COMPARATION OF EFFECTIVENESS OF NORMAL SALINE AND 10% POVIDONE IODINE IN PERIURETHRAL CLEANING IN REDUCING THE RISK OF URINARY TRACT INFECTION

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Abstract

Currently, the incidence of urinary tract infection in patients with indwelling urinary catheter ranges between 10-80%. They are at risk for other problems that can cause death. Appropriate action is required to decrease the risk of urinary tract infection by periurethral area cleaning. The aim of this study was to analyze the differences of the effectiveness of the use of normal saline and 10% povidone iodine for periurethral area cleaning in decreasing the risk of urinary tract infection. Research method was true experimental design with the population of patients who used indwelling urinary catheter in one of the hospitals in West Java. Samples size were obtained by consecutive and allocated by block randomization which were divided into 2 groups, each group were 17 respondents. In the treatment group, periurethral area was cleaned with normal saline and in the control group with 10% povidone iodine. Urinary tract infection risk assessment was carried out by the leukocyte esterase dipstick test at 8 hours after insertion. The results indicated that the incidence of urinary tract infections risk in the group using normal saline was smaller than 10% povidone iodine with a comparison of 1:1.3. Number need to treat in this study was 6. The conclusion of this study is normal saline is more effective in reducing the risk of urinary tract infection.

Keywords: normal saline, periurethral cleaning, 10% Povidone iodine, urinary tract infection risk

BACKGROUND

Nosocomial infection is a major topic selected in the global patient safety challenge during the period of 2005-2006 with the theme "Clean Care is Safer Care' (WHO, 2005a; 2005b). The incidence of nosocomial infections in the world is 1.4 million people.

Nosocomial infections include urinary tract infection (UTI), lung infection, surgical site infection (SSI), and blood infection (WHO, 2005a). The incidence of UTI in 2002 was 36% (Klevens et al., 2007). Hospital Infection Society (2007) found the incidence of nosocomial UTI in the UK is the second largest group with an amount of about 20% of all infections acquired in hospitals (Madeo & Roodhouse, 2009). The results of the prevalence survey in 11 hospitals in Jakarta by Perdalin Jaya and Infectious Diseases Hospital of Prof.Dr. Sulianti Saroso Jakarta in 2003 found that UTI was 15.1% (MoH RI, 2008).

Specific risk factor that underlies the occurrence of nosocomial UTI, one of them, is indwelling urinary catheter. The catheter provides a route for infectious agents such as bacteria to enter the bladder through the urethra. Bacteria can enter directly when the catheter is inserted. If the bacteria has entered to the bladder, the UTI can occur (Lawal, 2012; NICE, 2012; Warren, 2001; Maki & Tambyah, 2001). Madeo & Roodhouse (2009) states that the amount of catheterization in the acute care was 26.3% - 31%. While Hazelett et al. (2006) in their research founds in one month as much as 23.2% (379/1,633) of patients who admitted to the hospital through the emergency department was catheterized. Pellowe et al. (2004) and Tambyah (2004) found that 10-30% of patients was short-term catheterized (less than 28 days) will develop to UTI (Madeo & Roodhouse, 2009), and in the short-term or long-term indwelling catheter,

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infection rate is 3 -5% and 5% per day (Lawal, 2012; Nicolle, 2014). Gerberding (2002) found the incidence of UTI is 80%, with the risk factor is duration of catheterization more than 24 hours and the aging process.

The incidence of nosocomial UTI due to indwelling urinary catheter in several hospitals in Indonesia is quite varied. The incidence of nosocomial UTI due to indwelling urinary catheters insertion after 73 hours in the Raden Mattaher Hospital, Jambi as much as 23.91% (11/46) (Sepalanita, 2012). Study of Marlina & Samad (2013) who investigated the correlation catheterization with the incidence of nosocomial UTI found the incidence of nosocomial UTI in indwelling urinary catheterized patients in internal medicine room of dr. Zainoel Abidin Hospital, Banda Aceh was as much as 11.42% (4/35). The incidence of nosocomial UTI due to indwelling urinary catheters at dr. Hasan Sadikin Hospital in 2013 was as much as 0.06% (11/17,580) (PPI RSHS, 2013).

