IN BRIEF

# A Novel Ultrasound Transmission Gel for Resource-Constrained Environments

*Jonathan Monti, DSc, PA-C, RDMS*

## ABSTRACT

Ultrasound represents an ideal diagnostic adjunct for medical personnel operating in austere environments, because of its increasing portability and expanding number of point-of-care applications. However, these machines cannot be used without a transmission medium that allows for propagation of ultrasound waves from transducer to patient. This article describes a novel ultrasound gel alternative that may be better suited for resource-constrained environments than standard ultrasound gel, without compromising image quality.

KEYWORDS: *ultrasound; austere; ultrasound gel; military; POCUS*

## Introduction

Recent technological advances have led to the development of highly portable ultrasound machines that have proved to be invaluable in environments such as mountainous terrain, space, and military/operational settings.[1,2] In addition to its portability, there are an increasing number of applications for ultrasound that are being used easily and safely by many healthcare providers at the point of care, including Special Forces Medical Sergeants and the Special Operations Forces medical providers who support them.[3–7]

When using ultrasound, a transmission medium between the transducer and patient allows for propagation of sound waves from the transducer into the body to the target anatomic structure. Without such a medium, ultrasound image acquisition becomes impossible and expensive machines are rendered useless. Standard transmission gel can often be carried into austere environments but usually in limited supply because of its relative bulk. Additionally, upon arrival in resource-constrained environments, standard commercial gel may be unobtainable due to a lack of established supply chains and may be unlikely to be procured locally in such environments.

Previous studies have examined the feasibility of transmission gel alternatives that may be used in lieu of standard ultrasound gel. Olive oil was found to be a suitable transmission medium compared with standard gel when evaluating sonographic image quality.[8] Olive oil, along with several other alternatives, including hand lotion, liquid detergent, baby shampoo, and hairstyling gel, when evaluated for image quality, were found to be comparatively inferior to standard ultrasound gel, with only hand sanitizer producing similar-quality sonographic images.[9] Each of these alternatives comes in gel or liquid form, thereby increasing their relative bulk and weight, which must be considered when load planning before operating in resource-constrained environments. A mixture of cornstarch and water has been suggested as an ideal alternative for resource-constrained environments; however, this mixture requires boiling of water, which may not be feasible in an austere environment.[10]

## Novel Gel Alternative

Glucomannan powder is a water-soluble, bulk-forming fiber derived from Konjac root. It is available as a fiber supplement in many health food stores and online (Figure 1). Approximately 1 tsp of glucomannan powder, when mixed with 0.25L (8 oz) of water, the amount found in typical commercial ultrasound transmission gel bottles, will provide a gel consistency very similar to that of standard ultrasound transmission gel (Figure 2).

The quality of images can limit point-of care sonographers' ability to adequately interpret the findings, thus affecting medical decision-making. Therefore, it is imperative that any proposed gel alternative not significantly degrade image quality. Figure 3 is an ultrasound image of the right upper quadrant of a patient's abdomen obtained with standard transmission gel (Figure 3A) and with glucomannan-based gel (Figure 3B), using a low-frequency curvilinear transducer. Figure 4 is an ultrasound image of a patient's common femoral artery and vein obtained with standard transmission gel (Figure

**Figure 1** *Commercially available glucomannan powder supplement.*

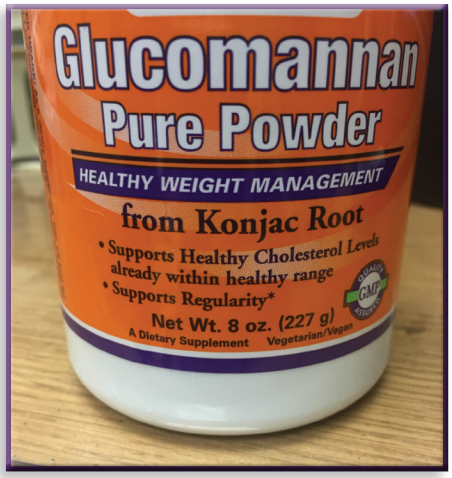
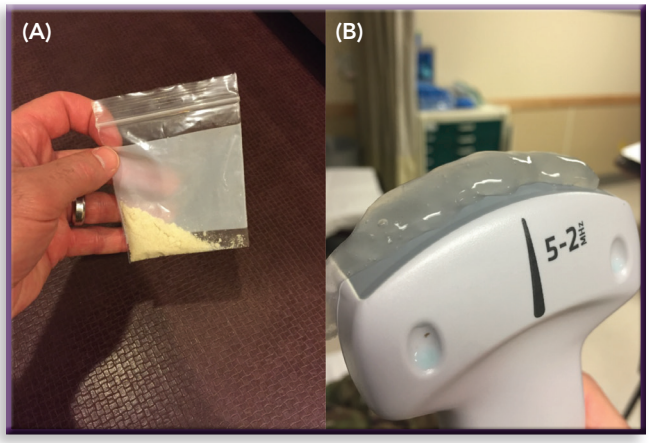


