ORIGINAL ARTICLE

SKIN ANTISEPSIS PRACTICES FOR CENTRAL NEURAXIAL BLOCKADE

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Background: Skin antisepsis is essential before the central neuraxial blockade. Various antiseptic solutions are in clinical use, like povidone-iodine, alcohol, or chlorhexidine. This study was conducted to assess current practices for skin antisepsis before central neuraxial blockade and observe the compliance of anaesthesiologists with international standards in Teaching Hospitals in Karachi, Pakistan**. Methods:** A cross-sectional study was conducted on all anaesthesia faculty members, working in Teaching Hospitals in Karachi from March to May 2022. Demographic data included institutional setup and current position at the institution. The type of solution used for skin anti-sepsis for the central neuraxial blockade, method of application, and subsequent practices of anti-sepsis were asked. Recommendations for skin anti-antisepsis and the reason for opting for their choice of solution and practices were also assessed. Stratification analysis was then performed to observe the effect modifiers of study variables. **Results:** Data from seventy faculty members were analyzed. Povidone-iodine was the most frequent solution used for skin antisepsis. Alcohol-based Chlorhexidine 2% and 0.5% were the choices. The application method prevalent was Sponge/swab with Gallipot (94.3%). Major reasons to opt for their choice of solution were personal preference, cost-effectiveness, and availability of the solution in their Institute. Fifty percent of physicians considered Chlorhexidine 2% as the recommended solution for central neuraxial procedures. Regarding sterility, over ninety percent adhered to the recommended practices. **Conclusion:** Povidone-Iodine is currently the most frequent solution used for skin antisepsis before central neuraxial blockade by anaesthesiologists. The recommended solution (Chlorhexidine) was not in clinical practice due to personal preference, cost-effectiveness, or unavailability.

Keywords: Skin antisepsis; Neuraxial anaesthesia; Regional anaesthesia; Patient safety

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INTRODUCTION

Skin antisepsis has been of paramount importance in neuraxial procedures. Mortality, though rare, has been associated with infections as a result of Neuraxial procedures.[1] Micro-organisms colonizing patients' skin, from the respiratory tract of Anaesthesiologists, and/or colonizing equipment used during the procedures have been suspected to be the major source of infections in these conditions.[2]

Different antiseptic solutions are found to have been used to achieve skin antisepsis, ranging from 10% Povidone-Iodine and 70% alcohol to Chlorhexidine in different concentrations and consistencys: aqueous and with alcohol. Povidone-iodine and Chlorhexidine are a preference among practitioners in attaining aseptic conditions, however, both are neurotoxic.[3] Chlorhexidine in alcohol is superior compared to Povidone-Iodine due to faster onset, longer duration of action, lesser incidence of allergic reactions, and being able to retain its efficacy.[4] The safety of anti-sepsis before central neuraxial procedures is still being debated all over the world. In 2008, U.S. Food and Drug Administration (FDA) issued a product warning against the use of the applicator in lumbar puncture and advice to avoid contact with meninges.[5] In 2009, the British Royal College of Anaesthetists 3rd National Audit Project guided the use of Chlorhexidine in spinal procedures, allowing for its off-label use and calling for formal institutional policies.[6] In 2014**,** the Association of Anaesthetists of Great Britain and Ireland (AAGBI) recommended the use of Chlorhexidine with caution to allow the solution to dry before the skin is palpated or punctured and to opt for 0.5% concentration instead of 2% due to neurotoxicity.[4] The American Society of Anaesthesiologists (ASA) Task Force later endorsed the practices in 2017, calling for adequate drying time.[7]

Skin antisepsis protocols vary widely across the globe. A 2015 UK survey revealed variation in skin antisepsis despite neuraxial block being a common procedure that demands standardization of practices.[8] Another survey conducted in Ireland revealed the use of both Chlorhexidine and Povidone-Iodine, with

Chlorhexidine being the preference in the majority of hospitals.[9]

In our region, the use of Chlorhexidine as a topical spray or splash-and-apply technique of the solution and Povidone-iodine prevails but the literature regarding the practices followed is scarce. Hence, there is a definite need to modify current practices for skin antisepsis for central neuraxial blocks as per the standard guidelines and recommendations of best practices and to create awareness of the international guidelines among anaesthesiologists working in our part of the world.

The rationale for conducting this study was to assess the practices for skin antisepsis before the central neuraxial blockade of the anaesthesia faculty members because that will be reflected in the practices of anaesthesia trainees and other physicians. This would help to create awareness about skin antisepsis before the central neuraxial blockade. The primary aim of this study was to assess current practices for skin antisepsis before central neuraxial blockade and the secondary aim was to observe the compliance of anaesthesiologists with international standards in teaching hospitals in Karachi, Pakistan.

