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## Comparing the Effect of Disinfectant Solution of 2% Chlorhexidine Gluconate and 70% Alcohol on Prevention of Phlebitis

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### ABSTRACT

Intravenous injection is the most common and important action in patients admitted to the hospitals. It may cause local or systemic complications or infections. One of the cases that can be effective in prevention of infection is to use appropriate skin disinfectant solution during injection. This study is a controlled, clinical, trial one in which two disinfectant solutions of 2% Chlorhexidine and 70% alcohol were compared. The study population included patients admitted to the female orthopedic department of medical educational center of Alzahra Hospital affiliated to Isfahan University of Medical Sciences in Isfahan, Iran. The studied sample consisted of 100 venipuncture cases (50 cases with disinfectant solution of 2% Chlorhexidine and 50 cases with 70% alcohol). SPSS software version 20.0 was used for data analysis. Results showed that out of the 100 cases of venipuncture, 59 cases of phlebitis were observed and the highest percentage of phlebitis was at the age of 50 years (70%). It has found that the use of 2% Chlorhexidine significantly reduced the cases and severity of venous phlebitis ( $P$  Value = 0.009). In the present study, 2% Chlorhexidine solution was associated with lower phlebitis compared to 70% alcohol.

**Keywords:** 2% Chlorhexidine gluconate, 70% alcohol, phlebitis

### INTRODUCTION

Intravenous injection is a common and important practice in hospitalized patients, so that its rate was estimated 25 million people in past decade, while its rate is higher than it [1]. Intravenous injection use for delivering fluids, medications, parenteral nutrition, blood components and hemodynamic status control. This intravenous injections may cause local complications such as phlebitis and systemic complications such as septicemia leading to increased rate of morbidity and mortality and prolonged hospitalization period. One of the cases that can be effective in preventing infection is to use appropriate skin disinfectants during the injection [2]. In a study, the efficacy of a new skin disinfectant, 2% (w/v) chlorhexidine gluconate (CHG) in 70% (v/v) isopropyl alcohol (IPA) (ChlorPrep), was compared with five commonly used skin disinfectants against *Staphylococcus epidermidis* RP62A in the presence or absence of protein, utilizing quantitative time-kill suspension and carrier tests. Overall, the most effective skin disinfectants tested against *S. epidermidis* RP62A were 2% (w/v) CHG in 70% IPA and 10% (w/v) PI. These results suggest that enhanced skin antisepsis may be achieved with 2% (w/v) CHG in 70% (v/v) IPA compared with the three commonly used CHG preparations [0.5% (w/v) aqueous CHG, 2% (w/v) aqueous CHG and 0.5% (w/v) CHG in 70% (v/v) IPA] [3]. The recommended preventive strategies with the strongest supportive evidence are full barrier precautions during central venous catheter insertion; contamination shields for pulmonary artery catheters; povidone-iodine ointment applied to insertion sites of hemodialysis catheters; and use of chlorhexidine-silver sulfadiazine-impregnated or minocycline-rifampin-impregnated short-term central venous catheters if the rate of infection is high despite adherence to other strategies that do not incorporate antimicrobial agents (for example, maximal barrier precautions) [4]. The risk of phlebitis in the presence of catheter colonization was 82% lower for

chlorhexidine-coated polyurethane catheters compared to otherwise identical uncoated catheters [5]. Bloodstream infections related to use of catheters, particularly central-line catheters, are an important cause of patient morbidity, mortality, and increased health care costs. Among patients with a central vascular catheter, chlorhexidine gluconate reduced the risk for catheter-related bloodstream infection by 49% [6].

In a study in which skin was disinfected before inserting catheters randomly by chlorhexidine, betadine, and alcohol, it was observed that the cases that chlorhexidine was used for disinfecting the injection site, the infection of catheter was 0.5 with 2.6% betadine. In addition, it was 2.3% in people alcohol was used and it was observed that chlorhexidine is related with catheter with the lowest percentage of infection. In a study, the researchers concluded that 0.5% chlorhexidine gluconate in 70% isopropyl alcohol appears to be more efficacious than 10% povidone-iodine for the prevention of peripheral intravenous catheter colonization in neonates [7]. As the effectiveness of chlorhexidine in preventing the infection was higher than alcohol and betadine, researchers decided to compare the effect of chlorhexidine with alcohol in preventing the venous phlebitis to examine adequacy of appropriate antiseptic. The aim of this study was to compare the effects of 2% chlorhexidine antiseptic solution with 70% alcohol to disinfect the skin at the injection site in phlebitis prevention.

