

# LABORATORY STUDIES OF A KNITTED VISCOSE FABRIC DRESSING MEDICATED WITH POVIDONE IODINE

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## Introduction

Iodine is a powerful antiseptic readily disinfecting bacteria and other micro-organisms in low concentrations. As little as  $1 \times 10^{-4}\%$  iodine are said to destroy one bacterial cell<sup>1</sup>. All bacterial species seem equally susceptible to iodine, hence its widespread clinical use which includes wound therapy.

Elemental iodine has long been discontinued for therapeutic purposes in favour of the more convenient iodophor, povidone iodine. This is water soluble and only transiently stains materials that it contacts. A simple test shows that povidone iodine readily diffuses from its source to disinfect a large peripheral area.

Although a variety of povidone iodine containing creams, ointments and lotions are available, few povidone iodine medicated dressings exist. This poster reports preliminary experiments of a povidone iodine medicated viscose fabric dressing using laboratory wound models to investigate its antibacterial activity and duration of active iodine under simulated 'in use' conditions.



Fig. 1. Removing the dressing from a petri pack.

## MATERIALS AND APPARATUS

The dressing, 9.5 x 9.5cm, is a knitted viscose fabric impregnated with povidone iodine suspended in polyethylene glycol. It is sandwiched between two sheets of silicone release paper and contained in a standard 'peel pack' (Fig. 1). Identically sized sheets of knitted viscose fabric served as a control dressing. Both were supplied by Seton Healthcare.

Dressing iodine content was measured by extraction with agitation in 100ml distilled water for 1 hr. at room temperature (20°C-24°C). Dressings were then removed and dried to constant weight at 105°C. Extracted iodine was titrated against N/100 sodium thiosulphate using starch to determine the end point.

## METHOD

### Static wound model.

After placing two filter paper squares in the dish, 6ml of culture fluid (equal parts of horse serum and nutrient broth) was added to just over-saturate the paper. Then 2.8ml of an overnight culture of *Staphylococcus aureus* and *Pseudomonas aeruginosa* (about  $10^8$  cfu per ml) was added to the third square which was then placed in the dish and the two dressings applied.

After 24 hours incubation at 37°C the model was carefully dismantled and examined. The small discs were removed and cultured on nutrient agar plus sodium thiosulphate.

### Dynamic wound model.

The 'wound' is a square aperture (5cm side) in the central region of a 1.5mm thick square (15cm side) plastic plate. Two 5cm side squares of 0.4mm thick filter paper were placed in this aperture and 1.8ml 'exudate' added. Then 0.9ml of an overnight culture of *Staphylococcus aureus* and *Pseudomonas aeruginosa* added to a further square and placed in the aperture. Dressings were applied above the culture and secured with waterproof adhesive tape (Stieck<sup>®</sup>, Smith & Nephew). The plate with 'wound' and dressings was weighed, clipped to the aluminium plate and 'exudate' pumped in at a rate of 14.25ml per day. Every 12 hours the plate was removed and re-weighed for 3.5 days. The bacteriology of the 'wound' was investigated at this time.

Two species were used in the bacteriological tests, *Staphylococcus aureus* and *Pseudomonas aeruginosa*; both recently isolated from chronic wounds. Cultures were maintained in standard nutrient broth but the inoculum for wound models was prepared by overnight incubation in equal parts of nutrient broth and deactivated horse serum. When examining wound models for presence of bacteria, media containing 1% sodium thiosulphate was used to neutralise any iodine carried over.

Two wound models were used:  
(a) **Static wound model.** The 'wound' comprised three squares, 9cm side, of filter paper 0.4mm thick. Each could hold 2.8ml culture fluid. These were placed in a 10cm square petri dish and covered with thin plastic sleeve (Telfa<sup>™</sup>, Kendall). Discs, 7.5mm diameter, of thin filter paper were placed on the base of the dish and between every filter paper square as the model was assembled.

(b) **Dynamic wound model.** This model was devised to investigate the fluid handling properties of dressings<sup>2</sup>. Its construction is shown in Fig. 2. A square aluminium plate, 15cm side and 2mm thick, is surrounded by a polystyrene container. Water at 37°C is circulated through this. A central hole in the aluminium plate and water jacket contains a short pipe extending above the water jacket. A syringe pump introduces sterile 'exudate' (equal parts of horse serum and broth) via thin flexible polythene tubing into this pipe.

