

extensive. The ischaemia could not have been caused by direct occlusion of the gluteal vessels, but may have resulted from thrombosis in the lower aorta with embolism to both internal iliac vessels. The catheters used were the smallest available but all three babies were of very low birthweights. 10% dextrose with heparin (500 units in 500 ml) was slowly infused through the catheter in each case and no drug or other fluid was given.

This complication of umbilical arterial catheterisation has not been widely reported. Cutler and Stretcher reported a baby with skin lesions similar to the lesions of these three infants, 2 days after catheter removal.³ Sciatic nerve damage and gluteal necrosis were reported in one baby after placement in the internal iliac artery and injection of multiple drugs, including 25% dextrose.⁴ Occasionally an aberrant umbilical artery results in placement of the catheter in an end artery—such as the internal pudendal artery—causing perineal skin necrosis.⁵ One baby of a diabetic mother has been reported with gluteal skin necrosis.⁶ It is known that polycythaemia and thrombosis are more common in such infants.

Gluteal skin necrosis in Cases 2 and 3 was diagnosed early because the buttocks and back were inspected routinely shortly after umbilical arterial catheterisation. The catheters were removed at once and there was complete healing. Babies who are

ill and require ventilatory support are generally nursed supine so that the buttocks and back are not visible. If an umbilical artery catheter has been inserted the nursing staff should inspect the baby's buttocks and back regularly for skin discoloration, in the same way that they look for signs of ischaemia on the baby's legs. If discoloration is discovered, the catheter should be removed at once.

I thank Dr N Rutter for help.

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Barrier properties of vernix caseosa

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SUMMARY Experiments are described which show that vernix caseosa has a mechanical barrier effect if it is deposited in an unbroken layer. Specific antibacterial properties were not detected in vernix. It is suggested that vernix is best left on a newborn infant because of its mechanical obstruction to bacterial passage.

The nursing care of newborn infants varies from place to place and there has been discussion whether washing off vernix exposes the skin of newborn babies to infection through removal of a substance that may have antibacterial activity. Older studies were in favour of preserving vernix on a newborn

baby for its ability to retain heat, especially in premature infants,¹ and for its anti-inflammatory properties.² Reports on the antibacterial properties of vernix are confined to investigations by Lubinski and Benjamin,³ and Sprunt and Redman⁴; neither investigation overcame the difficulty of evenly exposing the bacteria to vernix.

This study was undertaken to determine whether better methods of exposing bacteria to vernix would give different results.

Materials and methods

Vernix was collected from 9 African babies born in the department of obstetrics at Mulago Hospital,

Kampala. Within a few minutes of birth as much vernix as possible was scraped from the skin with a sterile wooden spatula held in hands covered by sterile rubber gloves. It was put into a sterile glass Petri dish and was either used immediately or after overnight storage at 4°C for the preparation of three culture media.

Vernix agar. Nutrient agar (Oxoid) in screw-capped bottles was melted at 60°C and 10% mass/vol of vernix was added. When the vernix had melted and mixed with the agar, the medium was poured into Petri dishes and allowed to solidify. Incubation at 37°C overnight showed that vernix agar prepared in this way was sterile.

Pure vernix medium. Vernix was spread with a sterile wooden spatula on to a circle of sterile filter paper in an unbroken layer about 4 mm thick and put into a Petri dish. It was not sterilised.

Vernix broth. Vernix is a fatty substance which is insoluble in water-based liquid medium. From preliminary experiments it was found that vernix added to 10% Tween 80 would give a fine suspension after vigorous shaking. The concentration of vernix used was 2.5% mass/vol.

Test organisms. These consisted of one strain each of *Staphylococcus aureus* and *Escherichia coli* isolated from newborn babies in Mulago Hospital. All inoculations were made from 5-hour broth cultures of the organisms.