MATERIAL AND METHODS

A cross-sectional study was conducted by using an online survey form, which was e-mailed to all anaesthesia faculty members who were fellows of the College of Physicians and Surgeons Pakistan (CPSP), working in teaching hospitals of Karachi from March to May 2022. Exemption from ethical review (ERC # 2021-6173-17882) was sought from the Institutional Ethics Review Committee.

The informed consent was taken before the data collection and all responses were kept anonymous. Participants were excluded from the study, who did not give consent or had submitted incomplete responses to the data form.

Demographic data included current institutional setup, years of practice, and current position at the institution. Types of solution used for skin anti-sepsis for the central neuraxial blockade, method of application, and subsequent practices of anti-sepsis practised were noted. Data was obtained regarding the current recommendations for skin anti-antisepsis and the reason for opting for their choice of solution and aseptic practices (sterile gloves, gown, face mask, mask, and drape).

The statistical analysis was carried out using R Studio version 4.2.1 software. Descriptive analyses are presented as mean (standard deviation) and median [minimum, maximum] estimates for quantitative variables such as total practice, and frequency with percentage for qualitative variables such as current institutional setup, current position, skin anti-sepsis practices, anaesthesiologists' knowledge, and attitude towards central neuraxial blockade, and so on. To determine the difference between various categories, stratification analyses were performed with respect to the institution, current position, and solution used.

RESULTS

A total of seventy-eight faculty members participated in this cross-sectional study, out of which data from seventy participants were included in this result. The median years of practice post fellowship were 14 years. Most of the physicians (67.14%) practice in private hospitals, 21.42% in the public sector, and 11.42% in charity-based hospitals. 24.28% were professors, 52.85% were either associate or assistant professors, and 22.85% were senior instructors/registrars as shown in Table-1.

The povidone-iodine solution was found to be the most frequent solution used by anaesthesia consultants (79.50%). Only 2.41% used surgical spirit/rubbing alcohol for skin anti-sepsis before central neuraxial blockade in their clinical practice as shown in Figure-1.

The application method prevalent was sponge/swab with gallipot (87.17%); followed by spray (10.26%) and applicator (2.56%). Almost fifty percent of them gave at least two minutes before wiping off the solution from the skin; 27.1% wiped after 1 minute while 28.6% waited for the solution to dry. 2.86% proceed immediately after the application of the solution.

About 33.7% of anaesthesia consultants had a personal preference for their choice of solution irrespective of recommendations, while 25.9% considered cost-effectiveness as the reason. 37.6% were using the available solution due to the non-availability of the recommended solution. Interestingly, two of them reported adverse reactions (skin burns) to Chlorhexidine 2% after which an alternative solution was introduced into practice within their Institution.

Approximately 52% considered Chlorhexidine 2% as the recommended solution for the central neuraxial procedure, 26% Povidone-iodine solution, and 22% Chlorhexidine 0.5% as the recommended solution for skin anti-sepsis, as shown in Figure-2.

Almost 36% use Chlorhexidine solution in their routine clinical practice, 51% mentioned its non-availability, 8% considered it not cost-effective, and 5% reported adverse reactions (skin burns) as the reason for not using it in their clinical practice.

Fifty percent of the Professors considered Povidone-iodine the solution of choice, 31% Chlorhexidine 2%, and 19% Chlorhexidine 0.5%. The reasons for selecting solutions of choice were personal

preference (41%), cost-effectiveness (35%), and non-availability (24%). Over 50% of Associate/Assistant Professors and Senior Registrars/Senior Instructors considered Chlorhexidine 2% as the recommended solution but reported its non-availability and a personal preference for their practice.

With adherence to sterility, 98.5% of faculty members adhere to the facemask in each of the central neuraxial blockade procedures. 98.5% adhered to sterile gloves in both Spinal and Epidural procedures but 95.7% adhered to sterile gloving in caudal anaesthesia. 97.1%, 98.5%, and 94.2% were wearing surgical caps during Spinal, Epidural, and Caudal Anaesthesia respectively.

97.1% donned sterile gowns for epidural anaesthesia, 55.7% for spinal, and 41.4% for caudal anaesthesia. The sterile drape was used in 98.5% of cases for Spinal, 97.1% for Epidural, and 92.8% for Caudal Anaesthesia. 95.7%, 98.5%, and 91.4% of physicians had their assistants wearing caps and masks in Spinal, Epidural, and Caudal Anaesthesia, respectively.

