

## THE CONTROL OF INFECTIONS IN THE NEWBORN\*

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THE CONTROL of infections in the newly-born is a challenge to all that have to do with this age group. The size of the problem can be illustrated by the example of our experience at the Vancouver General Hospital. There, in 1952, of 4,639 babies born alive, 8 died of infection, 114 had an apparent skin infection, 47 had oral thrush, 36 had conjunctivitis, 7 had an acute upper respiratory infection, 4 had omphalitis, 3 had diarrhoea, and one each had furunculosis, paronychia, mastitis, and meningitis. There were, therefore, 215 babies who were presumed to be infected during this 12 month period.

It is of interest to notice that during this one year infective pneumonia was not diagnosed in any newborn infant who subsequently survived. Six cases of pneumonia were discovered among the eight babies who died of infection. It is also noteworthy that infection caused 12% of the deaths of those live born infants who came to autopsy.

We have been studying the epidemiology and the control of skin infections in our nurseries. Some data on the epidemiology of pyoderma neonatorum have been accumulated, and it is hoped to publish this aspect of our work in the near future. This paper deals with the significant improvement obtained by us in the control of skin infections in our nurseries.

### REVIEW OF THE LITERATURE

I would commend to you a review of the subject of infection in the newborn baby by Professor Alan Moncrieff.<sup>1</sup> However, even this scholarly presentation leaves much unanswered about the particular subject of pyoderma neonatorum. Knowledge of the problem of skin infection in the newborn has increased slowly. The *Staph. pyogenes* has not always been thought to be the causative organism,<sup>2</sup> although it was implicated by Matzenauer<sup>3</sup> in 1900. In regard to the presence of pathogenic staphylococci in the nares of neonates, Bloomfield,<sup>4</sup> in 1922, said, "These organisms were found in a few cultures". Since then repeated surveys of the situation have revealed the very frequent presence of this organism in the nose of newborns,<sup>5, 6, 7</sup> being present in this location in 9.5% of babies by the end of the first day, in 50% of babies by the end of the second day, and in 88.8% of babies between the fourth and the 8th days.<sup>6</sup> That the *Staph. aureus* is more prevalent in the noses of hospital personnel, than among the general population,

has been repeatedly shown.<sup>8 to 11</sup> Duncan,<sup>12</sup> in 1942, found pathogenic staphylococci in the milk of 90% of nursing mothers.

An increase in the number of staphylococcal infections in the general population has been reported by some authors in Britain,<sup>13 to 18</sup> and from Canada.<sup>19</sup> The *Staph. pyogenes* occurring in nursery infections has been studied by many bacteriological techniques. Recently, their identification by phage-typing has been a popular method.<sup>20 to 28</sup>

Attempts to control nursery skin infections by elimination of dry dusting and the use of oil on the floors,<sup>20</sup> by surgical scrubbing,<sup>9</sup> wearing rubber gloves, masks and gowns,<sup>6, 10</sup> by isolation of all personnel and patients found to be nasal, skin or rectal carriers,<sup>30</sup> and by placing babies with their mothers or in very small groups rather than in large nurseries<sup>31, 32</sup> have all been tried and reported on by various writers. The strict isolation method, proposed by Knott and Blaikley<sup>30</sup> produced good results, but is not practical under the circumstances operating in most hospitals. Taking babies out of large nurseries and placing them in small groups has been suggested as a preventive measure. We are disturbed, however, by the very seriously high incidence of pyoderma neonatorum occurring in a small town, cottage-type hospital, with an average nursery population of 7, that we have recently been studying. It is now generally agreed that the use of rubber gloves by nurses, and the wearing of the usual type of face mask, are at best of doubtful value.

