charcoal cloth and not released into the wound'—although the nature of either the chemical or the physical carbon-silver bonds in the '100% pure activated carbon with silver' is not stated.

Of the remaining four products, Charcoal Cloth appeared to sorb a smaller quantity of diethylamine than did Actisorb, whilst the charcoal felt sorbed only a little more than the W.O.W. bandage used as a control. The charcoal felt was actually bonded onto a layer of a white support material thus effectively lessening the available amount of activated carbon per unit weight of fabric. The W.O.W. bandage sorbed insufficient diethylamine to exceed the lower limit of detection of the assay procedure.

In summary, the assay procedure described here is apparently capable of differentiating between a number of activated carbon fabrics whilst also being able to provide a limited amount of incidental information regarding possible chemical reactivity at the wound/dressing interface.

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New method for testing the absorbency of surgical dressings

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Abstract—Absorbent cellulose dressings have been tested by immersion in a standard aqueous solution of picric acid followed by standard draining, elution of the picric acid, and measurement of the absorbance of the yellow colour at 355 nm. Six samples of gauze were graded by this procedure, and two considered unsatisfactory, despite all sinking in less than 10s. Filmated gauzes and unwoven dressings required greater dilution for the absorbance readings, reflecting their different structures.

Following World War I, the British Pharmaceutical Codex introduced monographs on surgical dressings. The 1923 Codex set the first standard for the absorbency of Absorbent Cotton Wool—"one gramme . . . compressed to a volume of about 20 mils, and dropped . . . on to the surface of distilled water at about 15° . . . should sink readily". The 1959 Codex applied a time limit, requiring it to be "saturated within ten seconds", in water now at 20°C, and extending the standard to Absorbent Gauze BPC. In practice, good absorbent dressings would saturate in a couple of seconds, whilst those that still complied by becoming saturated in 9 s were not much better in use than those that failed by taking 11 s.

The saturation testing of Absorbent Gauze BPC could be more closely prescribed by specifying its folding, and this was done in the 1973 Codex, but Absorbent Cotton Wool remained a problem to handle. The 1971 first European Pharmacopoeia, followed by the British Pharmacopoeia of 1980, introduced a container to standardize the procedure. About 5 g of the dressing, in a defined, lightweight wire basket, was required to sink in not more than 10 s; and then, on draining for 30 s, to show a water-holding capacity of not less than 23 g of water g^{-1} dressing.

Water-holding capacity probably does not reflect the ability of a dressing to absorb wound exudate, but it gives another numerical standard to support the saturation requirement. The possibility of grading absorbent dressings by the use of these tests has been ignored, apart from the water-holding capacity of Absorbent Cotton and Viscose Wadding reflecting its 40–60% content of cotton by requiring only not less than 20 g of water g^{-1} dressing. Viscose fibres have a lower water-holding ability (between the fibres?) than cotton, although they have a higher moisture regain ability inside the fibres.

Over 35 years ago Savage et al (1952) published their method for assessing the water retention coefficient of absorbent dressings. This has not been used officially, possibly because it involved wetting a test dressing which had been held by bandage to an inflated balloon. A range of coefficients was obtained, and these values were different for woven and unwoven cotton. Other techniques have included measuring the uptake of dextran in saline applied to the underside of a dressing—possibly under pressure (Williams 1975).

The need for an improved absorbency test seems apparent, and the possibility of using aqueous coloured solutions which could be measured by spectrophotometry suggested itself. These solutions have several properties required of their colour: (i) it must not react with the cellulose of the absorbent dressing fibres (cotton or viscose); (ii) it must be eluted readily and completely from the dressing under test; (iii) it must be easily washed out of glassware used for repeated testing; (iv) it must show a stable strong absorbance maximum when diluted in aqueous solution, unchanged after contact with cellulose fibres.

After considering a number of coloured substances, including phenol red, picric acid was chosen for the coloured solution since it had an absorption maximum at 355 nm and possessed the required properties, except that owing to its explosive nature when dry, it is supplied wetted. However, the initial arbitary solution of it can be standardized by dilution to give a required absorption reading for the *test solution* in use.

Materials and methods

Picric Acid (BDH)—50% by weight of water. Pye Unicam SP6-500 spectrophotometer.

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Method devised. Prepare an aqueous *test solution* of picric acid so that on dilution 200 times (5 mL to 1 L) it has an absorbance at 355 nm of 0·50 (±0·01) in quartz 1 cm cells.

To test the absorbency of a sample of dressing, take about 1 g (±0·2 g) accurately weighed and place it on the surface of the *test solution* at about 20° within a large beaker. It should sink in less than 10 s. Remove the dressing from the *test solution* using forceps and allow it to drain for 30 s, agitating it gently for the final 10 s of this time. Place it in about 200 mL water in a beaker and swirl the dressing around for a few seconds. Pour off the water solution of eluted picric acid into a 500 mL volumetric flask. Add about 100 mL of water and swirl the dressing again, pouring off this weaker eluate of picric acid into the volumetric flask. Repeat this procedure with smaller portions until the eluting water and dressing have lost all yellow colour, and make the contents of the flask up to 500 mL.† Mix the contents of the flask, then pipette out an aliquot of 20 mL for dilution* and absorbance measurement at 355 nm. The reading obtained in a 1 cm quartz cell should not be less than that given by the 200 times dilution of the *test solution*, corrected for 1 g of dressing.

