



IJCRR

Section: Healthcare

Sci. Journal Impact

Factor: 6.1 (2018)

ICV: 90.90 (2018)



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Accidental Chlorhexidine-alcohol Induced Chemical Burns: Need for Regular Cross-checks in the Perioperative Period

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ABSTRACT

Introduction: Surgical site preparation refers to the preoperative treatment of the intact skin of the patient with the anti-septic solution within the operating room for prevention of surgical site infection.

Clinical Experience: Out of 87 surgeries performed, 11 patients; 9 males and 2 female, with no prior history of allergies, developed superficial skin lesions either on the evening of operation or the morning next day. The clinical presentation varied from erythema and superficial desquamation of skin to painful blister formation to sloughing of the whole skin of the genitalia and inner thighs. After ruling out another differential diagnosis, we inferred that 3-4 times concentrated CHG was used in these patients leading to the chemical burns. On Naranjo Adverse Drug Reaction Probability Scale, the probability for chemical burn by CHG was 6.

Conclusion: The case reports here described partial-thickness chemical burns in adults after accidental skin preparation with higher than desired concentrations of CHG in alcohol disinfectant. This stresses the need for collective responsibility of the health care team in peri-operative care as well as conduction of regular and thorough audits if any adverse event occurs.

Key Words: Chlorhexidine gluconate, Chemical burn, Audit

INTRODUCTION

Surgical site preparation refers to the preoperative treatment of the intact skin of the patient with the anti-septic solution within the operating room for prevention of surgical site infection. This includes not only the site of the intended surgical incision but also a wider area of the patient's skin. Amongst the 29 recommendations of the WHO panel for prevention of surgical site infection, there is strong evidence that alcohol-based Chlorhexidine gluconate (CHG) should be used for surgical site skin preparation¹. However, commercial preparations have varied concentrations of 0.25%, 0.5%, 1%, 2% and 4% in either aqueous or alcohol-based solutions^{2,3}. Depending on their available strengths, they need to be adequately diluted to achieve desired concentrations to get maximum benefit without causing harm to the surrounding skin.

We report here cases of accidental chlorhexidine-alcohol-induced chemical burns in urology patients resulting from

inadequate dilutions of the commercially available preparations.

Clinical Experience/Case Series

A total of 87 cases underwent surgery and operated in the Urology unit over 6 months from August 2019 to January 2020. All of them received prophylactic Inj. Cefuroxime 1.5 g after skin hypersensitivity testing. Part preparation was done using an alcoholic suspension of 2% CHG available in hospital supply. The total duration of operations ranged from 30- 90 minutes. Out of 87 surgeries performed, 11 patients (9 males and 2 female), with no prior history of allergies, developed superficial skin lesions either on the evening of operation or the morning next day. The clinical presentation varied from erythema and superficial desquamation of skin to painful blister formation to sloughing of the whole skin of the genitalia and inner thighs. In one case, Scrotal Edema was observed after the patient complained of pain and burning of the scrotal skin. Next day the patient developed blisters and

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ISSN: 2231-2196 (Print)

ISSN: 0975-5241 (Online)

Received: 07.05.2020

Revised: 02.06.2020

Accepted: 12.07.2020

Published: 08.08.2020

ulcers all over the scrotal surface. In another case, 50-year male undergoing cystoscopy and bladder biopsy, erythema, excoriation and scaling was noted the next morning of surgery. In another case, an eighty-year gentleman underwent bilateral orchidectomy for advanced carcinoma prostate and was discharged 2 hours after the surgery under stable conditions. However, he presented to emergency with redness on the inner thigh. On examination there was erythema. All the patients recovered uneventfully with conservative treatment. The details are given in Table 1 and Fig 1-3.

These cases occurred throughout the period. Culture samples were obtained from these skin lesions immediately. Urine cultures were also sent which later came out sterile. The wounds were dressed with skin ointments containing nanosilver colloid as active ingredients, which is used for treating wounds especially burns and chronic wounds effectively due to its antimicrobial properties. Due to the sustained release of silver onto the wound, it is less toxic than other forms of silver dressings and reduces the inflammatory processes and promotes wound healing effectually. To further its merits, it is cost-effective, reduces pain levels, and has a longer wear time, thus minimizing the frequency of dressing changes required. These patients overstayed in the hospital for a period of 3-7 days. They were followed up every week in outpatient clinics and fortunately as all the cases were partial-thickness burns, healed satisfactorily over 1-4 weeks without the need for cosmetic procedures.

Due to the sudden occurrence of these cases, the infection control team of the hospital was consulted, keeping in mind some outbreak. An audit was done to track the cause of the occurrence of these cases. A detailed questionnaire was prepared and all the medical staff involved in the care of these patients were interviewed. The differential diagnosis made by the audit team is summarized in Table 2.

After ruling out all the differential diagnosis, and on repeated questioning, we found that a newly appointed theatre staff was the common factor who was scrubbed in all these cases, who was unable to explain the correct dilution of disinfectant required for patient part preparation. Hence, 3-4 times concentrated CHG was used in these patients leading to the chemical burns. On Naranjo Adverse Drug Reaction Probability Scale⁴, the probability for chemical burn by CHG was 6.

DISCUSSION

Alcoholic preparation of Chlorhexidine gluconate (CHG) is one of the most widely used disinfectant and effective against a wide range of bacteria, fungi and viruses. The recommended concentration is CHG 2% in 70% alcohol suspension. Although the efficacy of CHG increases with higher concentrations but at the cost of potential skin damage. Combining isopropyl alcohol with CHG further enhances

the overall effectiveness of the solution but again alcohol is also implicated in higher incidences of adverse effects like it can de-esterify the skin leading to decreased defences from weakness in epidermal lipid barrier.

