The Effect of Various Brands of Chloroxylenol Disinfectants on Some Common Hospital PAthogens

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SUMMARY

Suspension and surface viability tests were carried out to determine the effects of various brands of chloroxylenol disinfectants on clinically important nosocomial gram negative and gram-positive organisms. Dettol and morigard brands of chloroxylenol inhibited gram-positive organisms at a dilution of 1 in 50. Tiscol brand of chloroxylenol achieved the same effect at 1 in 30. All the disinfectants had much less activity against the gram negative organisms tested, inhibiting them only in the undiluted form, though *Pseudomonas aeruginosa* was not inhibited even by the undiluted Tiscol.

The presence of organic matter resulted in a slight loss of activity, thus, raising the required inhibitory concentration of Dettol and Morigard on the gram-positive organisms to 1 in 40. When all organisms were exposed to recommended dilutions of disinfectants for 10, 30, 60 and 90 minutes on a glass tile at room temperature, dettol and morigard inhibited all organisms, including P aeruginosa at, a minimum contact time of 10 minutes while Tiscol inhibited only gram positives at 30 minutes but could not inhibit gram negative organisms even at 90 minutes.

Apart from having a different recommended dilution from dettol and morigard, Tiscol was also observed to have a lower activity, although they were all stated to have about the same concentration. In Nigeria, there is need for manufacturers to be able to sustantiate the activity of their products and also for the relevant government agencies to adequately control monitoring of disinfectants in the market.

INTRODUCTION

Chloroxylenol is a phenolic disinfectant agent, which acts by denaturing proteins[1]. It has good activity against gram positive and moderate activity against gram negative bacteria. It also has some activity against viruses and fundi[2,3]. Chloroxylenol had been in use before 1933 when it was launched in hospital[2]. However, its use in hospital has been discouraged because of reports that it is toxic and relatively easily inactivated[3,4]. It has therefore been restricted to the household.

In the 1950s there was gradual erosion of hospital endorsement, which coincided with introduction of clorhexidine in hospitals. Chlorhexidine, which is a biguanide antibacterial agent is very active against gram positive bacteria, has moderate activity against gram negatives but poor activity against other organisms. It is relatively non toxic to skin and its compatibility with alcohol and quartenary ammonium compounds which are themselves good antimcrobials makes it more broad-spectrum and therefore a more desirable disinfectant for hospital use[2,3,4].

Chemical disinfectants are widely used in hospitals, homes, industries and the veterianary field. The spread of HIV and hepatitis B virus infections and the increasing incidence of nosocomial infections underscore the need for carefully chosen disinfectants for use in specific circumstances. Furthermore, microorganisms are gradually acquiring resistance disinfectants It is therefore necessary to review the values of antiseptics and disinfectants available for use in the hospital.

Recently, the use of chloroxylenol in the hospital has been advocated and it is widely used in many clinics. Various trade names and concentrations exist in the Nigerian market. Odugbemi et al in 1996 evaluated a new chroloxylenol disinfectant and found that is was able to inhibit organisms that readily contaminate the hospital environment[5]. The study however did not check the activity in the presence of organic material, which is often a common situation in the hospital.

This study was set up to evaluate the efficacy of some chloroxylenol disinfectants available in the Nigerian market. It was also done to determine the effect of organic material on their efficacy against known nosocomial pathogens, and to compare these with those of chlorhexidine, which is popular in many hospitals and clinics.

MATERIALS AND METHODS

Samples: Dettol, (Reckitt & Colman Nig. Ltd.), (Tiscol Nig. Ltd.), and Morigad (Morisson Ind. Nig. Ltd.) brands of choloroxylenol present in the market were evaluated and compared with Savlon (Johnson & Johnson) and purit (CAPL) brands of cholorhexidine. The percentage of disinfectant and the recommended dilutions in each brand was noted – Dettol (4.8%) w/v), Tiscol (5% w/v), Morigad (5% w/v), Purit (0.3w/v) and Savlon (0.3% w/v).

Organisms: Gram positive and Gram-negative organisms known to be clinically important nosocomial pathogens were used as challenge organisms. The gram-positive organisms used included methicillin resistant Staphylococcus aureus (MRSA), methicillin sensitive *Staphylococcus aureus* (MSSA), *Staphylococcus aureus* control strain ATTC 29213, *Enterococcus faecalis* isolated from urine and Enterococcus faecalis control strain ATTC 29212.

The gram-negative organisms tested included sensitive and resistant strains of *Klebsiella pneumoniae* and *Escherichia*

coli, *E. coli* control strain ATTC 35218, *Proteus spp*, Pseudomonas aeruginosa, and Pseudomonas aeruginosa control strain ATTC 27853.

