Precautions with gentian violet: Skin marking made sterile, effective, and economical

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Background: Surgical site infections have been caused by gentian violet (GV) marking solutions that were contaminated with *Mycobaterium chelonae*. GV solution is also used in surgery to mark surgical sites. It is commercially available as a solution that may not have been prepared under sterile conditions.
Objective: Our objective is to describe a skin marking method that is sterile, effective, and economical.
Methods: GV solution; microcentrifuge tubes; and round, wood toothpicks are used as an alternative to the standard surgical marker. GV (4 drops) is dispensed into a microcentrifuge tube. After capping, the tube is autoclaved. The toothpick is used as the writing instrument and dipped into the GV as needed for intraoperative skin marking. Unlike commercially available skin markers, skin moisture will not cause the writing implement (toothpick) to become ineffective; merely dry the skin before skin marking.
Results: Autoclaving the commercially available shelved GV solution ensures sterility. The cost of the GV, toothpicks, and microcentrifuge tubes is approximately $0.10 per operation. In contrast, commercially available surgical markers range in cost from $0.79 to $3.89 per pen (manufactured suggested retail price), a 8- to 39- fold difference.
Conclusion: Infectious precautions should be taken with surgical site marking. Marking solutions should be prepared under sterile conditions in a pharmacy. Alternatively, commercially available nonsterile solutions can be autoclaved to ensure sterility.

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In an epidemiologic investigation, gentian violet (GV) marking solution was reported to be the source of a *Mycobacterium chelonae* surgery site infection outbreak in 1987.[1] The organism was isolated from the GV stock solution used by the surgeon, as well as in the stock at the pharmacy. Although this is a rare surgical complication, precautions must be taken to ensure sterility of marking instruments and ink.

GV is used by some surgeons to mark surgical sites with either a surgical marker or solution. The marking solution may be obtained from a pharmacy or commercially prepared. The solution may or may not have been prepared under sterile conditions, such as the GV solutions that are available through Delasco (Council Bluffs, IA) and Humco (Texarkana, TX). Although a standard protocol for shelved solutions has not been established at this time, cultures should be obtained prior to clinical use and replaced periodically.[2]

The ideal skin marking system should, therefore, ensure sterility. Additionally, it should remain effective on prepared skin and after contact with moisture, as well as be a cost-effective alternative to the standard surgical marker.

MATERIALS AND METHODS

- GV solution (Fig 1A);
- 0.6-mL microcentrifuge tubes (Axygen Scientific Inc, Union City, CA; MaxyClear microcentrifuge tubes, part No. MCT-060-C) (Fig 1A);
- fine-tip writing implement (ie, round, wood toothpick; wood skewers; cotton tip applicators with wood end shaved to a fine point) (Fig 1A); and
- optional: microcentrifuge tube rack (to facilitate preparation of multiple tubes for autoclaving) (Fig 1B).

Four drops of GV are dispensed into a microcentrifuge tube. After firmly securing the cap, the tube may

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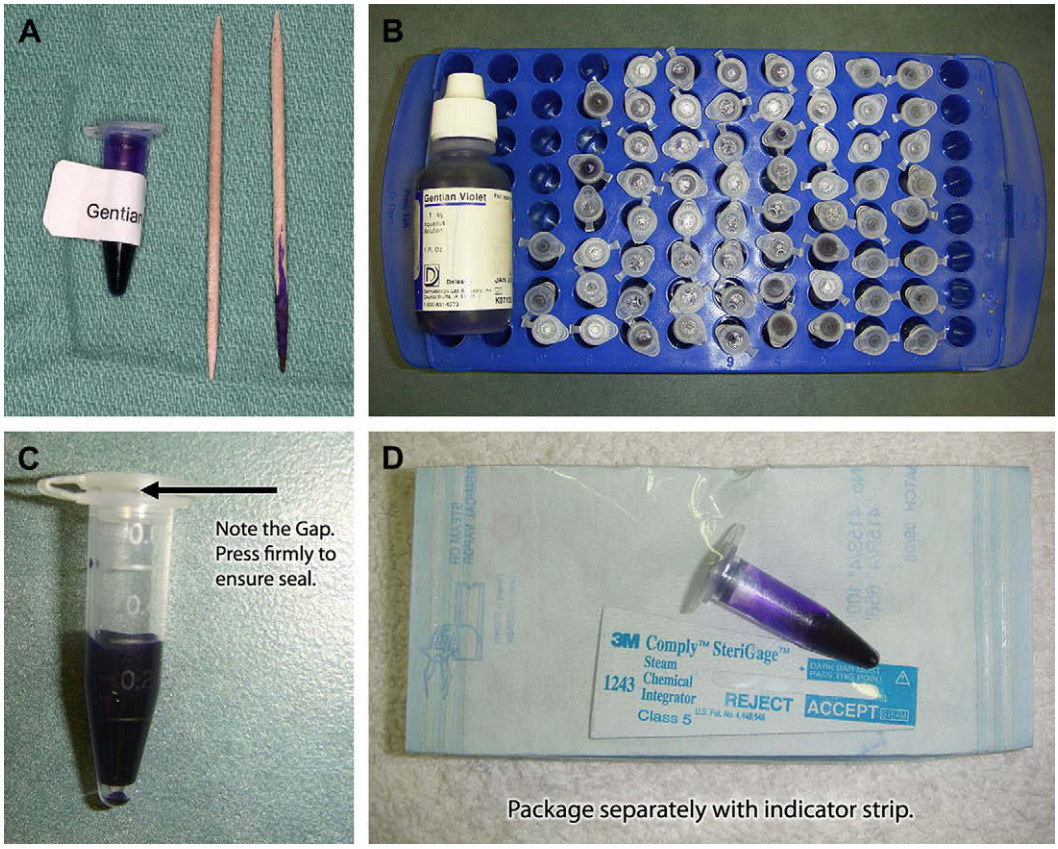

