

## Original Paper

# The Review of Surigcal Disinfectant

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### Abstract

*Surgical disinfectants are essential and commonly used items during surgical procedures. They can be used for disinfection of the skin and mucous membranes. This article introduces common disinfectant products, their ingredients, usage instructions, and precautions. It is crucial for healthcare professionals to have a thorough understanding of disinfectants to make correct choices, ensuring better service to patients and the medical field.*

### Keywords

*Surgery, disinfectants, ingredients, usage, correct selection*

Surgical disinfectant is an essential and commonly used item during surgery. Almost all surgical procedures involve epidermal and mucosal disinfectants. According to the requirements of Technical Requirements for Health Safety Evaluation of Disinfection Products (WS 628-2018) (National Health Commission, 2018), the safety indicators of mucosal disinfectants should meet the requirements in Table 1.

**Table 1. Security Index**

Project	Judging index
Acute oral toxicity test	non-toxicity or low toxicity
One test that led to a mutation	No mutagenic effect
One eye irritation test(occasionally)	No irritation or slight irritation
Eye irritation tests more than once(repeatedly)	No irritation or slight irritation
One vaginal mucosa irritation test(occasionally)	No irritation or slight irritation
Vaginal mucosa irritation tests(repeatedly)	No irritation or slight irritation

*Note.* Occasional use refers to use occasionally or use at intervals of several days; Repeated use refers to daily use or continuous use for several days.

It can be seen that although this safety index involves the ophthalmic mucosa, still it does not involve the ear, nose, throat, nasal mucosa and the tympanic membrane and the middle ear structure in ear surgery. This shows that there are relatively few studies on the effects of surgical disinfectants on middle and inner ear stimulation during ear surgery. This paper overviews commonly surgical disinfectants which are used in surgeries, in order to prepare for the future study of the effect of surgical disinfectant on surgery.

Surgical disinfectants are chemicals used in operating rooms and medical facilities to sterilize surgical instruments, surgical areas, and medical personnel. They are used to kill pathogenic microorganisms on the transmission media, in order to meet the requirements of harmlessness. Different from antibiotics, the main function of disinfectants in disease prevention is to eliminate pathogenic microorganisms which are outside the human body, and cut off the transmission of infectious diseases, so that to achieve the purpose of controlling infectious diseases. Surgical disinfectants can be divided into: chlorine disinfectant, peroxide disinfectant, aldehyde disinfectant, alcohol disinfectant, iodine disinfectant, phenolic disinfectant, ethylene oxide, biguanide disinfectant, quaternary ammonium salt disinfectant according to the difference in chemical composition, if they are followed by the effect, the surgical disinfectants can be divided into: high effect, medium effect, low effect.

The following are commonly used surgical disinfectants:

1. Povidone-Iodine, Iodophor, Povidone iodine, El iodine

Iodine is a commonly used antibacterial disinfectant. It is a mixture of iodine and ethanol. It is made of iodine and potassium iodide dissolved in alcohol solution. The liquid is clear reddish brown and has a special odor of elemental iodine and ethanol. This special odor kills a variety of bacteria, fungi and viruses and is often used for skin surface disinfection, mucosal disinfection, tissue dressing disinfection and skin disinfection before injection. It can also be used for disinfection of instrument surfaces and surgical areas. Iodine should not be used in large areas to prevent iodine poisoning.

Iodophor is not iodine, it mainly uses iodine as its main active component and it is an amorphous compound composed of elemental iodine and polyethylene pyrrolidone. Polyvinylpyrrolidone can dissolve and disperse 9% to 12% of iodine, at the same time, iodophor will become the liquid of purplish-black, but usually the concentration of medical iodophor is low and its color is light brown. The common concentration of medical iodophor is 1%, which can be used for burns, frostbite, cuts, abrasions, contusions and other general injuries and skin disinfection before surgery. Iodophor can generally play a disinfecting role, and be used for skin damage or mucous membrane damage, directly apply the drug to the affected area, preventing wound infection. The available iodine in the Iodophor usually is 4.5-5.5g/L. It can kill intestinal pathogenic bacteria, pyogenic coccus, pathogenic yeast and common bacteria of hospital infection. Suitable for skin, hands, mucous membrane disinfection. Usage:

Washing and disinfecting the hands, the skin of the incision site and the skin tissue of the neonatal umbilical cord, mucosal injection and puncture site before the operation; Wiping or rinsing the disinfection site with the original solution once or twice for 3-5 minutes.