Burns due to anti-septics are often under-recognized and are preventable events mostly. In cases reported in adults, povidone-iodine is frequently responsible for the chemical burns while CHG is mostly implicated in pre-term neonates with immature skins. In isolated cases, they may be misdiagnosed as diathermy burns. Neri et.al. reported 5 cases of chemical burns in very low birth weight neonates with different concentrations and formulations of CHG while insertion of intravascular devices⁵. Harsha described an aqueous 2 % CHG induced chemical burn in an extremely premature infant while performing umbilical catheter insertion⁶. Sivanathan reported a case of chemical burns in a 4 yr old child while preparing skin for left orchidopexy with 2% CHG in 70 % isopropyl alcohol⁷. Mannan reported a chemical burn caused by 0.5% CHG in 70 % alcohol which was mistaken for normal saline in an extremely preterm baby while cleaning skin before accessing umbilical vein and artery⁸. From the above studies, we note that both aqueous and alcohol-based CHG caused burns in the paediatric age group. The interesting finding in our case series was that CHG was responsible for burns in mature and intact skin of adults.

The proposed common pathogenesis mentioned in all the above studies includes chemical irritation combined with tissue injuries like maceration of skin, excess friction applied while part preparation, pooling of disinfectant leading prolonged contact with dependent skin surfaces and the inability of the patient to react to noxious stimulus while under anaesthesia.

The additional factor present in our study was the improper dilution of the disinfectant leading to accidental exposure of skin to a higher concentration of chemicals. Over-all the major contributory factor was a particular theatre staff who was unaware of the exact dilutions to be made before pre-operative scrubbing, which led to these repeated incidences.

In our study, we observed that these avoidable adverse events caused financial harm to the patients because of the loss of working hours as well as undue anxiety as the lesions involved in cosmetic regions. Moreover, it led to the unnecessary occupation of hospital beds which could have been used by other deserving cases.

Considering the above observations, we suggest the following precautionary measures:

- a) The disinfectant should not be allowed to pool in the dependent parts of the body and area should be dried before draping.
- b) Work to be defined, accountabilities to be established and regular cross-checks to be done.

c) Lastly, there should be accurate documentation of any adverse events and audits to be carried out thereafter.

CONCLUSION

The case reports here described partial-thickness chemical burns in adults after accidental skin preparation with higher than desired concentrations of CHG in alcohol disinfectant. This stresses the need for collective responsibility of the health care team in peri-operative care as well as conduction of regular and thorough audits if any adverse event occurs.

Acknowledgements: We are grateful to the Hospital Infection Control Committee for their valuable inputs.

Source of funding: There was no source of funding

Conflicts of interest: No conflicts of interest.

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Table 1: Clinical information and outcome of skin lesions of patients

S. No.	Age/Sex	Operation done	Site and nature of chemical burn	Lesions noticed first	Comorbidities	Outcome
1	70 Y/M	TURP	Blisters and ulcers Scrotum and B/L inner thighs	Next morning	NIL	Healed after 4 weeks
2	30 Y/M	URS and stone fragmentation	Scrotal blisters and ulcers	Next morning	NIL	Healed after 4 weeks
3	50 Y/M	TURBT	Painful excoriation and scaling present over scrotum and inner thigh	Next morning	Hypertension	Healed after 4 weeks
4	60 Y/M	TURP	Painful excoriation and scaling present over scrotum and inner thigh	Next morning	DM type 2	Healed after 4 weeks
5	60 Y/M	TURBT	Painful excoriation over scrotum	Evening of operation	NIL	Healed after 1 week
6	70 Y/M	B/L orchidectomy	Excoriation over scrotum	Next morning	NIL	Healed after 1 week
7	40 Y/F	URS with stone fragmentation	Erythema over inner thigh	Evening of operation	NIL	Healed after 1 week
8	40 Y/M	TURBT	Excoriation over inner thigh and scrotum	Next morning	NIL	Healed after 2 weeks
9	80 Y/M	B/L orchidectomy	Erythema over inner thigh	Next morning	NIL	Healed after 1 week
10	40 Y/M	TURBT	Excoriation over scrotum	Evening of operation	NIL	Healed after 2 weeks
11	36Y/F	URS and stone fragmentation	Erythema over labia and inner thigh	Next morning	NIL	Healed after 3 days

Table 2: Differential Diagnosis for the blisters developed after urologic surgeries

S. No.	Differential diagnosis	Points in favour	Points against
1	Steven Johnson Syndrome	Timing within 24 hours of surgery Cultures sterile Cefuroxime was recently added to antibiotic policy	Hypersensitivity testing was done lesions were restricted to the site of skin preparation i.e. genitalia and inner thigh
2	Infection through contamination of disinfectant used for part preparation	Lesions restricted to the part of the skin prepared	Timing within 24 hours of surgery Wound cultures were sterile Culture of the disinfectant was also sterile
3	Infection due to inadequate antibiotic coverage	Cefuroxime recently introduced. Stopped within 24hrs/single dose given. Clean contaminated surgery	Timing within 24hrs. Wound culture negative. Urine culture negative
4	Chemical Burn (Naranjo Adverse Drug Reaction Probability Scale=6)	Timing within 24 hours of surgery Cultures sterile Common nursing staff posted in OT on these surgery days and provided the disinfectant for part preparation.	Nil



Figure 1: Painful excoriation and scaling over scrotum due to significant burn.



Figure 3: Chemical burn causing erythema over inner thigh.



Figure 2: Blisters on scrotum.