### MATERIALS AND METHODS

Type of Study: This study was a randomized, controlled- clinical trial.

Population of study included patients admitted to the female orthopedic department in Medical and educational hospital of Alzahra Hospital affiliated to Isfahan University of Medical Sciences, Isfahan, Iran. Inclusion criteria: the age range of over 18 years was selected for equalization in terms of age. In terms of sex, only females were studied, and those patients were selected who had perfectly healthy veins and were not drug abusers. The used Branwell was same built with same factory. Orthopedic department patients were selected considering the similarity of type of injected drugs that most of them were Cephalexin.

Exclusion criteria: patients were discharged before first 72 hours, and in the case of sensitivity of the patient's skin to each of alcohol and chlorhexidine, they were excluded from study.

$$n = \frac{(Z_{1\alpha} + Z_{1\beta})^2 [P_1(1 - P_1) + P_2(1 - P_2)]}{d^2}$$

$$Z_{1-\frac{\alpha}{2}} = 1.96$$

$$Z_{1-B} = 1.28$$

$$D = 0.3$$

(Comparing the effect of betadine solution effect and  $P_2 = 80$ ,  $p_1 = 30$  and chlorhexidine on blood infection) and as in an investigation that researcher conducted, about 50-70% of phlebitis have were seen ( $n = 400$ ), which researcher randomly changed the venous infection site with disinfection 2% chlorhexidine, and after 72 hours (in the absence of phlebitis) the site of venipuncture was changed. Then, to disinfect the venipuncture site, that person used alcohol solution. Accordingly, 50 cases of venipuncture site with alcohol and 50 cases of venipuncture with 2% chlorhexidine were examined and compared in terms of severity of phlebitis.

Before venipuncture, disinfections was conducted by one of the 2% chlorhexidine and alcohol solutions and venipuncture site was checked every 8 hours up to 72 hours, and it was followed up to three days after removing venipuncture site Branwell in terms of phlebitis. A study was conducted in terms of phlebitis in each shift and the case of doubt to presence of phlebitis, a contact was made with executor of plan, and he confirmed the site of venipuncture with help of assistant in terms of swelling, redness and accuracy of diagnosis, and it was recorded and venipuncture was changed. In the case of discharge, patients were followed up through address and phone up to three days after the end of last venipuncture, and it was recorded in the information from in the case any complication. To prevent bias, observer and vein receiver were two persons and observer was not aware of type of disinfectants used, and data were recorded.

Variables: vein phlebitis was dependent variable and disinfectants (70% alcohol or 2% chlorhexidine) were the independent variable.

Data gathering tools: it was researcher-made questionnaire consists of two parts that the first part include age, diagnosis of disease, the number of intravenous antibiotics, and length of time of catheter in the vessel. The second part includes table to determine phlebitis graded from 0-4. In this grading, grade zero represents the presence of phlebitis, grade one represents redness at the injection site with or without pain. Grade 2 represents pain and redness at the injection site with or without swelling. Grade 3 represents pain and redness or swelling and tactility of venous vessel path. Grade 4 represents pain, redness, swelling, and tactility of venous vessel path at the length of more than 2.5 cm and removal of purulent discharge from vessel.

### Validity and Reliability

Scientific validity: multi-part questionnaire was used to collect data to determine its scientific validity by views of faculty members of infection department.

Practical validity: to determine the practical validity of the questionnaire, 10 patients were studied as pilot and drawbacks of questionnaire were modified

Analysis of the data: the data were analyzed by SPSS software version 20.0 to compare the severity of phlebitis, and results were reported.

### Ethical considerations:

1. Permission and oral consent was obtained from patients and explain the objectives of research for units that were studied and patients were given this allowance to go out of the project, if they wanted.