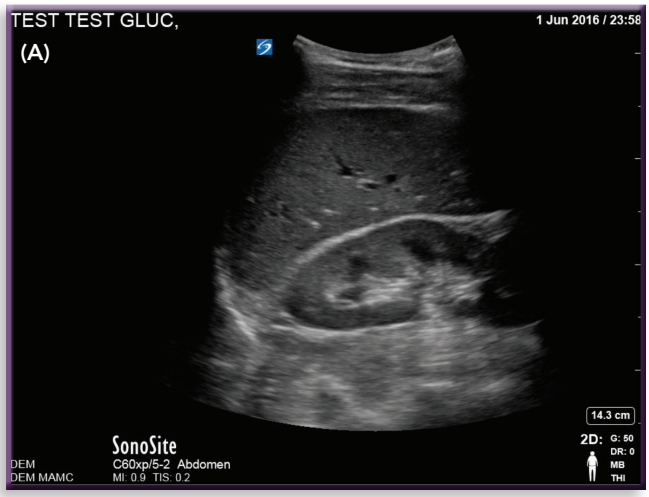

**Figure 2** *Glucomannan powder (1 tsp) in* **(A)** *a plastic bag and* **(B)** *after reconstitution with 0.25L of water, on a transducer.*

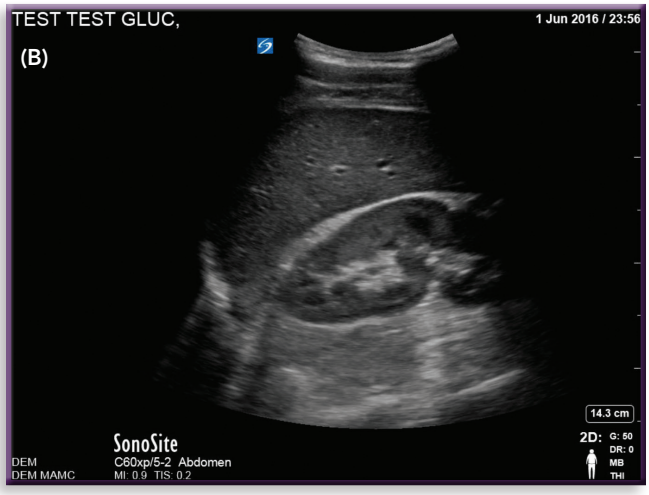



4A) and with glucomannan gel (Figure 4B), using a high-frequency linear transducer. Figure 5 shows a standard parasternal long cardiac view obtained with standard transmission gel (Figure 5A) and with glucomannan gel (Figure 5B), using a low-frequency phased array transducer. The images appear nearly identical in resolution, detail, and overall quality with either transducer.

These images suggest that glucomannan can be used as an effective ultrasound transmission gel medium without compromising image quality when performing high- and/or low-frequency ultrasound examinations or procedures. Because it can be carried in powder form, glucomannan is considerably more lightweight and lacks the bulk of commercial ultrasound transmission gel and of previously tested gel alternatives such as hand sanitizer and olive oil. Unlike the alcohol-based hand sanitizer found to offer high-quality sonographic images comparable to standard ultrasound gel, glucomannan will not evaporate quickly while performing the sonographic examination, thereby eliminating the need for reapplication of medium.[9]

**Figure 3** *Comparison of standard extended focused assessment with sonography. Right upper quadrant views, using* **(A)** *standard ultrasound gel and* **(B)** *glucomannan-based gel.*