Chlorhexidine 0.5% and 2% concentrations were applied either as a spray (37.5% and 40%) or with a swab and gallipot (40 and 60%) respectively. Only 1 user reported having used Chlorhexidine 2% as an applicator. Surgical Spirit/Rubbing Alcohol was applied with a sponge/swab and gallipot.

Table-1: General Characteristics of the study population (n=70)

Variables	Frequency (%)
Institution type	
Private	47 (67.14)
Public	15 (21.42)
Charity-based	8 (11.42)
Designation	
Professor	17 (24.28)
Associate/Assistant Professor	37 (52.85)
Senior Registrar/ Senior Instructor	16 (22.85)

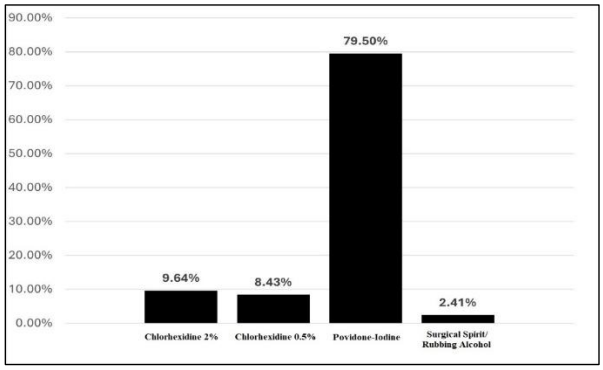

Figure-1: Type of solution used for skin anti-sepsis before the central neuraxial blockade

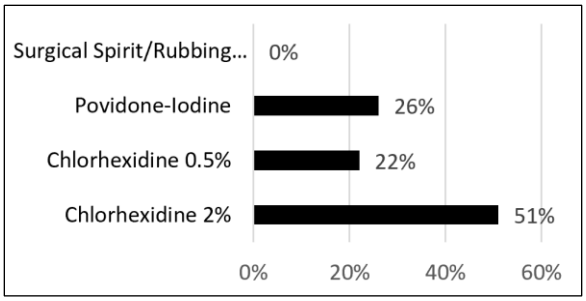

Figure-2: Choice of skin antiseptic solution for central neuraxial blockade

DISCUSSION

This study showed that the use of Povidone-Iodine prevails among anaesthesia faculty members and Chlorhexidine was not in routine clinical practice due to personal preference, cost-effectiveness, or unavailability. The skin antisepsis guidelines for central neuraxial blockade by AAGBI recommended Chlorhexidine as a superior choice compared to Povidone-Iodine in terms of faster onset, longer duration, and more efficacious with a low incidence of skin reactions.[6] This was reflected in this study as about three-fourths of the physicians chose Chlorhexidine as the recommended solution for skin antisepsis. However, guidelines urge to use of a less concentrated form of Chlorhexidine (0.5%) which was the choice of only 22% of faculty members in this study.

Doan *et al*. found both Chlorhexidine and Povidone-Iodine to be cytotoxic to neuronal and Schwann cells in their in vitro study and recommended allowing adequate drying time[3]. Permanent neurological injury due to chemical arachnoiditis following the use of Chlorhexidine for skin anti-sepsis has been reported in the literature.[10-12] In one of the cases pursued medico-legally, it was concluded that the injectate for spinal anaesthesia had become contaminated with a significant quantity (0.1 ml or more) of chlorhexidine 0.5% in alcohol 70%.[12] Hence, a prudent method of application and adequate drying time should be allowed to mitigate the risks associated with anti-septic agents.

Due to the very small bore of the spinal needle and the low density of alcohol, capillary action may occur readily if the needle comes into contact with even a small volume of chlorhexidine in alcohol. Therefore, the needle will hold a small but significant volume of chlorhexidine, especially if the stylet has been withdrawn, risking subarachnoid injection and chemical arachnoiditis.[13] Adequate drying time was recommended by the scientific societies before injection. Gunka *et al*. concluded that the mean ChloraPrep® applicator drying time was 123 seconds.[14] This study showed that fifty percent of

the anaesthesia faculty members do give 2 minutes or more for the agent to dry, while almost 30% wait for the solution to dry completely. Alcoholic Chlorhexidine 0.5% is applied as a spray, however, takes 45–60 seconds to dry passively.[15]

The prevalent method of application used by the study participants was Gallipot with sponge/swab. This is explained by the fact that Povidone-Iodine is only available in liquid bottles and not as a spray or applicator in our region. A small number, however, did use spray and/or applicator method which might be a method used for Chlorhexidine and Rubbing Alcohol. Stanley challenged the practice of spraying the skin with an anti-septic solution and called for abrasion of the outer skin layers to allow penetration of the solution to deeper epidermal layers.[16] Evans *et al*. demonstrated that splashing Chlorhexidine solution in gallipot has the potential to contaminate equipment in the vicinity.[17] It is important to avoid pouring altogether, keep the height of pouring the solution low even when Povidone-Iodine is being used for skin anti-sepsis, and sterile equipment kept covered or at a distance when the solution is being poured.