Five representative samples should be tested. The dressing fails if more than one result is below the required reading, provided the standard deviation of the results is less than 0·050.

This procedure is suitable for dressings containing cotton and/or viscose, but not those containing any animal wool or other fibres which react with picric acid. The gentle agitation towards the end of the draining period seems necessary to achieve a standardized draining. Unwoven absorbent cotton and filmated gauzes need careful manipulation and gentle squeezing to remove all picric acid within the 500 mL volume of eluate used.

Results and discussion

Results are presented in Table 1.

Table 1. Absorbances at 355 nm of diluted eluates of picric acid *test solution* per gram of absorbent dressing.

Dressing		Range of results*, with mean	N	s.d.
Absorbent cotton gauze				
H	5 cm^2 pad	0·76–0·78–0·80	5	0·014
S	21·7 cm wide roll	0·66–0·71–0·75	6	0·035
H	7·5 cm^2 pad	0·68–0·70–0·71	5	0·012
S	7·5 cm^2 pad	0·56–0·60–0·66	6	0·033
X	7·5 cm^2 pad (X-ray detectable)	0·47–0·54–0·64	8	0·075
I	7·6 cm^2 pad (individual packs)	0·36–0·45–0·53	5	0·081
Absorbent 'cotton' (Unwoven)—four times gauze dilution				
C	(pure cotton)	0·61–0·64–0·68	5	0·027
G	(cont. viscose)	0·47–0·50–0·52	5	0·017
D	balls (cont. viscose)	0·42–0·46–0·48	6	0·025
Filmated absorbent cotton gauze—twice gauze dilution				
Z	5 cm^2 pad (~30% w/w unwoven)	0·51–0·55–0·58	5	0·026
R	7·5 cm^2 pad (~40% w/w unwoven)	0·38–0·42–0·46	5	0·031

* Adjusted to 0·50 absorbance for the *test solution* of picric acid

It is encouraging that with the method devised, it is possible to obtain results for many samples of absorbent dressings with a standard deviation of no more than 0·035 or even less than half this. Brand H gauze pads, in two sizes, gave the most consistent results, and it must be assumed that gauze pads I and the old sample X (X-ray detectable thread portion removed before testing) did show a relatively wide range of absorbencies. Half the results for X were below 0·50. The values for the individually wrapped, sterilized pads I were surprising, and this was clearly a dressing inferior to the other gauzes.

Gauzes H (both sizes) and S roll appear to be excellent quality absorbent dressings. S pads are considered of medium quality. X and I are not acceptable as absorbents, although all sank well within 10 s in the picric acid solution.

The unwoven absorbent dressings gave surprisingly consistent results. In Australia, viscose fibres are commonly included with cotton in 'cotton wool'. The one pure cotton sample studied gave average results on the 'scale' applied to gauze (accepting that it is expected to be four times as absorbent as gauze by the test dilutions used), and the values for G and D are presumed to reflect lower absorbency due to their viscose content. D failed as an unwoven absorbent—it was a cheap supermarket brand. All samples recorded sank in the wire basket well inside ten seconds. Another sample did not satisfy this requirement by a considerable margin and was not further studied.

The two old filmated gauze pads had a 'sandwich' of unwoven cotton between two layers of woven gauze, and represent something like very thin Gamgee Tissue. The unwoven fibres were removed, and found to form 30 to 40 per cent of the weight of the dressing pads. It was calculated that dilution of the eluted picric acid to 2·5 L was an appropriate volume for evaluation of such combinations of about 35 per cent unwoven cotton, so pads R failed the test, whilst Z passed, although being somewhat below medium quality.

Thus this method of grading absorbent dressings, whilst assessing them to a particular pass/fail requirement, appears to show promise in refining the current obviously inadequate situation. The present authors will be pleased to hear of experiences from other laboratories that care to apply this procedure.

* For testing *absorbent gauze* (unfilmated) the dilution of the 20 mL aliquot should be to 50 mL (representing a total dilution of absorbed picric acid solution to 1·25 L). Drain in original folded form.

* For testing unwoven *absorbent cotton*, the dressing should be placed in a small wire basket (for manipulation) and the dilution of the 20 mL aliquot should be to 200 mL (representing a total dilution of absorbed picric acid solution to 5 L).

* For testing *filmated absorbent gauze* which contains a layer of unwoven cotton between two outside layers of gauze, the dilution of the 20 mL aliquot should be to 100 mL (representing a total dilution of absorbed picric acid solution to 2·5 L). Test in single ply.

† The residual wet dressing should be eluted with another 20 mL water to check for freedom from retained picric acid. This extra eluate, if measured at 355 nm against water, gives a reading no greater than 0·015 from absorbent gauze, no greater than 0·050 from unwoven absorbent cotton, and no greater than 0·030 from filmated absorbent gauze. It is discarded.

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