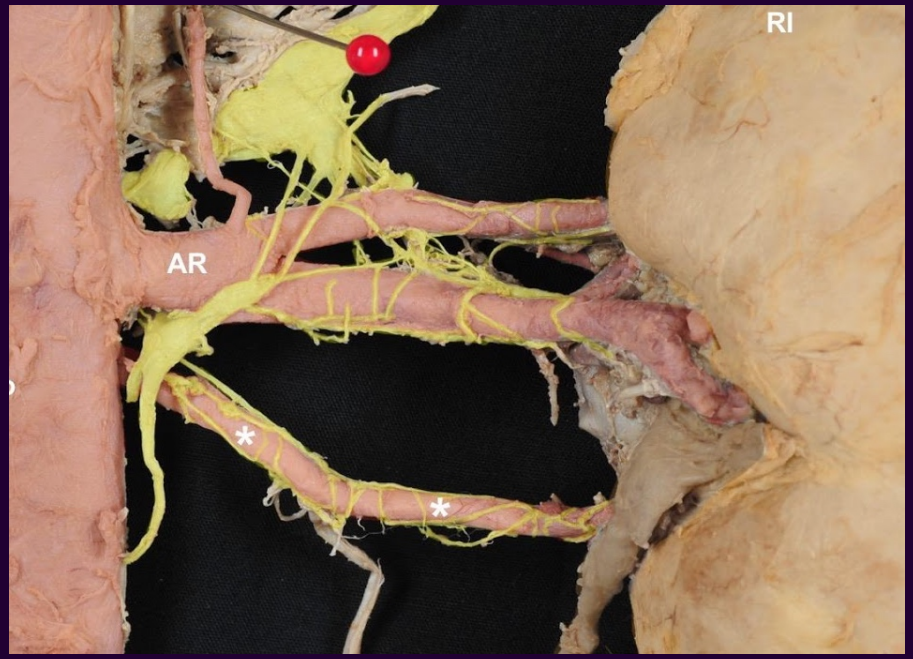
RESULTS



Polar arteries

- Relatively frequent (15% of the kidneys)
- When present, were also highly associated with the presence of late arriving nerves

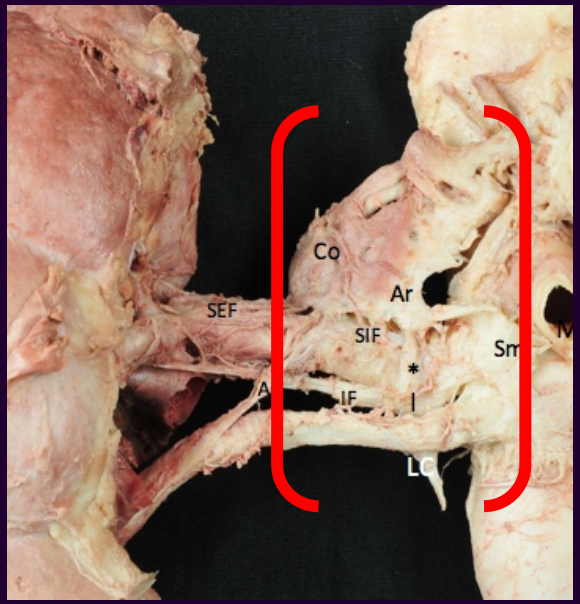
Results



Multiple renal arteries

- **Relatively frequent (30%)**
- **All highly innervated**
- **None had LAN**

RESULTS
Proximal Main Renal Artery



Frequently occupied by:

1. Fused ganglia from the solar plexus

- **right kidney: 53%**
- **Left kidney: 83%**

2. Lumbar sympathetic chain

- **Right kidney: 63%**
- **left kidney: 60%**

Both carried innervation
to the kidneys
but importantly also to other abdominal and pelvic organs, which can be accidentally denervated if the proximal renal artery is targeted for ablation

Conclusions

1. Contrary to current clinical perception, not all renal innervation goes through the MRA
2. Renal nerves conforming the classical “basket” type arrangement from the MRA origin is very uncommon
3. The renal innervation pattern can be statistically predicted based on the renal arterial vascularization (ratio, MRA lengh, polar arteries…)
4. Notably, the proximal MRA is frequently accompanied by ganglia from the solar plexus and/or by the lumbar sympathetic chain.
    1. They carried innervation to the kidneys but importantly also to other abdominal/pelvic organs, which can be denervated if the proximal renal artery is targeted for ablation.

Conclusions

- Our present results suggest that a prospective ablative strategy based on our vascular-neuro anatomic correlations could improve procedural response to RDN compared to current empirical strategies
- This hypothesis requires further prospective evaluations

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