Fifty percent of the anaesthesiologists considered Chlorhexidine 2% as the recommended solution of choice, while 26% and 22% considered Povidone-Iodine and Chlorhexidine 0.5%, respectively. AAGBI guidelines recommend using alcohol-based chlorhexidine over povidone-iodine and opt for 0.5% over 2% due to similar efficacy but a lesser risk of neurotoxicity.[7] However, based on availability and the safest mode of application, the choice should be made given that other core principles are followed to prevent the solution from reaching cerebrospinal fluid.

This study also enumerates chemical burns to Chlorhexidine as the reason for the discontinuation of the solution. Chlorhexidine is associated with skin burns in preterm infants.[18] Chlorhexidine solutions are advised to be used with caution for premature infants or those under two months of age,[19] while there are no restrictions for Povidone-Iodine by manufacturers.[20] Skin burns with Povidone-Iodine, however, are reported in literature where pooling of solution under tourniquets resulted in skin burns.[21-22] Similarly, burns with Chlorhexidine in older children and adults are rare unless immature or damaged skin. Pooling of solution during pre-operative preparation of skin remains a major but avoidable causative factor.[23] The Joint Committee of the European Society of Regional Anaesthesia and Pain Therapy (ESRA) and the American Society of Regional Anaesthesia and Pain Medicine (ASRA) published a practice advisory recommending the use of Chlorhexidine over Povidone-Iodine.[24]

The study showed that adherence and compliance to aseptic techniques before proceeding with central neuraxial blockade procedures was over 90%. Sterile gowns were worn during procedures by half of the participants. Siddiqui *et al*. showed no clear advantage of wearing a sterile gown during epidural placement procedures.[25] ASA guidelines are equivocal regarding the use of sterile gowning before neuraxial procedures and do not include it in their practice advisory.[8] It is, however, advisable to consider sterile gowns when placing continuous neuraxial catheters.[2] Sterile gowns not only put an additional economic burden but also have a significant carbon footprint and an environmental impact.[26]

There was an increased acceptance among senior faculty members regarding the use of Povidone-Iodine in this study. An argument can be presented regarding the need for awareness about recent updates and guidelines.

This study includes a local population-based sample that represents low and middle-income countries (LMIC). It may contribute as a reference for future research in the LMIC. The results of the study will help us to know the local practice of skin antisepsis by experts in the field and may help in making national guidelines on this topic. The sample of this study included only the teaching hospitals of Karachi, which remains a sampling bias. However, the results can be generalized owing to the metropolitan status of the city.

Study results were based on a relatively small sample size and are limited to one city only. Including multiple Institutes across the country would have given a more holistic view of the overall practice of skin antisepsis. The possibility of response bias also exists in this study during data collection.

Recommendations

Skin antisepsis practice is important before any procedure, especially before the central neuraxial blockade. There is limited data from lower-middle-income countries regarding the choice and availability of skin antiseptic solutions for central neuraxial block procedures. Although international guidelines have been published for almost a decade, it is a matter of urgency and importance to raise awareness regarding the safety of central neuraxial block procedures and appropriate choices made based on available resources.

Webinars can be an excellent source to disseminate necessary information, educate the targeted audience and identify the potential barriers to achieving optimal outcomes.

National guidelines for the standardization of the practice are the need of the hour. Further such studies are needed at the national level, root cause analysis of the unavailability of Chlorhexidine and its

cost-effectiveness analysis, and the incidence of infectious and neurological complications in resource-limited settings.

CONCLUSION

Povidone-Iodine is the agent of choice among anaesthesia faculty members in all teaching hospitals in Karachi. The recommended solution (Chlorhexidine) was not in routine clinical practice due to personal preference, cost-effectiveness, or unavailability.

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Declaration of patient consent

The authors certify that they have obtained consent from all participants. In the form, the participants have given their consent for reporting their information in the journal. The participants understand that their names and initials will not be published, and due efforts will be made to conceal their identity.

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Conflicts of interest

There are no conflicts of interest.

AUTHOR'S CONTRIBUTION

AN: Literature search, conceptualization of study design, data collection, data analysis, data interpretation, and manuscript write up. AR: Manuscript write-up and review. ASS: Literature search, conceptualization of study design, data collection, data interpretation, manuscript write-up and review.

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