Precautions 1. No oral disinfectants should be used in addition; 2. Alcohol iodine allergy with caution; 3. The article has a corrosive effect on metal, can not be used for disinfection of metal products. 4. Please place the article in a cool, dry and ventilated place.

Iodophor and iodine are the same iodine containing disinfection preparations, the two effects are similar with a strong broad spectrum bactericidal impact, and both through the use of iodine oxidation invasion of bacterial proteins, to inactivate bacteria, make bacteria lose vitality, so as to kill bacterial reproduction, fungi, protozoa and some viruses. Iodophor is a common bactericidal disinfectant in medical treatment, which is widely used in skin disinfection and mucous membrane disinfection. Compared with iodine, iodophor has a wider range of sterilization and less skin irritation, but iodine is easier to produce, the cost is lower, and because iodine is added to alcohol, its sterilization effect will be faster. Iodophor is mainly used for skin disinfection, skin disinfection before injection and skin disinfection before operation in medical treatment, while iodine is mainly used for skin disinfection, mucosal disinfection, tissue dressing disinfection and skin disinfection before injection. The concentration of iodophor is relatively low and usually appears as an almost colorless liquid. Iodine, on the other hand, has a higher concentration and is usually brownish-yellow or yellow-brown. Iodophor is less irritating to human skin and mucous membrane, while iodine is opposite. Iodine is the main effective disinfection ingredient in iodophor and iodine. Iodophor is formed when iodine is dissolved in water by a special process. It can be used to disinfect the skin and the mucous membrane and also can be used in mouthwash for stomatitis or rinsing for vaginitis. Iodophor can also be used in surgical procedures to disinfect the surgical site or the skin of the operative. Iodine is less irritating and non-corrosive, and can be used on damaged areas such as surgical wounds without causing skin pain.

Povidone iodine: Povidone iodine solution (also known as Polyvinylpyrrolidone iodine) and iodophor (also known as iodide), are a class of matters classified by the chemical composition. Povidone iodine is an amorphous combination of elemental iodine and Polyvinylpyrrolidone, that is, a loose compound formed by combining elemental iodine and polymer carrier, Povidone only plays the role of carrier and solubilization. Povidone iodine is light colored, easy to eluate, less irritating to mucosa, and has low toxicity. Polyethylpyrrolidone as a carrier not only is helpful to enhance the solubility of iodine, but also provides a reservoir for the continuous release of iodine. When the effective iodine content reaches 0.45%-0.55%, Povidone iodine, as the main component, can kill intestinal pathogens, pyogenic coccus, pathogenic yeast and common bacteria in the hospital. This usage is suitable for hands, skin and mucous membrane of surgical disinfection. Usage NO.1: Injection, wipe with the original solution twice, the action time is 1 minute; NO.2: The operation, with the original liquid wipe twice, the action time is 2 minutes; NO.3: Surgical hands disinfection, wipe with liquid, the action time is 3 minutes; NO.4: Encountered burns, wounds, oral and vaginal mucosa, to dilute this 10 times, rub or rinse, the