Incidence of urinary tract infection risk can be reduced by periurethral area cleaning before catheter insertion. Cleaning can be carried out by using normal saline solution or 10% Povidone iodine. Normal saline has several advantages, that is, causing plasmolysis effect on bacteria, sodium competes with protein molecules to obtain water molecules in the solution, resulting a protein liquid sheath will damaged, chloride can destroy the bacteria through the process of oxidation, has bactericidal effects and is not toxic and does not cause irritation (Alvarez, 2010; Jeong et al., 2010; Kaehn & Eberlein, 2009; Melliawati, 2009). Ten percent of Povidone iodine is effective against many bacteria and fungi, but iodine can lead to skin irritation (Boyce & Pittet, 2002). Irritation of the urethra will be predisposing factor for the entrance of bacteria into the tissues (Potter & Perry, 2005), so that the use of povidone iodine in the periurethral area does not reduce the risk of UTI (Tietjen et al., 2004). Besides irritating the skin, povidone iodine is also quite expensive (Jeong et al., 2010).

The purpose of this study is to analyze the differences of the effectiveness of the use of normal saline and 10% povidone iodine for periurethral area cleaning prior to indwelling urinary catheter insertion in decreasing the risk of urinary tract infection.

METHODS

The design of this study is experimental. In this study, the respondents were divided into 2 groups. One group was the treatment group and another group was a control group for comparison. In treatment group, periurethral area was cleaning with a solution of normal saline and in the control group, periurethral area was cleaning with a solution of 10% Povidone iodine. Post test in both groups is risk assessment of UTI for 8 hours after catheter insertion using leukocyte esterase dipstick test. The sample was a new patient has indwelling urinary catheterization in one of the hospitals in West Java. The sampling technique used in this study is consecutive and subject allocation which was block randomized. The study was conducted on June 2 to July 6, 2014. Data was processed and analyzed by descriptive and clinical significance parameter.

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RESULTS

Table 1 Frequency Distribution of Respondent Characteristics by Age, Sex and the Room of Respondent at June - July 2014 (n = 34)

Characteristics of Respondents	Group			
	Treatment		Control	
Age	Mean : 50.12		Mean : 49.94	
	n	%	n	%
Sex				
Male	7	41.2	11	64.7
Female	10	58.8	6	35.3
Room				
Medical	9	52.9	11	64.7
Surgical	8	47.1	6	35.3

Description of the average of age of the respondents in the treatment group was 50.12 and the control group was 49.94 (minimum of 40 and maximum of 60 years). Most of the sex of the respondents in the treatment group were female with a total of 10 respondents (58.8%), whereas in the control group, most of the sex of the respondents were male as many as 11 respondents (64.7%). Most of the rooms of the respondents in the treatment group and the control is medical, as many as 9 respondents (52.9%) and 11 respondents (64.7%) respectively (Table 1).

Table 2 Analysis of Comparison of Effectiveness between Normal Saline and 10% Povidone iodine in Periurethral Cleaning in Patients will Undergo Indwelling Urinary Catheterization in Decreasing the Risk of UTI in June - July 2014 (n = 34)

Group	Risk of UTI				Total		NNT
	Yes		No				
	n	%	n	%	n	%	
Control	13	76.5	4	23.5	17	100	5.6
Treatment	10	58.8	7	41.2	17	100	

Description:
NNT = 1 / ARR
ARR = CER - EER
ARR = 0.765 - 0.588 = 0.177
NNT = 1 / ARR = 1 / 0.177 = 5.6

Number need to treat (NNT) in this study was 5.6 (6) which means if the periurethral area cleaning with a solution of normal saline before indwelling urinary catheter in 6 people can avoid one occurrence of risk of UTI. Absolute risk reduction (ARR) in this study was 0.177, which means if normal saline solution was used as a cleaning agent for periurethral area before indwelling urinary catheter, then the difference of incidence of UTI risk between patients who was cleaned with normal saline compared to 10% Povidone iodine was 17.7%. Relative risk reduction (RRR) in this study was 0.23, which means if normal saline is used as a cleaning agent for periurethral area before indwelling urinary catheter, the incidence of UTI risk can be reduced by 23% from the previous one.

