at 3 months (**Fig d**) demonstrated a 70% reduction in prostate volume to 39 cm^3 with 1 residual 2.5-cm stone. The quality-of-life score was 1 (pleased), and a cystolitholapaxy is planned to remove the stone.

At the present time, there are no urologic guidelines or algorithms specifically stated by the American Urological Association or European Association of Urology for the treatment of bladder calculi. Surgical management is individualized to each patient with the urologist considering the size of calculi and that of the prostate. Combined cystolithotomy and transurethral resection of the prostate is considered the treatment of choice for patients presenting with multiple or large stones (2). However, there are challenges to the current dogma that bladder calculi are associated with or secondary to chronic bladder outlet obstruction. Millán Rodríguez et al (3) demonstrated that although multifactorial, bladder stones are not always associated with bladder outlet obstruction. Furthermore, urodynamics and uroflowmetry studies demonstrated no statistical differences before and after stone removal. Therefore, the conventional dogma of outlet obstruction correction at the same time as bladder stone removal may not be necessary.

The rapid expulsion of bladder stones after PAE in this case was unexpected. Immediate prostate shrinkage within this time frame is implausible. A possible explanation is that after PAE there is an immediate change in the texture of the prostate gland through coagulative necrosis facilitating passage of stones through the prostatic urethra. During the initial few days following PAE, the architecture of the infarcted tissue remains intact, which could account for the same volume of prostatic tissue. Immediate prostatic necrosis following PAE has been shown, as reflected by a dramatic increase in prostate-specific antigen relative to baseline 24 hours after PAE (4). Additionally, faster than expected results have been shown following PAE where a Foley catheter was removed 1 day after the procedure in patients with previous urinary retention (1). This is suggestive of an alternative means of symptomatic relief in the immediate PAE period rather than simply through prostate volume reduction.

In this case, there was marked symptomatic improvement with the patient expelling all but 1 of his bladder stones. Given the limited experience of PAE in the setting of bladder stones, an interdisciplinary approach with a urologist is paramount. PAE may be considered when urologic interventions are considered technically difficult secondary to difficult anatomy or pathology.

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A 5-Dollar Nephrostomy Training Phantom Using Common Household and Hospital Supplies

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Editor:

Ultrasound (US)-guided needle access is a fundamental component of interventional radiology (IR). US-guided percutaneous nephrostomy is particularly challenging for trainees to master given kidney depth and intercostal approach. Modeling US-guided renal interventions allows trainees to master basic skills and gain confidence in a risk-free setting (1). Animal and commercial nephrostomy phantoms are available (1,2), and studies show that these phantoms can improve trainee confidence and competence (1,3). However, hygiene considerations need to be considered when using animal models, and commercial models can be prohibitively expensive. Low-cost, do-it-yourself nephrostomy phantoms have also been described (4). These phantoms are unnecessarily complicated and require supplies not readily accessible, such as addition of silicon carbide or fashioning a split mold plastic container (3,4). Additionally, previously described phantoms do not include overlying ribs, a technical aspect of localizing the kidney that proves problematic for trainees. We describe an easy-to-make nephrostomy phantom using common household and hospital supplies that simulates an intercostal approach for nephrostomy.

Required supplies are listed in the **Table**. Prices listed are as found on amazon.com at the time of purchase. Shipping costs are excluded. We calculated a cost of \$40.35, which provides sufficient material for 9 phantoms, or \$4.48 per phantom.

First, ballistics gel is made by mixing 1 part Knox gelatin with 9 parts warm tap water. Several drops of cinnamon oil can be used to eliminate small air bubbles. Next, Metamucil is added using one-quarter volume that was used for gelatin powder. Metamucil adds echotexture to the solution creating

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Table. Required Supplies

Supplies Readily Found in Hospital	Additional Supplies
Disposable suction canister	Knox gelatin (32 oz/946 mL), $19.95
Latex glove	Metamucil (23 oz/680 mL), $16.45
Intravenous extension tubing	Cinnamon leaf oil (10 mL), $3.95
2 tongue depressors	
Small rubber band	
Plastic medical tape	
Luer-Lok syringe	

