Antiseptic Agents

Clark C. Smith, MD, MPH and David C. Miller, MD, MA on behalf of the Spine Intervention Society's Patient Safety Committee

1 Columbia University Medical Center, Rehabilitation and Regenerative Medicine, New York, New York, U.S.A.;
2 Napa Pain Institute, Napa, California, U.S.A.

Myth: For an epidural injection, Betadine® (povidone-iodine) is just as good a skin antiseptic as any of those modern expensive skin preps.

Fact: Properly applied chlorhexidine in alcohol (ChloraPrep™) is a superior skin antiseptic.

Application of an antiseptic to the skin prior to spinal interventions is an important component of the broader topic of surgical site infection risk management [1]. Indeed, an effective skin antiseptic is only one of the required elements of a good aseptic technique. Although rare, three types of infections have been reported following routine epidural steroid injection: superficial skin injection-site infection, discitis, epidural abscess [2-5].

There are two topical solutions commonly utilized to disinfect clean intact skin: povidone-iodine (PVI) and chlorhexidine gluconate (CHG). Both are commercially available, as either an aqueous or alcohol-based solution.

PVI, CHG, and alcohol all have broad-spectrum antimicrobial coverage against gram-positive and gram-negative bacteria, including methicillin-resistant Staphylococcus aureus (MRSA), fungi, virus, and mycobacterium tuberculosis. Effectiveness of these agents has not degraded over time. PVI works primarily through the release of free elemental iodine, which denatures microbial proteins and damages microbial DNA. CHG’s mechanism of action is primarily through disruption of microbial cell membranes. Alcohol works through a combination of disruption of microbial cell membranes and denaturation of proteins. The addition of alcohol improves the antiseptic profile of both PVI and CHG. Compared to aqueous-based antiseptics, alcohol-based antiseptics have a broader antimicrobial coverage, a briefer application process, a more rapid onset of action, and a longer duration of action.

CHG 2% in alcohol 70% kills over 99.999% of the 23 most common bacterial skin flora in less than 3 minutes. No skin antiseptic can eliminate all microbes because some reside deep off the surface in glands. The most important safeguard is to ensure that any skin antiseptic used must be allowed to completely dry prior to initiating an intervention.

<table>
<thead>
<tr>
<th>PREP</th>
<th>ANTIMICROBIAL SPECTRUM</th>
<th>SPEED OF ONSET</th>
<th>APPLICATION/DRYING TIME</th>
<th>DURATION OF ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Betadine® (PVI + aqueous)</td>
<td>Broad</td>
<td>Minutes</td>
<td>4 min/4-8 minutes</td>
<td>2 hours</td>
</tr>
<tr>
<td>Hibiclens® (CHG + aqueous)</td>
<td>Broad</td>
<td>Minutes</td>
<td>4 min/4-8 minutes</td>
<td>6 hours</td>
</tr>
<tr>
<td>DuraPrep™ (PVI + Alcohol)</td>
<td>Broader More gram -</td>
<td>30 Seconds</td>
<td>40 sec/180 seconds</td>
<td>48 hours</td>
</tr>
<tr>
<td>ChloraPrep™ (CHG + Alcohol)</td>
<td>Broader More gram -</td>
<td>20 Seconds</td>
<td>30 sec/30 seconds</td>
<td>48 hours</td>
</tr>
</tbody>
</table>
Optimal antimicrobial activity of all preps requires careful adherence to application instructions provided by the manufacturer. Alcohol-based surgical preps are flammable until fully dried and require vigilance [6].

Many laboratory and clinical studies have been conducted comparing the relative safety and effectiveness of the various antiseptic agents in reducing both laboratory determined bacterial colony counts as well as surgical site infections (SSI). Alcohol-based skin preps are superior to aqueous-based preps in all measures. There is abundant evidence validating the superiority of CHG in alcohol over other preparations [7-31]. Several systematic reviews and meta-analysis yield consistent results that the lowest risk of SSI follows the use of Chloraprep (CHG 2% in alcohol 70%), and the reduction of infectious complications is in the order of 30% [32-41]. Use of 70% alcohol, by itself, has not been adequately studied as a pre-procedural skin antiseptic, but compared to Betadine Paint: it possesses broader antimicrobial spectrum, is quick to apply, has a rapid onset, is not messy, and is the least expensive [42]. Adverse events such as skin irritation, erythema, and pruritus attributed to CHG and PVI are uncommon and are comparable [11,15,18,29].

Several medical societies have endorsed the routine use of ChloraprepTM specifically for spinal injections as the first choice for a skin antiseptic. The Spine Intervention Society’s (SIS) Practice Guidelines for Spinal Diagnostic and Treatment Procedures (Second Edition) and The American Society of Regional Anesthesia and Pain Management (ASRA) endorse ChloraPrep™ as the preferred skin disinfectant [43, 44]. The CDC Guideline for the Prevention of Surgical Site Infection (2017), as well as, the WHO Global Guidelines for the Prevention of SSI recommends the use of chlorhexidine in alcohol for skin antisepsis because of its superior effectiveness and speed of application [1, 45]. Preoperative skin antisepsis with chlorhexidine in alcohol is not only more effective than preoperative skin antisepsis with iodine formulations for preventing SSI, it also results in cost savings [45].

Concerns over toxicity of chlorhexidine are based upon two reports on the effect of injection of large amounts of CHG directly into the cerebrospinal fluid in monkeys (1955) and into the anterior chamber of the eye in rats (1984), which resulted in neuronal damage [46, 47]. After 30 years of extensive clinical use, there are no reports of chlorhexidine causing nerve damage in humans and the incidence of neurologic complications following neuraxial blockade utilizing ChloraPrep™ is no different than that of Betadine® [48]. Anything which kills bacteria such as CHG, PVI, and alcohol is potentially harmful to neural structures.

### Recommendations

1. Chlorhexidine 2% in isopropyl alcohol 70% (ChloraPrep™) is the preferred choice for topical antisepsis of clean intact skin prior to spinal interventions.
2. Povidone-iodine in alcohol (DuraPrep™) is a reasonable alternative to ChloraPrep™ for patients sensitive to CHG.
3. Aqueous-based skin preps are proven to be less efficacious than alcohol-based preps.
4. Directions for using Chloraprep should be carefully followed, particularly: systematically paint the area for 30 seconds (not scrub), avoid solution pooling, allow time for complete drying.

### References


45. WHO Surgical Site Infection Prevention Guidelines www.who.org Web Appendix 8 Summary of a systematic literature review on surgical site preparation.