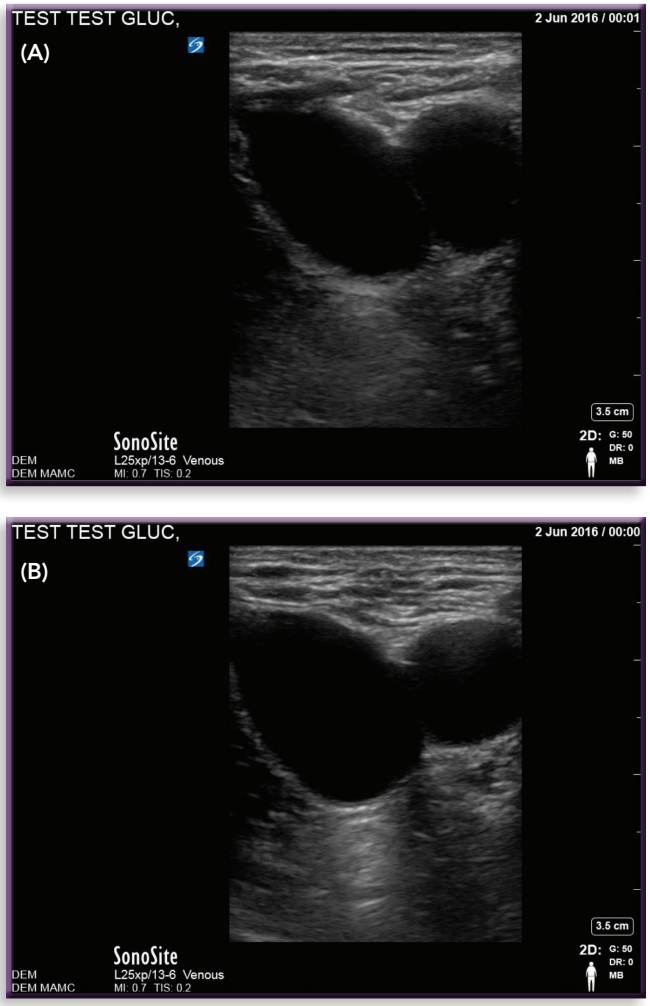



The cost of a 227g bottle of glucomannan ranges from $11 to $15, as compared with $3 to $5 per 0.25L bottle of standard transmission gel. However, when reconstituted, a single 227g bottle of glucomannan can produce the volume equivalent of nearly 50 standard transmission gel bottles, making the cost per 227g of gel approximately $0.30. Glucomannan powder can be carried in lightweight, waterproof plastic bags and then be combined with room-temperature water as needed at the time of examination, and done so in only the amounts required to complete the examination. Additionally, no heat source is required to constitute glucomannan powder, as is required with the gel alternative made with corn starch.

Once constituted, the glucomannan gel has a limited shelf-life of 2 days before its ideal viscosity degrades, which should be considered a limiting factor of glucomannan. Additionally, if not used after several days, bacterial growth can occur. However, even commercial

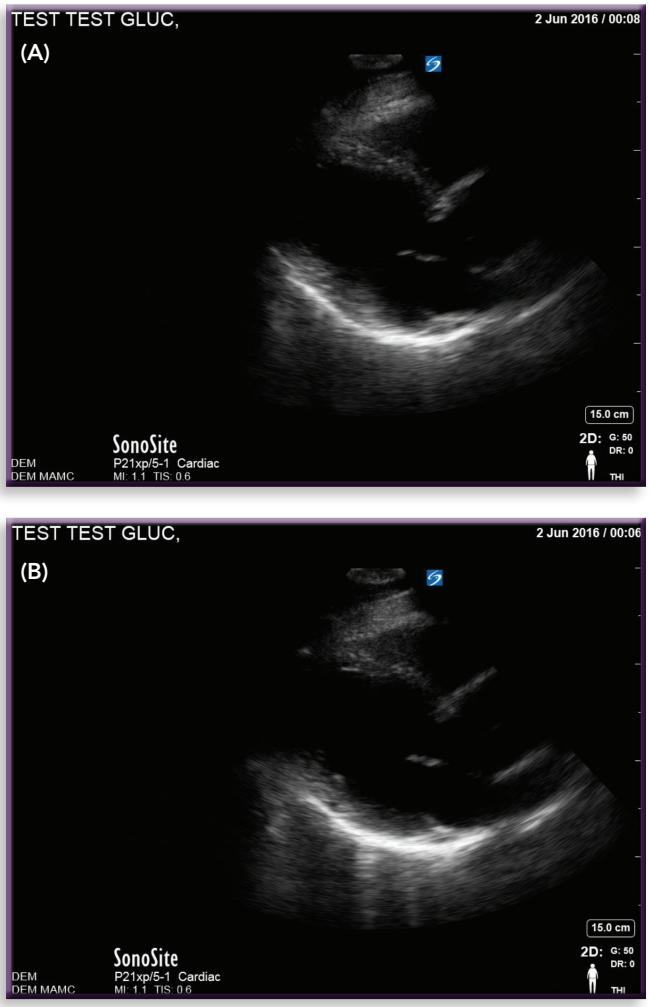
**Figure 4** *Comparison of common femoral artery and vein images.* **(A)** *Standard ultrasound gel.* **(B)** *Glucomannan-based gel.*




nonsterile gel can exhibit bacterial contamination over time and with exposure to the elements.[11]