action time is 5 minutes. Precautions 1: This is a topical disinfectant, not oral; 2, Alcohol iodine allergy with caution; 3, it has a corrosive effect on metal, can not be used for disinfection of metal products; 4, it should be placed in a cool, dry, ventilated place. Povidone iodine solution and iodophor both belong to the broad spectrum of strong sterilization disinfectants, and have a strong killing effect on bacteria, germs, and fungi, their irritation are relatively small, the effect lasts longer; Povidone iodine solution for external use may cause allergic reactions to the skin, adverse reactions to burns and skin peeling places, not recommended for infants and young children; However, iodophor is safer and can be used by infants and young children. Povidone iodine solution is a disinfectant preservative, but iodophor disinfectant's composition is relatively simple. Povidone iodine solution has a strong irritation, we need to avoid contacting with the eyes, mouth and other mucous membranes when using it, patients who are allergic to the drug should avoid using it. Iodophor disinfectant should be dipped in sterile gauze or sterile cotton swab, wrung out and applied on the skin surface. There are many dosage forms of Povidone iodine, including Povidone iodine cream, Povidone iodine gargle and Povidone iodine suppository and Povidone iodine solution. Different efficacy: Iodophor can be used to treat suppurative dermatitis, skin fungal infections, and for wound disinfection of small areas of skin or mucosa, while Povidone iodine needs to be judged according to the dosage form. For example, Povidone iodine cream can be used for bacterial vaginitis, mixed infectious vaginitis, etc. Povidone iodine gargaries can be used for stomatitis, oral ulcers, periodontitis, etc., and Povidone iodine suppository can be used for bacterial vaginitis and vulvovaginal candidiasis, and also can be used for the treatment of hemorrhoids. The main difference between the two drugs is in the complexing agent: iodophor is a skin disinfectant, Povidone iodine is a skin mucosal disinfectant; Iodophor is stronger than Povidone iodine in terms of bactericidal effect. And they are both complexed iodine, but the composition of the complexing agent is not the same: Iodophor is complexed by iodine plus surfactant and chlorhexidine alcohol, while Polyketiodine is PVP and iodine complexed. And the effective concentration of vidone iodine is 0.5% to 1%, and the effective concentration of iodophor is 0.2%. The using object of Povidone iodine and iodophor is also different, iodophor is mainly used in skin disinfection, while Povidone iodine is mainly used in the disinfection of skin mucous membranes. The concentration of iodophor is 0.5%, Povidone iodine solution is 5%, to a certain extent, Povidone iodine solution is better than iodophor, and the sterilization time is longer.

El Iodine Skin Sanitizer: It's a formula that contains ethanol, so it can be painful to disinfect broken skin. Eliodide is not a simple tincture of iodine, it contains iodine, chlorhexidine acetate, alcohol, which can kill pathogenic pyogenic bacteria, intestinal pathogens, pathogenic yeast and hospital infection common bacteria, so as to play a role in preventing infection. Its main components are ethanol and iodine, consisting of iodine 0.23%, chlorhexidine acetate 0.5%, ethanol 65%, and can be used for trauma, preoperative skin disinfection. Technically speaking, Ieriodide is an iodine complex. The difference with iodine is that it is not necessary to use alcohol to deiodide after disinfection, and iodine needs to be deiodized otherwise it will cause iodine absorption. Both Eriodide and iodophor can be

used to disinfect surfaces of objects or skin. But relatively speaking, the iodine content of iodophor is higher than that of Eriodide, so the disinfection effect is better. Aier iodine is mainly used for the disinfection of the skin surface, because it contains a certain amount of alcohol, so it is generally not used for the disinfection of mucous membranes and wounds, due to alcohol will cause certain irritation to mucous membranes. Iodophor does not contain alcohol, so it can be used to disinfect mucous membranes and wounds, and is relatively common in life. In addition, because of the short disinfection time and long-term sterilization, Eriodide can maintain the antibacterial ability of the disinfection site for a long time, and strive for more treatment time. Eriodide is usually used for preoperative disinfection of surgery, as well as the doctor's hand washing disinfection.