1. Lack of 2% chlorhexidine solution was one of the problems of this project that it was produced by Shahr Daru Company in Tehran.

2. The discharge of patients before 72 hours that caused the person to be excluded from the study.

3. Lack of access to some patients after discharge for follow up of phlebitis led to exclusion of the person from the study and new case was given for alternatives.

## RESULTS

In this study, among 100 cases of normal venipuncture, 59 cases of phlebitis were observed (59%). Most patients (68 patients) in the age group under 30 years (68%) and the lowest number (8 patients) were in the age group of 50-30 years (8%). Vein phlebitis in patients over 50 years was observed in 17 patients (70%) and it was observed in 36 patients in the age group under 30 years (52.9%).

Out of 100 cases, the most cases of phlebitis were 1 and 2 grade with total number of 49 cases in two groups of 70% alcohol and 2% chlorhexidine that among this number, 17 cases were in 2% chlorhexidine group and 32 cases were in 70% alcohol group. Significant difference was observed statistically. The most cases of phlebitis occurred in the third day in both groups.

In this study, 50 patients with a mean age and standard deviation of  $21 \pm 32.5$  in the 2% chlorhexidine group and 50 patients with same standard deviation in the 70% alcohol group were examined.

In patients which 70% alcohol was used before inserting the catheter, their catheter was used due to phlebitis that significant difference was observed between two groups. In the current study, the effect of 2% chlorhexidine-alcohol solution after routine venipuncture was compared in terms of creation of phlebitis in the venous catheter entrance site, and the number of phlebitis cases in the 70% alcohol group was higher.

**Table 1- Relative frequency distribution of the studied subjects according to age**

Age	N	%
18-30	68	% 68
31-50	8	% 8
50>	24	% 24
Total	100	% 100

The highest percentage was in the age group under 30 years (68%) and lowest percentage was in the age group 50-30 years (8%).

**Table 2 - Relative frequency distribution of venous phlebitis in patients in terms of age**

Age	The number of phlebitis cases	%
18-30	36	52.9%

31-50	5	62.5%
50>	17	% 70

Table 2 shows that the highest percentage of vein phlebitis was in age group over 50 years (70%) and the lowest percentage of vein phlebitis was in patients aged less than 30 years (52.9%).

**Table 3 – Comparing the phlebitis frequency percentage in two groups of case and study**

Phlebitis severity	Chlorhexidine	Alcohol group	P value
Grade 1	14 (% 28)	21 (% 42)	0.009
Grade 2	3 (%6)	11 (%22)	
Grade 3	5 (%10)	5 (%10)	
zero	28 (% 56)	13 (%26)	

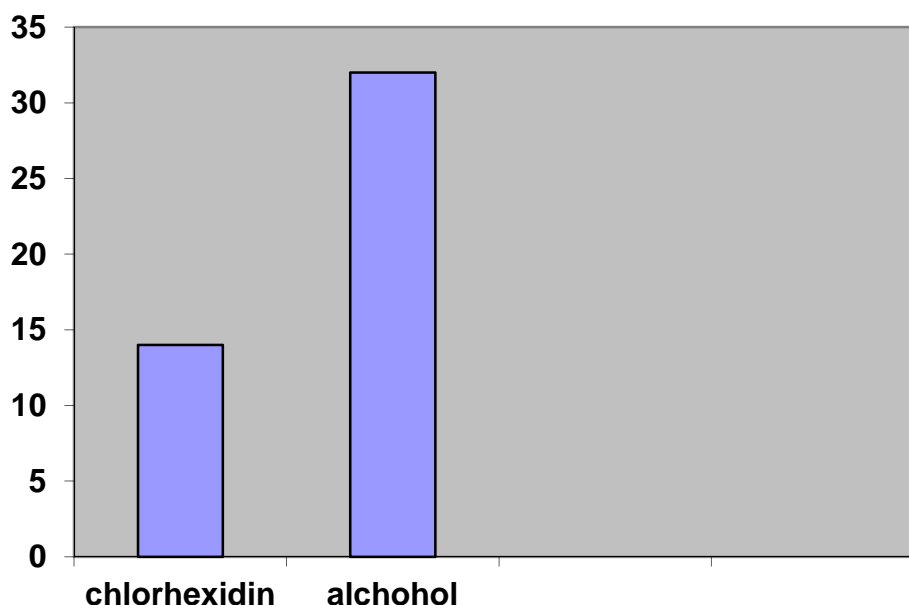
In the present study, phlebitis changes in the two studied groups (2% Chlorhexidine) and control (alcohol) were significant using chi-square test.