Bacterial growth rates. These were determined as follows. The test organisms (0.2 ml of 5-hour culture) were inoculated into vernix broth and nutrient broth and incubated at 37°C. Every two hours for 10 hours and finally at 24 hours, the bottles were shaken and samples removed for the determination of bacterial counts using the method of Miles *et al.*⁵

The rate of bacterial growth in these cultures was indicated by the mean generation time (G) which is the mean time from one cell division to the next. It was determined by plotting the logarithms of bacterial colony counts against time and applying the formula:⁶

$$G = (t_2 - t_1) \log 2 / (\log b - \log a)$$

where G = mean generation time, t_1 = time at start of log phase of growth, t_2 = time at end of log phase of growth, a = bacterial colony count at t_1 , b = bacterial colony count at t_2 .

Results

Mechanical protection. The filter paper covered with pure vernix was placed on the surface of a nutrient-agar culture plate with the vernix uppermost, and the vernix was inoculated with drops of *S. aureus* and *E. coli*. After overnight incubation the filter paper and vernix were removed and the surface of the agar was found to be sterile. Similarly, bacterial growth was not found on the agar plates if the filter paper was soaked in vernix dissolved in ether, evaporated to dryness, placed on the culture plate, and inoculated with bacteria.

Antibacterial action. To determine whether organisms collected by babies during parturition survive on vernix, loopfuls of fresh vernix were inoculated on to blood agar and MacConkey agar plates and into meat broth. These cultures yielded a moderately heavy growth of *S. aureus* and *Streptococcus faecalis*.

Vernix placed in the middle of blood agar plates which had been flooded with broth cultures of either *S. aureus* or *E. coli* did not inhibit bacterial growth. Both organisms grew equally luxuriantly on vernix agar and control nutrient agar from heavy and light inocula. When inoculated on pure vernix the test organisms survived and inhibitory activity was not demonstrated.

Mean generation times and bacterial colony counts at the end of 24 hours showed no significant antibacterial effects of vernix on the test organisms (Table).

Discussion

Lubinski and Benjamin³ attempted to demonstrate an antibacterial effect by mixing vernix with *Corynebacterium diphtheriae* and applying the mixture to scarified skin of guinea-pigs. All the guinea-pigs died after 7 days with classical diphtheritic lesions and it was concluded that vernix did not prevent invasion of skin by bacteria. In another experiment⁴ contact cultures from washed and unwashed babies' chests showed no difference in colony counts. It was concluded that vernix *in situ* did not protect infant skin from bacteria. The possible effect of

Table Effect of vernix broth on growth of *Staphylococcus aureus* and *Escherichia coli*

Culture medium	Mean generation time (min)		Colony count at 24 hours	
	<i>S. aureus</i>	<i>E. coli</i>	<i>S. aureus</i>	<i>E. coli</i>
Plain broth	14.1	10.7	2.7×10^7	3.7×10^9
Vernix broth	14.8	10.2	1.8×10^7	3.5×10^9

vernix as a mechanical barrier was neglected in both these studies. The experiments reported here suggest that vernix has a mechanical barrier effect when deposited in an even layer.

In the *in vitro* experiments, Lubinski and Benjamin³ mixed broth with vernix, which left the vernix in clumps, and inoculated the mixture with either *S. aureus* or *E. coli*; while Sprunt and Redman⁴ smeared vernix to the inside of a series of test-tubes and filled them with a suspension of either *S. aureus* or *E. coli* in saline. Only one surface of the vernix was therefore exposed to the bacteria. In both experiments the exposure of bacteria to the vernix was uneven.

In the present experiment an even contact of vernix with the inocula was achieved by emulsification of vernix in Tween 80.

Our method of measuring the rate of bacterial growth by calculation of mean generation times from serial bacterial colony counts is likely to be more sensitive for assessing lesser degrees of inhibitory activity. However, even by this method, no antibacterial activity was shown.

It is concluded that vernix deposited experimentally in an unbroken layer forms a mechanical barrier through which bacteria do not pass. It is therefore probably advantageous to leave the naturally acquired vernix on an infant's skin.

Moreover, vigorous removal of vernix often results in erythema and skin damage with the liability to infection of the skin.

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