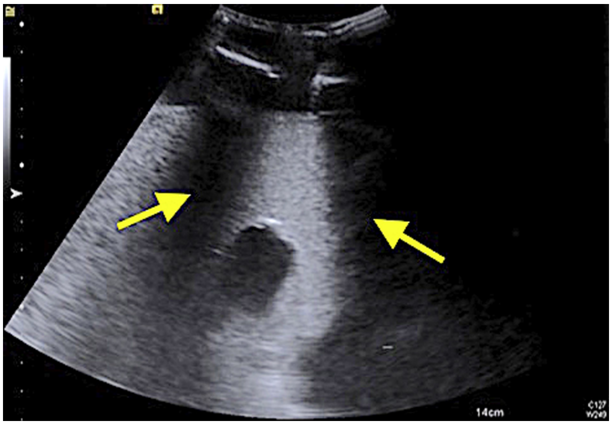

Figure 1. Ultrasound of the nephrostomy model. The probe is incorrectly placed perpendicular to the ribs creating shadowing and inadequate visualization of the collecting system. Arrows indicate the acoustic shadowing of the tongue depressors simulating the ribs. Also, note the echotecture created by Metamucil.

a more realistic appearance under ultrasound (Figs 1–3). Additionally, Metamucil makes the gelatin opaque so that the operator cannot simply use plane of sight to navigate around ribs and to target the calyx (Fig 4).

The fingers of a small latex glove are tied and cut to one-third their length to serve as the blunted, hydronephrotic calyces. The glove is filled with water and cinched around intravenous (IV) extension tubing at its base. IV tubing allows for the kidney model to be refilled with water if aspiration is performed (Fig 5).

Next, the glove is taped to the inner base of the canister and oriented midline with calyces pointing toward the opening of the canister. Two tongue depressors are cut to length and taped to the canister oriented parallel to the calyces to mimic normal rib anatomy (Fig 6). Finally, the canister is filled to the top with the gelatin mixture with care to remove surface air bubbles. The gelatin is allowed to set in the refrigerator overnight. This phantom is easily assembled in approximately 1 hour and can be refrigerated for 2 weeks.

This phantom design can be modified for specific uses. A container with less depth can be used to simulate thinner patients for easier puncture. To add complexity, the trainee

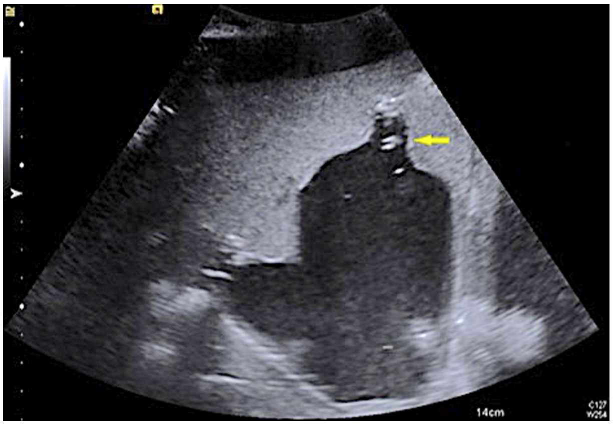

Figure 2. Successful needle access of a blunted calyx. Visualization of the access needle in the calyx is much brighter compared with the overlying tissue owing to the added echotecture of Metamucil. Arrow indicates the needle puncture.

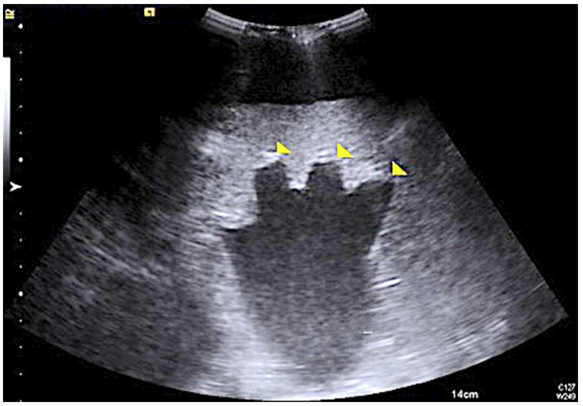

Figure 3. Correct probe positioning parallel to the ribs within the intercostal space. Arrowheads indicate the blunted calyces, which should be targeted for needle access.