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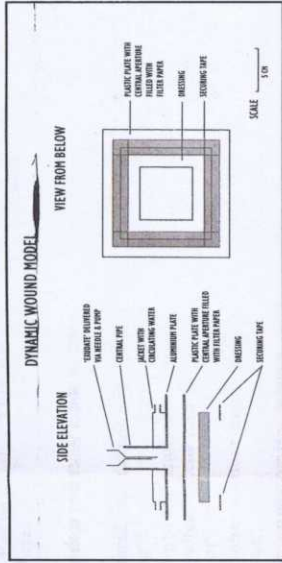


Fig. 2. Diagram showing the construction of the dynamic wound model.

## RESULTS

contrast, heavy bacterial growth of both test organisms was found in all layers of the 'wound' and in the overlying dressing.

### Dynamic wound model.

The weight gain over 3.5 days was 5.7g with the control dressing and 6.02g with povidone iodine knitted fabric dressing (three tests with each dressing on separate occasions). Since 42.75ml 'exudate' was pumped into these 'wounds' during the 3.5 days, evaporative losses from the 'wound' surface were considerable, over 45ml (or 12.5ml per day). Separate tests showed 'Telfa<sup>™</sup>' could hold about 8ml 'exudate'.

### Inactivation of iodine by serum.

Tests showed that each medicated dressing could cope with about 7ml horse serum before available iodine was exhausted. The relationship between iodine inactivation and amount of serum appeared to be linear.

### Static wound model.

After incubation, traces of an iodine colour could be seen in the Telfa<sup>™</sup> dressing but the underlying test dressing was almost colourless - no titratable iodine could be extracted. However, the underlying filter paper squares showed an irregular 'blotchy' staining with iodine covering about one third of the area of the outermost layer. The colour extended irregularly to the lowest layer but with marked decrease in intensity. No surviving bacteria could be detected in any area showing signs of iodine being present but scanty growth of both test bacteria was obtained from non-iodine coloured regions of the base layer and, sometimes, from the central layer. No bacteria were detected in any other part of the model including the Telfa<sup>™</sup> dressing. By

from its central region but signs of iodine could be seen on the 'wound' margins. After 24-36 hours little iodine was evident in the 'wound', the margins of which tended to dry by 48 hours; the central region contained small pools of a viscous 'exudate'. On completion of a test the Telfa<sup>™</sup> was soggy but residual iodine was evident in the test dressing beyond the 'wound' except where 'exudate' had tracked (Fig. 3).

Bacteriology of the central region of the dressing showed scanty growth of test organisms above the wound but the remainder was often sterile. The 'wound' surface yielded heavy bacterial growth but growth was only moderate in the lower

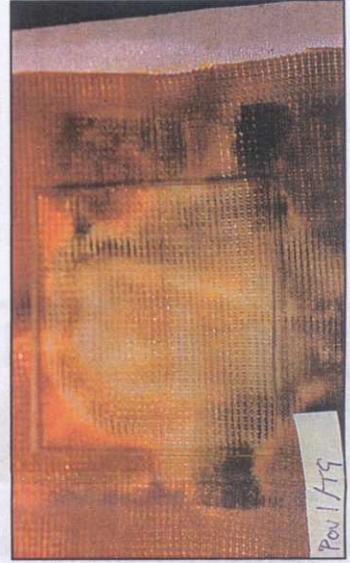


Fig. 3. Underlayer of povidone iodine medicated dressing after 3.5 days in the dynamic wound model showing loss of iodine in the region of the 'wound' and some tracking of 'exudate' at the edges. The staining in the central region is 'serous exudate'.

## DISCUSSION

Simple tests confirm that povidone iodine is a powerful bactericide; if laboratory tests with PVPI are repeated with non-serum containing agar, heavily seeded plates show no bacterial growth.

The iodine content of the dressings appears to be adequate; further experiments are needed to discover if there is advantage in increasing the iodine content.

The static model shows that the dressing can contain wound bacteria and also favourably modify the bacterial content of underlying 'tissue'. Possibly further benefit could be accrued by replacing the dressing after one or two days. Thus the dressing should prevent acquisition of bacteria by a wound from external sources and have value as a topical antibacterial prophylactic.

The dynamic model tends to confirm these findings but also demonstrates that volume of exudate is the most important factor as far as useful antibacterial activity is concerned. These preliminary experiments may provide an extreme challenge for this dressing since the 'exudate' rates chosen were high, about double that reported in burns<sup>3</sup>; there is a lack of similar information relating to chronic wounds. Moreover, although Telfa<sup>™</sup> can hold 8ml exudate in practice, this amount is considerably less, perhaps about one quarter. Thus, reducing the exudation rate would obviously lengthen useful dressing life. Whether replacing dressings shortly before iodine is exhausted would confer benefit remains to be determined.

## REFERENCES

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