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A durable, realistic, low-cost training model for percutaneous renal access using ballistic gelatin

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INTRODUCTION AND OBJECTIVES: The purpose of this study was to design and implement a durable, realistic, and low-cost phantom kidney model for percutaneous renal access that could improve a novice surgeon's technical skills without compromising patient safety.

METHODS: Ballistic gelatin (10% gelatin powder, 60% water by weight) mixed with radiographic contrast (30% contrast) was poured into surgical gloves to create a radio-dense renal collecting system. Calyceal length was adjusted by tying off the fingers of the gloves with silk sutures and the infundibular width was narrowed using half inch electrical tape. The collecting systems were then embedded in the bottom of a 9.5 x 5 x 2.5 cm pure 10% ballistic gelatin block resting upon a clear acrylic glass base. Finally, the model was covered by a visually opaque polyfoam cover with 10 x 1.5 x 1.5 cm chalk sticks embedded between layers of polyfoam to simulate ribs. Experienced attending urologists and interventional radiologists, urology residents, and novice medical students used the model to access the upper, middle, and lower renal calyces under fluoroscopic guidance. Successful puncture was confirmed by direct visualization through the clear base. Primary outcomes included model cost and durability. Model realism was rated by resident and attending physicians using a Likert scale (1-10).

RESULTS: The ballistic gelatin model was durable and anatomically realistic. Each model sustained over 200 needle punctures with no significant compromise in structural integrity. The ribs provided radio-opaque barriers to needle insertion, and the gelatin contrast allowed repeat punctures without contrast leakage. The total cost for 5 models was $300. Attending urologists rated fluoroscopic calyceal visualization, rib realism, and overall realism highly. Residents and attending urologists considered it to provide an accurate simulation of renal access (8.3/10 residents vs. 9.7/10 attendings) as well as a practical training modality (8.4/10 residents vs. 9.3/10 attendings).

CONCLUSIONS: The ballistic gelatin-based training phantom provided a durable, realistic, and low-cost renal access training model. Phantom use could allow trainees to develop skills without compromising patient safety.

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