Description:
RRR = CER - EER / CER
= 0.765 - 0.588 / 0.765

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= 0.177 / 0.765 = 0.23

DISCUSSION

The results of this study showed that normal saline is more effectively in reducing the risk of UTI compared to 10% Povidone iodine in periurethral area cleaning in patients will undergo indwelling urinary catheterization. This is because of normal saline can be used as an antiseptic (Alvarez, 2010). The solution which contains electrically salt ion (such as sodium) will compete with the protein molecule to obtain water molecules in solution, as a result, protein fluid sheath will be damaged (Kaehn & Eberlein, 2009). Chloride can destroy the bacteria through the process of oxidation. Chloride in the water causes the free of O_2 so that these substances can kill the bacteria. Relationship of chloride with protoplasm also cause oxidation (Melliawati, 2009). Normal saline solution has an osmolarity of 310 mOsm/L (Kee et al., 2009).

Effectiveness of NaCl in this study because of NaCl has an antibacterial effect. Antibacterial effect of NaCl can be seen from in vitro studies conducted by Rams et al. (1984), that was aimed to evaluate the antibacterial effect of 1.0% chloramine-T (sodium paratoluene sulfonchloramide), saturated citric acid (pH1) and saturated solutions of several inorganic salts, including 0.74 M sodium bicarbonate ($NaHCO_3$), 5.3 M NaCl and 2.6 M hydrated magnesium sulfate (Epsom salts, $MgSO_4$) and water as a control against subgingival bacteria. Morphological effect were seen with a phase-contrast microscopy at 20 samples treated with NaHCO3, NaCl, MgSO4, citric acid, or chloramine-T, that was found the killing effect of bacteria, namely complete immobilization of the entire movement of spirochetes and the motile of the rod after 1 minute in vitro exposure. In contrast, there was no discernible effect on 4 samples exposed to the water, where the active spirochetes and motile rods $\geq$ 125 per microscopic field of view remains at the control sample. All of agents, except water, cause a marked change in the movement of the structure of the bacterial cell. Larger rods and filaments had a segmented appearance from precipitation or coagulation of intracellular structures. A pronounced reduction in bacterial cell-to-cell coaggregation was apparent. A fine granular material was seen through-out the fluid environment of the sample preparation after exposure to an agent (which includes NaCl).

Further, Rams et al. explain that the morphological effect of NaCl seen with the transmission electron microscopy. Cytotoxic effects of $NaHCO_3$ and NaCl were seen after exposure to the sample. Disorder and segmentation of cell wall and membrane of bacteria was seen, which cause leakage and release of intracellular cytoplasmic elements. In the control sample, it was not seen a large number of extracellular granular material in the sample if associated with extensive cell damage. Samples in the control did not show any morphological changes. A large number of spirochetes and gram-negative rods was seen morphologically normal in control samples.

The technique used in the above study to measure the presence or not of mobility and display abnormal cell morphology by direct microscopy, previously ever used in other studies to evaluate the in vitro effects of penicillin, erythromycin and other antibiotics on Treponema pallidum and non-oral spirochetes. Antibacterial effect of inorganic salts is usually considered to be mediated by the changes in large osmotic pressure caused by concentrations of hypertonic of salt in the aquatic environment. Changes in osmotic pressure cause the discharge of water from the bacteria cells into the extracellular, causing dehydration, plasmolysis, and cell death (Melliawati, 2009; Rams et al., 1984). This effect is observable in transmission electron microscopy, in which cytological damage in the form of cytoplasmic extracellular leakage and loss of integrity of the cell wall of bacteria seen in microorganisms that exposed to NaCl (Rams et al., 1984). Cytoplasmic membrane located