**Table 4 – Creation of phlebitis in days in alcohol and 2% Chlorhexidine groups**

Creation of phlebitis day	Chlorhexidine groups	Alcohol group	P value
1	3(6%)	3(6%)	0.015
2	5(10%)	7(14%)	
3	13(26%)	27(54%)	
4	1(2%)	---	
Non-creation of phlebitis	28(56%)	13(26%)	

In this study, most cases of phlebitis were observed at the end of third day in both groups.

Table 4 shows the phlebitis created in chlorhexidine and alcohol groups. Comparing two groups in terms of phlebitis creation was significant in terms of phlebitis creation using chi-square test.



**Figure 1: percentage of frequency of catheter removal in each of the two groups in which disinfectant was used.**

In the current study, in 100 cases of routine venipuncture, 59 cases of phlebitis were observed. (59%) . most of the patients (68 patients (59%)) were at the age group under 30 years and the lowest number (8patients) were at the age group of 30-50 (8%).

Venous phlebitis occurred in 17 patients at the age group over 50 years and it occurred in 36 patients at the age group under 30 years (52.9%).

Out of 100 cases, the highest cases of phlebitis were at the grade 1 and 2 with total number of 49 cases in two chlorhexidine and alcohol groups, which 17 cases were in the chlorhexidine and 32 cases were in the alcohol group, and results were different statistically with p-value (0.009).

The greatest cases of phlebitis occurred on the third day in both groups. Acceptable level to create phlebitis is about 50% or less [2], while it exceeds from this value in hospital, the change in the hospital policy to replace the vessel site early seems to be necessary (usually 72 hours). The highest cause of mechanical phlebitis is due to mismatch between the catheter and vessel or chemical due to use of solutions with high or low PH or osmolality.

When the catheter is appropriate and standard solution (such as this study conditions), the agent of creating the phlebitis is bacterial accumulated between skin and catheter and it is proliferated. The transfer of bacterium to vessel may lead to septicemia, as approximately 80,000 cases occurs in patients hospitalized in special parts of USA hospitals costing 296 million to 3.2 billion US \$ [4,5]. In the current study, the effect of 2% chlorhexidine and 70% alcohol was compared after routine venipuncture in terms of creation of phlebitis at the venous catheter entrance site, and the number of phlebitis cases was higher in the alcohol group.

In a prospective, randomized, and double-blind study, Sheretz et al. showed that catheters coated with chlorhexidine have less chance of phlebitis. Although this chance was significant with control group statistically [5]. Sheretz et al. results are consistent with results of the current study, and they verify the superiority of chlorhexidine.

Additionally, another study that compared chlorhexidine with a solution of iodized - Povidone solution found that microbial accumulation is due to attachment site of catheter and septicemia. Garland et al used chlorhexidine 0.5% and compared it with iodized-Povidone and they finally reached to same results [7]. The difference between this study and the current study is use of alcohol and chlorhexidine together in mixed form, but results confirmed the superiority of chlorhexidine. In a systematic review and meta-analysis of 8 trials involving 4,143 unique catheter insertions, skin antisepsis with chlorhexidine was found to be associated with a 50 percent reduction in the subsequent risk of central-line associated bloodstream infection (CLABSI) compared with povidone iodine [6,8]. Sarani et al. finding showed that, the use of alcohol - povidone-iodine for skin preparation before attaching catheters based on this study, the incidence of phlebitis with alcohol and povidone-iodine is no different, but in terms of local infection control more effective than sole alcohol or povidone-iodine [9]. The results of this study and other research colleagues showed that the effect of 2% chlorhexidine Gluconate compared with alcohol and povidone-iodine for preventing in venous catheter complications is more effective [10, 11, 12].