This transmission gel alternative is highly portable, lightweight, cost effective, and is easy to make and use, while also allowing the sonographer the ability to obtain high-fidelity imaging without compromising image quality. These benefits of glucomannan should be of particular interest to those medical personnel who operate in austere environments such as remote wilderness settings, tactical/operational settings, or space, where supplies and logistical area may be limited to what can be carried; or those who may have limited mobile assets and those operating in locations where resupply is difficult or nonexistent. Although these images and the author's experience suggest glucomannan-based gel is a suitable alternative, prospective studies designed to formally evaluate the quality of images obtained with glucomannan powder compared with commercially available ultrasound gel and other proposed gel alternatives, are recommended.

**Figure 5** *Comparison of parasternal long cardiac view.* **(A)** *Standard ultrasound gel.* **(B)** *Glucomannan-based gel.*




## Disclaimer

The opinions or assertions contained herein are the private views of the author and are not to be construed as official or reflecting the views of the Department of the Army or the Department of Defense. The author has no relationships to disclose regarding this product. This is not, and in no way, should be construed as an endorsement of this product by the Department of the Army or Department of Defense.

## Disclosure

The author has no financial interests in the products contained within this work to disclose.

## References

1. **Russell TC, Crawford PF.** Ultrasound in the austere environment: a review of the history, indications, and specifications. *Mil Med.* 2013;178:21–28.
2. **Nelson BP, Melnick ER, Li J.** Portable ultrasound for remote environments, Part I: feasibility of field deployment. *J Emerg Med.* 2011;40:190–197.

3. **Moore CL, Copel JA.** Point-of-care ultrasonography. *N Engl J Med*. 2011;364:749–757.
4. **Stolz LA, Muruganandan KM, Bisanzo MC, et al.** Point-of-care ultrasound education for non-physician clinicians in a resource-limited emergency department. *Trop Med Int Health*. 2015;20:1067–1072.
5. **Hile DC, Morgan AR, Laselle BT, et al.** Is point-of-care ultrasound accurate and useful in the hands of military medical technicians? A review of the literature. *Mil Med*. 2012;177:983–987.
6. **Monti JD, Younggren B, Blankenship R.** Ultrasound detection of pneumothorax with minimally trained sonographers: a preliminary study. *J Spec Oper Med*. 2009;9(Winter):43–46.
7. **Morgan AR, Vasios WN, Hubler DA, et al.** Special operator level clinical ultrasound: an experience in application and training. *J Spec Oper Med*. 2010;10(Spring):16–21.
8. **Luewan S, Srisupundit K, Tongsong T.** A comparison of sonographic image quality between the examinations using gel and olive oil as sound media. *J Med Assoc Thai*. 2007;90:624–627.
9. **Savaser D, Gray S, Medak A, et al.** The USAGES study (Ultrasonographic Study of Alternative Gel Experimental Substances): a trial of alternative substances for use in clinical sonographic imaging. Presented at the 2013 American Institute of Ultrasound in Medicine Annual Convention, New York, NY; April 6–10, 2013.
10. **Binkowski A, Riguzzi C, Price D, et al.** Evaluation of a cornstarch-based ultrasound gel alternative for low-resource settings. *J Emerg Med*. 2014;47:e5–9.
11. **Muradali D, Gold WL, Phillips A, et al.** Can ultrasound probes and coupling gel be a source of nosocomial infection in patients undergoing sonography? An in vivo and in vitro study. *AJR Am J Roentgenol*. 1995;164:1521–1152.

MAJ Monti is the director of the US Army/Baylor EMPA Residency Program, Department of Emergency Medicine at Madigan Army Medical Center, Joint Base Lewis McChord, 9040 Jackson Ave, Box 339500 MS 56, Building #9040, Tacoma, Washington 98433-9500.
E-mail: jonathan.d.monti.mil@mail.mil.