Procedure

The Suscpension test (Cruickshank, 1975) was done to determine the inhibition concentration of dettol, tiscol and morgad against the bacteria listed above[7]. This was compared with the efficacy of savlon and purit.

Serial dilutions of the disinfectant(1 in 10, 1 in 20, 1 in 30, up to 1 in 80) were prepared in sterile water. 1ml of each dilution was mixed with 15mls of nutrient agar (oxoid) and poured into sterile petri dishes. Bacterial suspensions were inoculated on each set of plates and incubated at 37°C for 48 hours. Tests were repeated 5 times, and also with the addition of 5% yeast extract (oxoid) as an organic material. Included in each set of plates were a plate without disinfectant, a plate without organism and a plate with neither organism nor disinfectant for quality control of all parameters.

Surface test (Cruickshank, 1975) was done to determine the ability of the disinfectants to kill microorganisms on the surface of clean tiles, which simulates what happens in a hospital setting[7].

0.1ml of microbial suspension, which has been standardized to 0.5 McFarland was added to the surface of clean tile and allowed to dry. This was exposed to the recommended dilutions of the different disinfectants at varying specified periods of time (10 minutes, 30 minutes, 60 minutes and 90 minutes). The action of the disinfectant was then neutralized using Tween 80 and the tile surface swabbed and inoculated on nutrient agar, which was incubated at 37°C in air and examined for growth after 48 hours. Growth observed anytime before 48 hours was imterpreted as inability of the disinfectant to kill the organism at the contact time.

RESULTS

All the disinfectants both chlorocylenol and chlorhexidine brands except Tiscol inhibited the gram-positive organisms at a dilution of 1 in 50 (Table I). Tiscol achieved the same at a higher concentration 1 in 30. On the other hand, all the disinfectants had much less activity against the gram negative organisms tested, inhibiting them only in the undiluted form, though *P. aeruginosa* was not even inhibited by the undiluted purit and tiscol.

The presence of organic substance resulted in a slight loss of activity as shown on table II. A lower dilution of 1 in 40 of all disinfectants tested was required to inhibit the gram-positive organisms in the presence of yeast. However, there was no change in the effect on gram-negative except for concentrated savlon, which could no longer inhibit *Pseudomonas aeruginosa*.

When organisms were exposed to recommended dilutions of disinfectants for 10, 30, 60 and 90 minutes on a glass tile at room temperature (Table III), dettol, morigard and savlon were found to inhibit all organisms – both gram-negative and gram-positives including *P.aeruginosa*, at a minimum contact time of 1o minutes, while tiscol inhibited only gram positive organisms at 30 minutes but could not inhibit the gram negative organisms even at 90 minutes. Purit on the other hand inhibited both gram positive and gram negative organisms at 60 minutes.

Table I

Maximum Inhibiting Dilution of Various Disinfectants

Organisms	Chloroxylenols			Chlorhexidines	
	Dettol	Savlon	Morigard	Purit	Tiscol
Staphylococcus aureus ATCC 29213	1 in 50	1 in 50	1 in 50	1 in 50	1 in 30
Methicillin resistant *Staph aureus* (MSSA)	1 in 50	1 in 50	1 in 50	1 in 50	1 in 30
Coagulase negative *Staph aureus*	1 in 50	1 in 50	1 in 50	1 in 50	1 in 30
Entecococcus faecalis ATTC 29212	1 in 50	1 in 50	1 in 50	1 in 50	1 in 30
Entecoccus faecalis	1 in 50	1 in 50	1 in 50	1 in 50	1 in 30
Escherichia coli control ATTC 35218	conc	conc	conc	conc	conc
Escherichia coli	conc	conc	conc	conc	conc
Klebsiella species	conc	conc	conc	conc	conc
Proteus species	conc	conc	conc	conc	conc
Pseudomonas aeruginosa ATTC 27853	conc	conc	conc	–	–
Pseudomonas aeruginosa	conc	conc	conc	–	–

Table II

Maximum Inhibiting Dilution of Disinfectants in the Presence of Yeast

Organisms	Chloroxylenols			Chlorhexidines	
	Dettol (1 in 20)[a]	Savlon (1 in 17)	Morigard (1 in 17)	Purit (1 in 34)	Tiscol (1 in 34)
Staphylococcus aureus ATCC 29213	1 in 40	1 in 40	1 in 40	1 in 40	1 in 20
Methicillin resistant *Staph aureus* (MSSA)	1 in 40	1 in 40	1 in 40	1 in 40	1 in 20
Methicillin resistant *Staph aureus* (MRSA)	1 in 40	1 in 40	1 in 40	1 in 40	1 in 20
Coagulase negative *Staph aureus*	1 in 40	1 in 40	1 in 40	1 in 40	1 in 20
Entecococcus faecalis ATTC 29212	1 in 40	1 in 40	1 in 40	1 in 40	1 in 20
Entecococcus faecalis	1 in 40	1 in 40	1 in 40	1 in 40	1 in 20
Escherichia coli control ATTC 35218	conc	conc	conc	conc	–
Escherichia coli	cone	conc	conc	conc	–
Klebsiella species	conc	conc	conc	conc	–
Proteus species	cone	conc	conc	conc	–
Pseudomonas aeruginosa ATTC 27853	conc	–	conc	–	–
Pseudomonas aeruginosa	conc	–	conc	–	–