Despite the fact that none of our patients received lipid solution and venous nutrients, central venous also was not used. Most cases of phlebitis happened on the third day, but the cases of phlebitis were at the grade 1 and 2. However, the number of cases of phlebitis seems to be high than patients, and it seems that it relates to factors such as catheter types, age of patients, or improper care of catheter site.

As in the age of fifty years, cases of phlebitis were more than other groups. That is why change in catheter site seems to be necessary in our parts after 72 hours at maximum. In general, in the current study, 2% chlorhexidine solution was associated with less phlebitis than alcohol. By using various concentrations of these two solutions and comparing them with other materials, better and most appropriate concentration can be determined in future, as solution 0.5% was equally effective in other different studies.

### **Executive Recommendation**

Since the use of chlorhexidine 2% has reduced both cases and severity of phlebitis in an intravenous injection compared to alcohol, it is recommended that chlorhexidine can be used instead of alcohol for disinfection injection. Infection rate is a outcome standard which it not only consisted of all patients has acquired the infections but also it indirectly evaluated and measured the effectiveness of infection control techniques and procedures [13]. It is recommended to train expert nurses to adhere the disinfectant techniques in all treatment procedures especially injections. It is more important because the infections led in job stress and threaten the health and life quality of nurses [14].

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## REFERENCES

- [1] Alycr A, Schuitzpauletce Gallant, Evidence – based Quality improvement project for determining Appropriate discontinuation of peripheral intravenous cannulas . Nursing spectrum evidence – based practice contest winners **2003** November2.
- [2] Doris A .Millan , RN , Susan Masoorli . Avoiding the pitfalls of IV therapy. Nursing spectrum, career fitness online . Education / CE, self-study Modules.
- [3] Adams D1, Quayum M, Worthington T, Lambert P, Elliott T. Evaluation of a 2% chlorhexidine gluconate in 70% isopropyl alcohol skin disinfectant, **2005** Dec;61(4):287-90. Epub **2005** Oct 10. PMID: 16221509.
- [4] Mermel LA . *Ann Intern Med.* **2000**;132(5):391-402. Doi:10.7326/0003-4819-132-5-200003070-00009
- [5] Sheretz RJ .Stephanes JL .Marosok RD. Carruth WA. Rich HA, Hampton KD , Motsinger SM , Harris LC , Scuderi PE , Pappas JG , Felton SC , Solomon DD . *Infect Control Hosp Epidemiol* . **1997**, 18(4): 230-6. PMID: 9131364.
- [6] Chaiyakunapruk N .Veenstra DL Lipsky BA , Saint S . *Ann Intern Med.* **2002** Jun 4; 136(11):792-801. PMID: 12044127.
- [7] Garland JS , Buck RK , Maloney P , Durkin DM , Toth – Lioyd S , Duffy M , Szocik P , McAuliffe TL , Goldmann D. *Pediatr Infect Dis J.* **1995** Jun; 14(6):510-6. PMID: 7667056.
- [8] Vineet Chopra V.; Krein S L. Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices, Evidence Reports/Technology Assessments, No. 211. Rockville (MD): Agency for Healthcare Research and Quality (US); **2013** Mar.
- [9] Sarani H., Ebrahimitabas E., Arbabisarjou A. (2004). *JQUMS*, **2004**, 32, 8-14.
- [10] Zamanzadeh V., Kolahdoozipour J., Abdollahzadeh F., Lotfi M. *The Journal of Tabriz University of Medical Sciences*, **2008**, 30(3); 55-60.
- [11] Maki MD, Prof C., Alvarado M. *Ringer Lancet*, **1991**;338(8763):339-343.
- [12] Olivier M., *Ann Intern Med*; **1991**, 131:834-837.
- [13] Arbabisarjou, Azizollah. Practical leadership and Management in nursing (translated), **2012**, Tehran: Nashre Jameanegar.
- [14] Arbabisarjou, A. Kord F., Ansari H. *Der Pharmacia Lettre*, **2015**, 7(9):305-309.