2. Chlorhexidine: Chlorhexidine is a broad-spectrum antibacterial disinfectant that can kill many bacteria, fungi and viruses. It is often used to disinfect the skin, but can also be used to disinfect instrument surfaces and surgical areas. Chlorhexidine is mainly composed of gluconochlorhexidine and ethanol (gluconochlorhexidine 2%, ethanol 70%), which can kill intestinal pathogenic bacteria, pyogenic coccus, pathogenic yeast and common bacteria of hospital infection. Chlorhexidine is suitable for complete skin disinfection, venous puncture catheterization, blood collection and skin disinfection at surgical sites. The effect is 1 minute and waited till to dry. Cautions 1. Chlorhexidine is a topical disinfectant and should not be taken orally. 2. Avoid touching the eye and ear canal; 3. It is prohibited for those allergic to chloridine; 4. Place in a cool, dry and ventilated place. Main ingredients of common hand sanitizer: chlorhexidine gluconate 0.18-0.22%, which has bactericidal effect on intestinal pathogenic bacteria and suppurative coccus. Suitable for skin cleaning, decontamination and first hand disinfection before the surgery. Usage: Firstly wash hands with a small amount of water, take an appropriate amount of hand sanitizer and palm, following the seven-step washing method to fully rub, rinse with water. Please notice that for external use only, not oral.

3. Peracetic acid: Peracetic acid is an oxidizing disinfectant that kills many bacteria, fungi, and viruses. It is often used to disinfect the surface of instruments and can also be used to disinfect the surface of surgical areas. Peracetic acid uses hydrogen peroxide as the main active ingredient. Acetic acid content is 2.7% to 3.3%. This acetic acid can restrain intestinal pathogens and streptococcus pyogenes, and can be used in antibacterial skin rinse and clean wounds. When using it, apply with a cotton swab dipped in the original solution to wipe or rinse. Precautions 1. For external use of disinfectants, not oral; 2. It has a corrosive effect on metal, use with caution; 3. Avoid mixing with alkaline and reducing substances 4. Placed in a cool dry ventilated place.

4. Ethanol: Ethanol is a commonly used disinfectant that can kill many bacteria, fungi and viruses, such as intestinal pathogens, suppurative coccus, pathogenic yeast. It is often used to disinfect skin surfaces, instrument surfaces and surgical areas. When using, the original solution should be evenly applied on the skin surface for 2 times, and the effect is 3 minutes. However, ethanol does not kill all of the microbes, so it may need to be combined with other disinfectants. Precautions in the trial: 1. Close in time after opening and using to prevent volatilization; 2. Alcohol allergy prohibited; 3. External use,

not oral; 4. Flammable products, away from fire and high temperature; 5. Placed in a cool dry ventilated place.

5. Chlorhexidine gluconate: Chlorhexidine is a broad-spectrum antibacterial disinfectant that kills many bacteria, fungi and viruses. It is commonly used for the disinfection of skin, instrument surfaces and surgical areas. The main ingredients of commonly used hand disinfectant are glucose acid chlorhexidine, ethanol, chlorhexidine: 1.2%, ethanol 12%, which can kill intestinal pathogens, pyogenic coccus, pathogenic yeast and common bacteria of hospital infection. Chlorhexidine gluconate is suitable for disinfection of surgical hands and hygienic hands at work. 1. Disinfect surgical hands. After cleaning hands, take appropriate amount and rub evenly for 3 minutes until dry. 2. When you at work, take appropriate amount, knead for 1 minute. Note: 1, for external use of disinfectant, not oral: 2. Used to clean dry hands; 3. Alcohol allergy is prohibited; 4. Place in a cool, dry and ventilated place.

6. 84 Disinfectant: Using Sodium hypochlorite as the main component, the effective chlorine content of 3.7%-4.99%, can kill intestinal pathogens, pyogenic coccus, pathogenic yeast and common infection bacteria in the hospital, suitable for the surface of general objects, mucus and other body fluid contamination articles, excreta disinfection. Usage 1: Wiping the surface of the items that need to be cleaned, the ratio of liquid to water is 1:200, the action time is 10-30 minutes; 2: Blood, mucus and other body fluids pollution, the ratio of raw liquid to water is 1:9, the action time should be longer than 60 minutes. Precautions 1. This product is for external use and should not be taken orally; 2. Do not dilute with hot water above 40 °C; 3. It has a corrosive effect on metal, can not be used for disinfection of metal products; 4. Place in a cool, dry and ventilated place.