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just beneath of the cell wall, is semi-selectively permeable, because of these characteristics, the cytoplasmic membrane has important characteristics in the exchange of substances between the cell wall. The cytoplasmic membrane greatly affects the survival of bacteria, because if the membrane is damaged, then in a short time the bacteria will die (Melliawati, 2009). Furthermore Rams, et al. (1984) explains that after one year of evaluation, there was a significant decrease in the amount of total subgingival bacteria and spirochetes found in patients who underwent irrigation of inorganic salts.

Those findings are supported by Tortora et al. (2007) that the microorganisms obtain almost all their nutrients from the water. Microorganisms need about 80-90% of water for their growth. When microbial cells is in a solution with higher concentration than the cell (the environment more hypertonic from the cell), then the water in the cell will exit through the plasma membrane into a solution of higher concentration. This water loss will result in plasmolysis.

The results of the study showed normal saline is more effectively used to reduce UTI was found by Jeong, et al. (2010) with the result was an average of the cumulative incidence of UTI in 4 agent (soap and water, skin cleansing foam, povidone iodine and normal saline are 3.72; 2.65; 4.18; 1, 96, respectively. Although the conclusion of this study indicates that there was no significant difference in the incidence of UTI in the four agents, but the lowest cumulative incidence seen in normal saline.

The result of this study is also supported by the Department of Health and Human Services: Health Protection Scotland (2012) which recommends cleansing the urethral meatus with normal saline prior to indwelling urinary catheter insertion. It is also supported by the Head (2006) who used normal saline as a cleaning fluid before urinary catheterization, and the genitals of patient are recommended to be cleaned when bathing or at least cleaning the genitalia area before catheterization procedure. Pratt et al (2007) and Peate & Gault (2013) also suggest cleaning the meatus with sterile normal saline prior to short-term indwelling urinary catheter insertion in hospital (Wright & Pomfret, 2009).

The use of 10% Povidone iodine solution as a cleaning agent of periurethral area prior to indwelling urinary catheter based on result of this study has a lower effectiveness compared to normal saline solution. The reason for the low effectiveness may be related to the effects of iodine that can lead to skin irritation (Boyce & Pittet, 2002) and the use of povidone iodine in the periurethral area does not reduce the risk of UTI (Tietjen et al., 2004). In addition, iodine and 10% povidone iodine are characterized by a tendency to irritation and damage to the skin, also have an allergic or toxic effects in sensitive people (Larson & 1992, 1993, and 1994 APIC Guidelines Committee, 1995). Irritation of the urethra will be a predisposing factor for entry of bacteria into the tissues (Potter & Perry, 2005). Although antiseptic solution such as Povidone iodine traditionally has been used to clean the periurethral area before urinary catheter (Leaver, 2007), but according to the results of this study and supported by other guides, recommendations and expert opinions, then normal saline is better used as solution in the periurethral area cleaning prior to indwelling urinary catheter insertion.

The results of this study indicate the incidence of UTI risk in the treatment and control group is still quite high, namely 58.8% and 76.5%, respectively. This number is lower compared to Gerberding (2002) who found 80% incidence of UTI. The incidence of UTI risk in this study is quite high that might be due to the ages of respondents in this study were between 40-60 years. There has been a decline in the immune system since 30 years old of age and will continuously decrease in line with the age. Impaired secretion of timosin starts at that age. Timosin is an important hormone to increase the proliferation of new T cells in peripheral lymphoid tissues and strengthen the ability of T cell immunology. Reduced

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capacity of T cells causes the patient susceptible to infection.

CONCLUSION

Normal saline is more effectively in reducing the risk of UTI compared with 10% Povidone iodine in the periurethral area cleaning in patients with indwelling urinary catheterization.

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