Table III

Maximum Time (in minutes) Required to Prevent Growth at Recommended in-Use Dilution

Organisms Tested	Chloroxylenols			Chlorhexidines	
	Tiscol	Dettol	Morigard	Savlon	Purit
Staphylococcus aureus ATCC 29213	30	10	10	10	60
Methicillin susceptible *Staph aureus* (MSSA)	10	10	10	10	60
Methicillin resistant *Staph aureus* (MRSA)	10	10	10	10	60
Coagulase negative *Staph aureus*	30	10	10	10	60
Entecococcus faecalis ATTC 29212	30	10	10	10	60
Entecococcus faecalis	30	10	10	10	60
Escherichia coli control ATTC 35218	30	10	10	10	60
Escherichia coli	>90%	10	10	10	60
Klebsiella species	>90%	10	10	10	60
Proteus species	>90%	10	10	10	60
Pseudomonas aeruginosa ATTC 27853	>90%	10	10	10	60
Pseudomonas aeruginosa	>90%	10	10	10	60
	>90%	10	10	10	60

DISCUSSION

All the disinfectants except tiscol inhibited the gram-positive organisms at concentration much lower than the recommended concentration. This implies that sufficient safety margin has been incorporated during production making room for efficacy in the face of imprecise dilution. This may be a safety device in clinical practice particularly as it is known that users of these disinfectant often top them up.

The presence of organic matter has been clearly shown to reduce the activity of disinfectants[8]. In this study the presence of yeast uniformly lowered the activity of the disinfectants. It however did not affect the efficacy at recommended in-use dilutions of any of the disinfectants except for tiscol, which became completely inactive in its presence.

While the suspension test showed that only undiluted

concentration of the disinfectants could inhibit the growth of the gram negative organisms, the surface test showed that they were inhibited at recommended in-use dilutions at contact times ranging from about 10-60 minutes, except tiscol which required more than 90 minutes for any probable effect. The contact time of 10 minutes is achievable in practice and suggest that the chloroxylenols dettol and morigard and the chlorhexidine, savlon may be effective in clinical practice provided adequate contact time in accordance with the manufacturer's recommendation is allowed. Contact time of 30 - > 90 minutes required by tiscol and purit is too long and unlikely to be adhered to in practice. Unfortunately the effect of organic matter on surface test was not carried out but looking at the results of the suspension test, it is likely that this would have prolonged the contact times or required higher concentrations of disinfectant.

There was marked difference in the inhibition of Gram-negative organisms as shown by the results of the suspension and the surface test, but considering that the surface test better simulates practice in the hospital, it would appear to be a more relevant test of activity than the suspension test. However, the apparent improved activity against the gram negatives as shown by the surface test though interesting and exciting will need more controlled tests and testing of many strains under various conditions before an unequivocal conclusion can be made.

Using the results of the suspension test, it would appear that the effects of dettol and morigard on both gram positive and gram negatives were comparable to those of savlon and purit but better than savlon and purit on *Pseudomonas aeruginosa* in presence of organic material. This preliminary study suggests that the chloroxylenols and chlorhexidines tested have the same degree of efficacy on bacteria in-vitro.

The different brands of chloroxylenol –dettol, morigard and tiscol claim to contain 4.8-5% (w/v) of the active ingredient, which would indicate that they should have the same efficacy at the same dilution. The recommended dilutions for dettol and morigard are basically the same (1 in 20 and 1 in 17 respectively), but that for tiscol is 1 in 34. This may imply that contrary to claim, tiscol does not contain the same concentration of chloroxylenol as these other two brands or that the manufacturers in determining the efficacy of their product did not carry out proper tests because from the result of the suspension test, a much higher concentration of tiscol was required to achieve the same effect as dettol and morigard. Purit and savlon are also supposed to contain the same concentrations of chlorhexidine yet contact time for adequate inhibition are different as shown by the surface tests and maximum dilution for inhibition are the same even though the recommended in-use dilutions are far apart. In Europe and other developed countries, manufacturers must be able to substantiate the activity of a disinfectant against a variety of organisms through standard tests like the surface and suspension tests before their products can be placed on the market[9]. In Nigeria there is obvious ly need for adequate quality control monitoring of disinfectants in the market by the relevant government agencies.

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