Fig 1. Gentian violet marking system. Labeled microcentrifuge tube and 2 round, wood toothpicks. Cotton tip applicators with wood end shaved to a fine point may also be used (A). Microcentifuge tube rack may be used to facilitate preparation of multiple tubes for autoclaving (B). The cap should be pressed firmly to ensure a tight seal (C). The tube may be packaged separately (D) for autoclaving in case a spill does occur (see Figure 2, left).

be autoclaved along with the writing implement (2 toothpicks) and, if applicable, the instrument set. The toothpick is dipped into the GV as needed for intraoperative skin marking. Unlike commercially available skin markers, skin moisture will not cause the writing implement (toothpick) to become ineffective; merely dry the skin before skin marking. When not in use, the tube does not have to be placed upright, as surface tension will prevent the GV from spilling out. Of note, the toothpick should not be stored in the tube because capillary action will cause the toothpick to become saturated.

Commercially available surgical markers range in cost from $0.79 to $3.89 per pen (manufactured suggested retail price). In contrast, the components of this system are inexpensive: approximately $0.10 per operation, an 8- to 39-fold difference. Approximately 150 tubes can be prepared from a 1-fluid ounce bottle of GV ($8 per bottle; $0.05 per tube). A bag of 500 microcentrifuge tubes is approximately $10 ($0.02 per tube). A box of 1000 round, wood toothpicks can be purchased for a dollar ($0.001 per toothpick). Finally, labor costs can be calculated from the following: 1 medical assistant working at a national average hourly pay of approximately $13.00 will spend approximately 15 minutes to fill 100 tubes ($0.03 per tube).[3]

Several precautions should be mentioned. Occasionally, the tube will become uncapped during the autoclaving process spilling the contents. To obviate this, autoclavable microcentrifuge tubes made of high-quality plastic were selected (Axygen Scientific Inc, Union City, CA; MaxyClear microcentrifuge tubes, part No. MCT-060-C). Additionally, firmly press the cap closed before autoclaving to ensure a tight seal (Fig 1C), as well as package the tube separately (Fig 1D) in case a spill does occur (Fig 2, left). Additionally, uncap slowly to avoid a GV spray across the surgical field (Fig 2, right).

To demonstrate efficacy of sterilization within a sealed microcentrifuge tube, 3 qualitative heat process indicators (Comply SteriGage; 3M Co., St. Paul, MN; Comply indicator tape, 3M Co; Convertors self-seal pouch, Cardinal Health, McGaw Park, IL) were placed within closed microcentifuge tubes. After autoclaving, all indicators

Fig 2. Precautions. A spill may occur when the cap is not pressed firmly to close the tube (left). The tube should be uncapped slowly to avoid a GV spray across the surgical field and/or personnel (right).

changed color, confirming that the contents within a closed microcentrifuge tube is processed correctly and exposed to steam.

DISCUSSION

GV is a triphenylmethane dye and has a variety of indications for use, including the following: skin marking, Gram's stain of gram-positive bacteria, staphylococcal colonization, and candida infections.[4] It has selective toxicity and is reported to be effective against some gram-positive cocci,[5] pathogenic yeasts,[4] *Clostridium perfringens*,[3] scherichia coli,[3] and *Micrococcus lysodeitricus*.[4]

Commercially prepared GV solutions are packaged for multiple use with a shelf life of 2 to 5 years. These solutions may be water based (ie, Delasco, Council Bluffs, IA) or 10% ethyl alcohol-water based (ie, Humco, Texarkana, TX) and are not prepared under sterile conditions. Although GV and 10% ethyl alcohol both have some inherent antiseptic properties, these marking solutions do not have a comprehensive antimicrobial effect.[6,7] Non-tuberculous mycobacteria, for instance, may survive in these conditions.[1] As a result, microorganism growth is possible with subsequent infection, as demonstrated by the *Mycobacterium chelonae* surgery site infection outbreak in 1987.[1,2] Consequently, shelved solutions should be periodically replaced, and cultures should be obtained, particularly when used in sterile surgery.[2]

A variety of marking systems have been described to meet the surgeon's needs in the sterile operative setting.[8-10] The system described here maintains sterility, as well as overcomes several limitations of the reported skin marking systems. Wood skewers are suitable for making incision lines, reliably drawing a line that is 2 to 0.2 mm wide and with efficacy of sterilization demonstrated.[11] In contrast to the standard surgical marker, skin antiseptics and moisture will not cause the writing implement to become ineffective, minimizing disposal and replacement of ineffective marking pens. Efficiency is introduced when all components of the marking system are packaged and autoclaved along with the instrument set. Finally, the unit cost per operation is 8- to 39-fold less than the standard surgical marker. This technique may be appropriate for health care settings with insufficient resources where addition of surgical instrumentation worth 1 dollar may be significant additional cost. Additionally, in an age of cost-effective quality health care, an insignificant cost savings can be significant in the setting of large volumes of surgery and when projected over a time period (ie, 1 year). The return on investment is manifold.

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