The prophylactic use of antibiotics has, of course, been advocated, including the intra-nasal instillation of penicillin to reduce the incidence of skin contamination. The increasing resistance of hospital staphylococci to penicillin has much decreased the value of this antibiotic both in prophylaxis and in treatment.<sup>7, 11, 19, 34</sup> Aureomycin has more recently been advocated as a routine prophylactic agent.<sup>26, 35, 36</sup> The now well-known ability of the staphylococcus to become resistant to antibiotics makes one wonder how long this agent will remain effective.<sup>11</sup>

I would next like to discuss methods of prophylactic skin care. Ammoniated mercury ointment used as an ununction has been popular,<sup>37</sup> and Potter<sup>2</sup> in 1936 reported an impetigo incidence rate of 19.8 (per 1,000 live births). Sanford's work,<sup>38</sup> published in 1937 was possibly responsible for the popularity of not washing or oiling the baby. This "no-handling" method has been officially recommended by the Committee on the Fetus and the Newborn of the American Academy of Paediatrics. Parmalee,<sup>39</sup> in 1946, recommended this same principle. In the same year, Corner<sup>40</sup> reported an incidence rate of 59, when daily soap and water bathing was used. I should mention that Moncrieff, in the lecture referred to earlier,<sup>1</sup> stated that he advocates daily soap and water bathing as his personally preferred method. The use of 5% sulfathiazole cream as an ununction has been urged by Weymuller,<sup>41</sup> and supported by others.<sup>42, 43</sup> They show incidence rates of from 9 to 18 in their reports.

Since 1945, various publications on the use of a substance called hexachlorophene have appeared.<sup>42, 44 to 47</sup> This bactericidal agent has been used in soap, in a lotion, and in a detergent. All of these reports claim the virtual disappearance of newborn skin infection, reported rates being as low as 1.4 per 1,000 live births.

### MATERIAL FOR PRESENT STUDY

First it is necessary to define to you what we mean by the term, pyoderma neonatorum.

Pustular skin infections in the newborn are generally called impetigo neonatorum, sometimes pemphigus neonatorum and sometimes pemphicoid. We have preferred to use the term pyoderma neonatorum because the other names, impetigo and pemphigus are unsatisfactory. The

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majority of the pustular lesions seen are small, discrete vesicles with a surrounding erythema, containing a cloudy fluid or frank pus. Such lesions are easily broken and leave no scar, neither does crusting occur and seldom are the lesions truly bullous. We have our own definition of pyoderma neonatorum which is as follows: Any lesion one millimetre or more in diameter on the skin which is pustular and from which *Staph. pyogenes* can be cultured.

As will be seen in Fig. 1, the incidence of pyoderma neonatorum in the nurseries of the Vancouver General Hospital reached epidemic proportions in the winter of 1948-49. The peak of this incidence was attained in January 1949, when the rate reached 121 cases per 1,000 live births. Coincidentally with the introduction of control measures, applied in April and May of

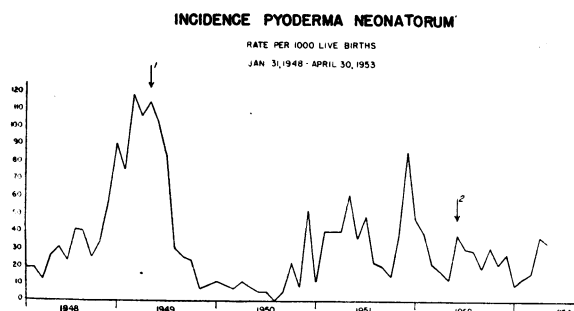


Fig. 1.—Arrow 1—April 1949. Introduction of control measures. Arrow 2—May 1952. Introduction of experimental methods of skin care.

1949, and with the appointment of a physician to be in charge of nurseries, the incidence fell rapidly until in July 1950, no cases were reported. The rate from September 1949, until July, 1950, had ranged between 7 and 15. Then, with no change in our techniques, an increase in the rate occurred, so that in January and February 1951, the rate was 51, and in December 1951, a peak of 90 per 1,000 live births was reached. In April and May, 1949, the following improved nursery techniques were introduced. Barrier examining rooms were built at each nursery, prohibiting the entrance into the nursery of everyone excepting those nurses caring for the babies. All personnel were required to be capped, masked and gowned, and their hands washed with soap and water. Dry dusting in the nurseries was forbidden. All linen used in the nurseries was autoclaved. The common changing table was eliminated. Commencing in June 1949, and continuing until April 30, 1952, every newborn baby has had a complete body inunction at birth with 1% ammoniated mercury in a

eucerine base. This inunction has been repeated on the fifth day of life.