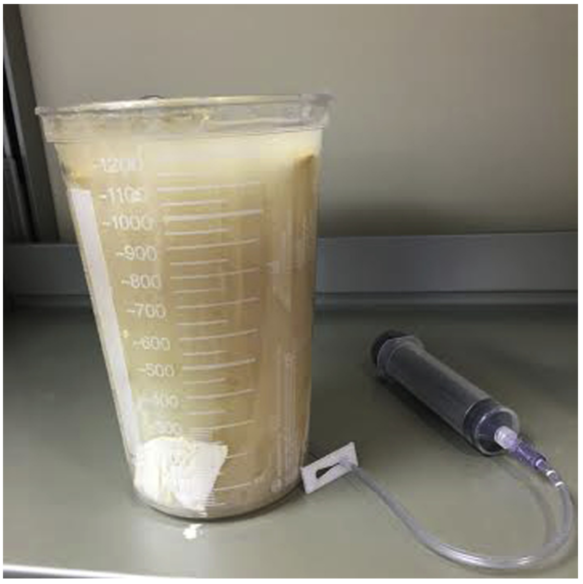

Figure 4. Canister filled with hardened gelatin mixture and nephrostomy phantom secured inside. Metamucil has rendered the ballistics gel opaque.

Figure 5. Surgical glove simulating a dilated collecting system. The syringe allows the model to be refilled and for degree of hydronephrosis to be augmented.

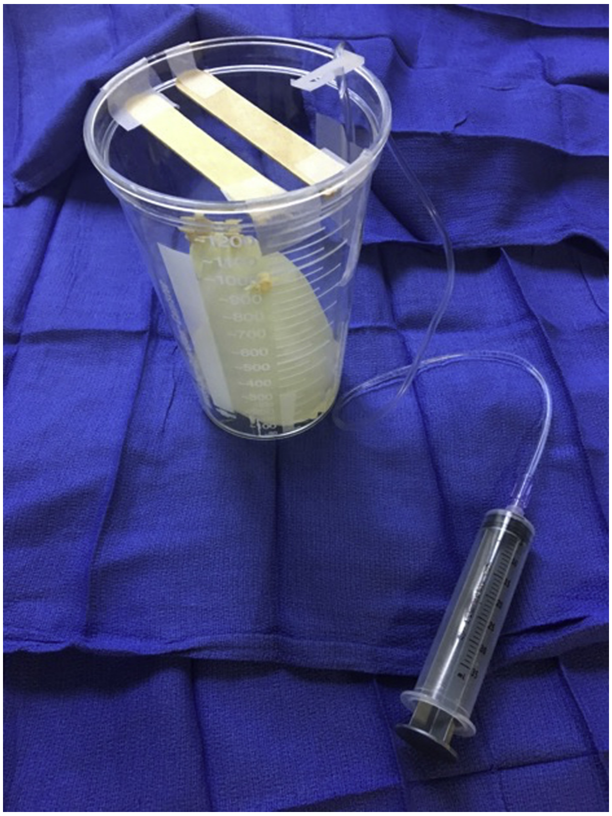

Figure 6. Nephrostomy phantom and simulated ribs within the canister.

can be instructed to target a calyx that is directly under the simulated rib. This will force the trainee to angle the probe and take an oblique needle path to the calyx. The phantom can also be used to model aspirating a urine sample, injecting contrast agent, and passing an initial guide wire.

The syringe and IV tubing are useful for changing the degree of hydronephrosis but can be left out by simply knotting the base of the glove. If using an electric hand mixer to dissolve the gelatin, any gas trapped under the cup and blade of the mixer needs to be released before blending. If not, air will be emulsified into the solution and obscure the US waves. Procedural gloves made of thicker material provide more tactile feedback during puncture and are less likely to tear compared with thinner bedside gloves.

When using the simulator, the trainees should be instructed that when redirecting the needle, they should retract the needle fully to the surface. Otherwise, torqueing the needle can cut through the gelatin like a cheese wire. Multiple punctures can be made allowing the trainee to spend adequate time targeting multiple calyces at different angles and probe positions. We have found that trainees are able to develop fundamental skills on this phantom that directly translate to the procedure room.

Other aspects of nephrostomy tube placement such as tract dilation and forming a pigtail loop are not well simulated by this phantom. Additionally, the tactile feedback of passing a needle through the renal parenchyma is not simulated with the materials used in this model.

This low-cost, simple-to-build nephrostomy phantom can be very beneficial for IR training programs. It can be built in less time and with more readily accessible materials compared with previously described low-cost phantoms. The hands-on simulation it provides is an excellent way to train residents and fellows and can provide means for engaging medical students interested in pursuing a career in IR.

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