

## Introduction

Ultrasound-guided kidney biopsies are routine procedures in diagnosing and managing renal diseases, offering a minimally invasive approach with high diagnostic yield.<sup>1</sup> However, mastering these techniques requires procedural training to ensure proficiency and minimize complications. Traditional training methods, such as simulation models and virtual reality simulations, may not fully replicate the anatomical structures or properties of real tissue. Therefore, there is a need for practical training approaches that provide a high-fidelity simulation environment.

Cadavers have previously demonstrated to be effective training tools for ultrasound-guided procedures, but this study aims to compare how preservation technique effects trainee confidence and procedural accuracy.<sup>2</sup> Our study addresses this by comparing the efficacy of four different cadaver preservation methods as training tools for ultrasound-guided kidney biopsies: traditional embalming, Thiel surgical reality, Genelyn custom fluid blend, and GreenMBalm anatomical training blend. By comparing these methods, we hope to identify the optimal choice of cadaver for enhancing procedural skills and confidence among medical trainees.

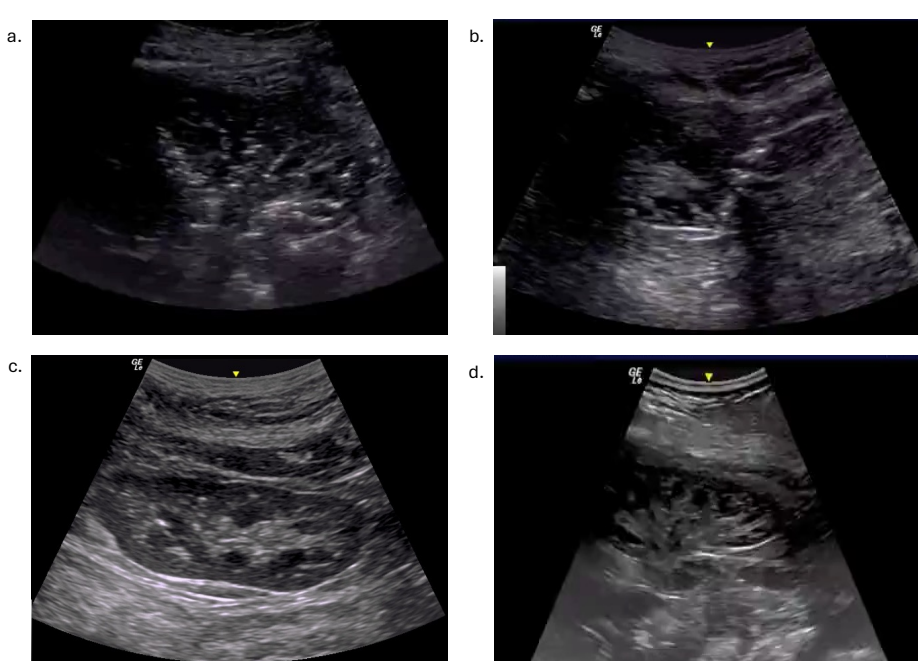


Figure 1: Cadaver US images of kidneys – a. Traditional preservation, b. Thiel surgical reality preservation, c. GreenMBalm anatomical training blend, d. Genelyn custom fluid blend

## Methods

Two procedural training workshops were held with cadavers with four different types of preservation methods.

- Twenty-nine first- and second- year medical students were recruited by email.
- Participants were instructed on basic kidney anatomy and the steps of performing ultrasound-guided renal core biopsies with a formal instructional presentation by an interventional radiologist.
- Before performing a biopsy, participants were able to practice manipulating the US probe and core biopsy needles with instruction.
- Participants were randomized to which cadaver they biopsied first.
- Participants also answered pre- and post-workshop surveys to determine participant confidence in performing the procedure after this training method.

The collected biopsy samples were histologically examined by a pathologist to determine whether the sample was procured from the cortex or the medulla.

- Glomeruli count was utilized as a measure of procedural accuracy and quality of ultrasound visualization.

Statistical analysis was conducted to compare pre/post-survey scores to assess differences in procedural confidence and to compare glomeruli counts as a measure of procedural accuracy between different cadaver preservation methods.

## Results

### Survey Results:

- 100% of participants reported improved procedural confidence after completing hands on procedural training
- Participants trained with Thiel, Genelyn, and GreenMBalm cadavers exhibited statistically significant increases in confidence levels ( $p < 0.05$ ) based on pre/post-survey scores.

### Glomeruli Counts:

- Furthermore, analysis of mean Glomeruli count, as a measure of procedural accuracy, showed no significant differences between traditional and Thiel cadavers, or between GreenMBalm and Genelyn cadavers.
- However, a significant difference was observed in mean Glomeruli count between traditional and Genelyn cadavers ( $p < 0.05$ ), indicating potential differences in tissue properties and procedural outcomes based on visualization quality

	Traditional Cadaver	Thiel Cadaver	Green Cadaver	Genelyn Cadaver
Mean Glomeruli Count	8.94117647	12.0588235	19	20.3
Median Glomeruli Count	8	12	19.5	19.5
Standard Deviation	6.51412492	12.8572479	8.81917104	7.68909762

Figure 2: Descriptive statistics of glomeruli counts by cadaver type

Comparison	p-value	Conclusion
Traditional vs. Thiel	0.1647	No significant difference in mean Glomeruli count (Matched t-test)
Green vs. Genelyn	0.3896	No significant difference in mean Glomeruli count (Matched t-test)
All Cadavers	0.0101	Only the traditional and Genelyn cadavers show a significant difference in glomeruli count (ANOVA with Tukey's HSD)

Figure 3: Differences between glomeruli count between workshops/cadaver types

## Conclusion

- The qualitative survey data highlights the perceived benefits of alternative preservation methods in improving participants' confidence levels in performing the procedure over traditional cadaver preservations.
- Furthermore, the analysis of mean Glomeruli count suggested potential differences in the effect of cadaver choice on future procedural outcomes.
- While certain preservation methods may offer advantages in enhancing procedural confidence, differences in tissue properties may influence procedural accuracy and patient outcomes.
- These findings underscore the importance of selecting the most effective cadaver preservation method for procedural training, considering factors such as fidelity, realism, and procedural outcomes.
- Future research should explore the long-term impact of cadaver preservation methods on procedural proficiency and clinical performance.

## References

1. Uppot RN, Harisinghani MG, Gervais DA. Imaging-Guided Percutaneous Renal Biopsy: Rationale and Approach. *American Journal of Roentgenology*. 2010;194(6):1443-1449. doi:<https://doi.org/10.2214/ajr.10.4427>
2. Meek ME (Mollie), Meek JC, Hollowoa B, Li R, Deloney LA, Phelan KD. Lightly Embalmed Cadavers as a Training Tool for Ultrasound-Guided Procedures Commonly Used in Interventional Radiology. *Academic Radiology*. 2018;25(11):1503-1509. doi:<https://doi.org/10.1016/j.acra.2018.05.019d>

## Acknowledgements

Thank you to the ETSU Quillen Anatomy lab, Dr. Klosterman, Heidi Corrubias, and Tiffany Gasperon for sharing their resources and time. Thank you to the ACR for letting us share our project.