It is obvious that these methods have not adequately controlled pyoderma in our newborns. Our rate, although low in part of 1950, has generally been higher than that reported from many other centres. We have not had any serious complications in either the infants or their mothers. There has not been an increase in the number of cases of breast abscess in the mothers such as has been reported from the centres.

From May 1, 1952, until April 30, all the babies born at the Vancouver General Hospital were

TABLE I.

INCIDENCE OF PYODERMA NEONATORUM IN DIFFERENT TREATMENT GROUPS IN THE NURSERIES, VANCOUVER GENERAL HOSPITAL—MAY 1, 1952 - APRIL 30, 1953

Culture results	<i>Staphylococcus</i> coagulase positive	<i>Staphylococcus</i> coagulase negative	No growth	No culture but typical clinically	Total
Type of treatment					
X	43	3	4	3	53
Y	5	0	16	0	21
Z	23	6	9	1	39
Total:	71	9	29	4	113

Type of treatment	Babies treated	Babies receiving no treatment	Total live births
X	1506		
Y	1517	87	
Z	1466		
Total:	4489	87	4576

divided into three groups at birth. In each delivery room one of three types of skin care was instituted. Thus the babies were not selected, but the skin care they were given depended on the delivery room in which they were born. In one delivery room, the baby was treated with the ammoniated mercury technique as has been applied during the previous three years and which was described earlier (Method Z). In another case-room, the baby was anointed at birth with a lotion containing 1% hexachlorophene. The baby so treated had a daily inunction with this lotion in the nursery (Method Y). In yet another case-room, the excess blood and vernix was removed from the face, groins and axillæ with sterile liquid petrolatum and then no other skin treatment was applied to the baby (Method X). None of the babies were bathed. The babies were distributed

in the usual way throughout the nurseries, so that they were all exposed to equal risk of infection in the nurseries, whatever that risk might have been.

Table I will show you that of 4,576 babies born in this 12 month period, we had to eliminate 87 from our series because they were too ill, or too small, or for other various reasons, leaving 4,489 babies at risk. These were fairly evenly divided between the three skin methods. Clinical pustule-like lesions were discovered and cultured in 53 of the non-treatment group, 39 in the ammoniated mercury group, and 21 in the hexachlorophene group. However, we feel that the true significance of this clinical experiment lies in reporting on the number of cases developing pustules from which we could culture

TABLE II.

INCIDENCE OF PYODERMA NEONATORUM IN DIFFERENT TREATMENT GROUPS IN THE NURSERIES, VANCOUVER GENERAL HOSPITAL—MAY 1, 1952 - APRIL 30, 1953

Type of treatment	Babies treated	Pustules culturing coagulase positive staphylococci	Coagulase positive staphylococci in pustules: rate per 1000 babies treated
X	1506	43	28.5
Y	1517	5	3.3
Z	1466	23	15.5
Total:	4489	71	15.8

the *Staph. pyogenes*. In the others, either no organism was found, or other organisms, usually the *Staph. albus*, generally considered non-pathogenic, were grown. The cultures were taken from unbroken pustules with a Pasteur pipette, so far as possible by one technician.

A very few were not cultured because the lesions had broken before this could be done. True cases of pyoderma, lesions from which could be cultured a pure growth of *Staph. pyogenes*, occurred in 43 treated by "non-inunction", 23 treated with ammoniated mercury, and in only 5 treated with hexachlorophene in a lotion.

Table II shows the same information expressed in rates per 1,000 babies treated. We have discovered that in our hospital, with our nursery facilities, it is necessary to apply some prophylactic to the skin. Without prophylaxis, the infection rate of 28.5 is produced, which we consider too high. This rate is halved (15.5) when 1% ammoniated mercury is applied. The

application of hexachlorophene in a lotion almost eliminates (3.3) this infection.

Fig. 2 presents the same results in graphic form. The heavy black line portrays the average incidence rate for all babies treated. Note that the ammoniated mercury method roughly approximates this average. The "non-inunction" method produced a pyoderma incidence higher than the average in almost every month. The hexachlorophene method produced a pyoderma incidence that was consistently very low.

At the present time we are observing the efficiency of other skin methods. We are subjecting them to the same rigid control. So far we have no evidence that the staphylococcus can become resistant to hexachlorophene.