7. Glutaraldehyde: The main component is glutaraldehyde, its effective content is 2.2%, which can kill bacterial propagules, fungi and bacterial spores, and is used for soaking disinfection and sterilization of medical devices. 1. Before using it, adding sodium nitrite and sodium bicarbonate, make them fully mixed (sodium bicarbonate to adjust the PH value, when the ph value is higher than 9, lose the sterilization ability, sodium nitrite is to prevent corrosion of the instrument); 2. Disinfect and soak for 60 minutes; 3. Sterilize and soak for 10 hours. Precautions 1, shall not be used for injection needles, surgical sutures and cotton products to do disinfection or sterilization 2, shall not be used for indoor articles' wiping.

8. Phthalic aldehyde disinfectant (OPA): It is a disinfectant with phthalic aldehyde as the main effective ingredient, and the content of phthalic formaldehyde is 0.5% to 0.6%, which can kill intestinal pathogenic bacteria, pyogenic coccus, and subtilis black variant spores. Its role is in the high-level disinfection of heat-resistant endoscopes and other instruments: with the endoscope cleaning and disinfection machine and manual cleaning and disinfection for the same procedure as the endoscope cleaning and disinfection machine to carry out high level disinfection of endoscopes. The commonly used disinfection and sterilization methods of OPA include immersion method: the endoscope to be sterilized or sterilized is thoroughly cleaned according to the requirements of the "Disinfection Technical Specifications", and the soft endoscope joint to be sterilized is opened and completely soaked

in the disinfectant. The disinfection time should longer than five minutes, and after disinfection things must be thoroughly rinsed with sterile water. Precautions: 1. This product is for external use, should not be taken orally, and should be placed in a place inaccessible to children; 2. Before disinfection, medical devices must be thoroughly cleaned in accordance with the “disinfection technical Specifications”; 3. After disinfection the product must be thoroughly cleaned; Disinfection operators should use appropriate size and length of gloves, wear protective glasses and anti-fluid clothing; 4. Disinfection operation room must have good ventilation conditions; 5. The disinfection container should have a closed cover; 6. It can be reused for 14 days, but the content must be tested during reuse to ensure that the content of phthalaldehyde is higher than 0.3%; 7. This product has a certain irritation, and may cause allergies, such as splashing on the eyes or skin, please immediately rinse with water for at least 15 minutes, and seek medical attention immediately. Phthalaldehyde disinfectant (OPA) should be stored in a cool, ventilated place away from light.

These disinfectants all have their advantages and disadvantages. For example, iodine is less resistant to certain microbes, and chlorhexidine may cause allergic reactions in some people. When choosing a disinfectant, we need to consider factors such as the type of surgery, the patient's condition, and the disinfectants available. In addition, when using any surgical disinfectant, it is important to follow the correct application method and dosage to ensure effective and safe disinfection. Surgical personnel should fully understand the proportion, performance and use of disinfectants, because it is difficult for patients after anesthesia to have accurate information feedback. Surgery related to the eye, ear, nose and throat must pay special attention to mucosal and functional damage when selecting disinfectants, such as the middle ear and inner ear disinfection, alcohol-based disinfectants will have a serious impact on hearing and vestibular function.

The problem of safety use and waste of disinfectants are also common in clinical work, which will also affect the colonization of drug-resistant strains in hospitals (Yang, Yu, Fu, et al., 2010; Wang, Zhang, Zhang, et al., 2015). The research report pointed out that with the extension of the using time, the disinfectant would cause bacterial contamination, and the pollution rate was 2.52%, and the over-standard rate was 1.83% (Zhang, Song, Zhang, et al., 2013). The safety and effectiveness of skin disinfectant is generally affected by environmental temperature, humidity, air cleanliness, exposure time, human factors (operating habits, use of sterile cotton swabs, repeated use) and other factors (Wang, Bie, Cheng, et al., 2015).

In short, the use of disinfectants requires medical staff to fully understand and correctly select them in order to better serve patients and medical treatment.

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