PYODERMA NEONATORUM

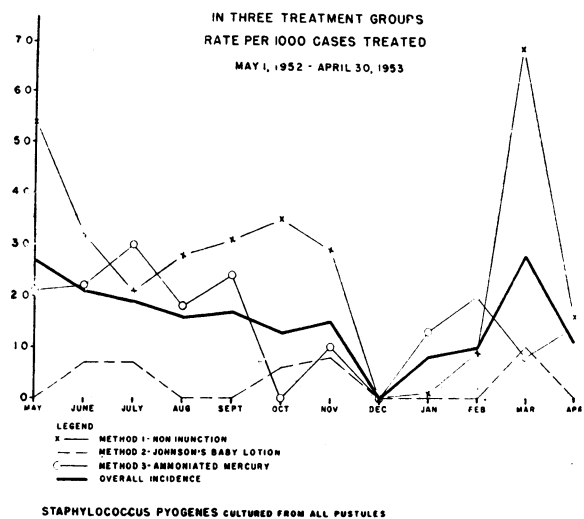


Fig. 2

SUMMARY

1. Experience of the Maternity Department of the Vancouver General Hospital, relating to all nursery infections, and in particular in pyoderma neonatorum, has been described.
2. The medical literature has been reviewed and a bibliography prepared.
3. A definition of pyoderma neonatorum has been suggested.
4. A preliminary report of our studies of various methods of prophylactic skin care to the newly born has been given.

The data on the epidemiology on pyoderma neonatorum will be published under the authorship of Hardyment, A. F., Wilson, R. A., and Cockcroft, W. H. This work has been done under the Federal Health Grant, Research Project No. 609-7-5.

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### NEWBORN INFECTIONS AND BREAST ABSCESSSES OF STAPHYLOCOCCAL ORIGIN\*

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THE HOSPITALS of Winnipeg experienced an unusual incidence of staphylococcal infections of newborn infants and of puerperal breast abscesses from 1947 to 1951. The experience of one hospital during 1949 has been reported previously by McGuinness and Musgrove.<sup>1</sup> The first use of bacteriophage typing of staphylococci in the investigation and control of the epidemic has been reported by Colbeck.<sup>2</sup> The year 1948 was the peak year of the outbreak, 1950 a quiet year with a low incidence of infection in all hospitals. There was evidence late in 1950, however, that the infection was still present and an epidemiological investigation was planned but was delayed in starting until the fall of 1951. At that time it was apparent that two hospitals of the city had had an unusual incidence of the disease in 1951, and the following is an analysis of the

available information concerning these outbreaks.

An association of purulent infections of newborns and puerperal breast infections has been reported recently by Jeffrey,<sup>3</sup> Pyle,<sup>4</sup> and Isbister,<sup>5</sup> as well as the reporters of this outbreak. The use of bacteriophage typing of staphylococci in investigations of nursery infections has been reported by Williams,<sup>6</sup> Allison and Hobbs,<sup>7</sup> Miller<sup>8</sup> and Parker and Kennedy.<sup>9</sup> The outbreaks to be reported followed this pattern.

Very early in the outbreak it was established that the causative organisms were coagulase positive staphylococci and in 1948 bacteriophage typing was introduced to aid in the identification of the staphylococci. Dr. J. C. Colbeck, Director of the Laboratory Services of the Province of Manitoba at that time, prepared a bacteriophage which lysed a high proportion of the staphylococci isolated from pathological material from September, 1948 to May, 1949. This phage he designated as W. The method of bacteriophage typing of staphylococci now in use was initiated by Dr. G. B. Leyton some months after he became Director of Laboratory Services. An article by Dr. Leyton,<sup>10</sup> on the resistance to antibiotics of staphylococci isolated at the laboratory, appeared in 1952. Since late February 1951, 23 bacteriophages have been used with the result that the identification of staphylococci has become more precise. Some of these bacterio-

\*This is part of the report made to the Committee on Staphylococcal Infections of the Section of Obstetrics and Gynecology of the Winnipeg Medical Society under the chairmanship of Dr. Henri Guyot. The investigation was conducted by personnel of the Department of National Health and Welfare at the request of this Committee and was supported by funds supplied by Federal Health Grants.

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