

NEONATAL TETANUS IN SINGAPORE 1960-1970

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SYNOPSIS

A retrospective study is made of eighty-six cases of Tetanus neonatorum for the period 1960 to 1970 in Singapore. Sixty of these were delivered in Government Hospital, seventeen by private midwives and nine self-attended deliveries. The incubation period, symptoms and condition of the umbilicus are presented. The pathogenesis of the disease is discussed. Owing to the short incubation period, it is most likely that the infection occurred at birth. The birth attendant played an important part in the causation of the disease.

A brief description is given of the local custom of treating the umbilicus. The methods of prevention which are presently used, and which could be applied to Singapore are discussed.

INTRODUCTION

Infections of the umbilical stump were once common, but they have diminished in number since the introduction of aseptic obstetric practice. In Singapore, where a government-subsidised maternal service is available both in Hospitals and as a domiciliary service with trained midwives in attendance, together with a domiciliary after-care service during the years under review, it is regrettable that tetanus neonatorum should still occur sporadically. Deaths from tetanus neonatorum are often related to the standard of socio-economic development of the area. It is most surprising that the infection should persist in substantial numbers annually in an urbanized economically well-developed Singapore. The present review of cases of tetanus neonatorum seen in the years 1960-1970, is presented to emphasize the continuing importance of this eminently preventable infection which still poses as a challenging Public Health problem.

MATERIAL AND METHOD

This is a retrospective study of cases of neonatal tetanus investigated by the Maternal and Child Health Department, and records of patients admitted to the Children's wards in Outram Road General Hospital. Patients with neonatal tetanus would be known to the Maternal and Child Health Department either through the midwife or Health Visitor's routine visits to newborn babies, or when the baby was brought to the clinic for illness, or when hospital clinicians inform the Department of the existence of such a case.

Cases of neonatal tetanus when known to the Department are immediately investigated by the District Sister and Supervisor of Midwives. Details of delivery and medical care from delivery to the time of the illness were sought. The home environment, general hygiene of the mother and cleanliness of the home were investigated. History of drugs and application on the umbilicus was specifically enquired. For cases delivered by Private Midwives, the midwife concerned was interviewed and her "delivery" and "bathing" bags examined by the Supervisor of Midwives, in an effort to trace the source of infection and to check on her techniques of asepsis. Where necessary, laboratory investigations were performed. Reports of all these investigations were then handed to the Senior Health Officer in charge of the Maternal and Child Health Service.

During the years under review, Outram Road General Hospital was the only civilian hospital where there were children's wards. Diagnosis of all the cases was entirely clinical.

INCIDENCE

Although tetanus neonatorum is not a notifiable disease in Singapore, but because of the seriousness of the signs and symptoms in a newborn with tetanus, it might be assumed that all cases would be admitted to Hospital unless death occurred before the child arrived in Hospital. Such infants would be known to the Maternal and Child Health Department because all births are notified within 24 hours of delivery, and these are then followed by the Maternal and Child Health home visiting service.

The number of cases of tetanus neonatorum fluctuated yearly. The trend was falling until in 1968 when it began to rise again. This increase in number was seen mainly among the Malays. Before 1967 only 14% of the cases were Malays, but since

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1968 almost half of the cases were Malays (Table I). The total number of cases was 86 giving a rate of 14.4 per 100,000 live births over the 11 years under review. The rate of neonatal tetanus was highest among the Malays. This was especially seen in the last 2 years when there was a sudden rise.

There were 59 males and 27 females, giving a sex ratio of two is to one. This difference in sex incidence was seen in both the Malays and Chinese in all the years reviewed. No explanation could be offered for this sex difference.

BIRTH ATTENDANCE

The rate of neonatal tetanus was lowest among cases delivered in Government hospitals, by Government midwives and by private doctors (Table II). It was twice as high in cases delivered by private

midwives and highest among the self-delivered cases. Thus, the type of birth attendance is an important causative factor in neonatal tetanus. The 9 cases of tetanus in self-delivered babies occurred before 1968. All the babies delivered by private midwives were born at home. One of the self-delivered cases occurred on board a sampan and the cord was cut with a piece of bamboo. In the remaining 8 cases the cord was cut by ordinary scissors by either the mother herself or the grandmother or the father of the child.

Between 1960 and 1968, most of the cases (49) were delivered in Kangang Kerbau Maternity Hospital. Only six cases were delivered by private midwives. In 1969 and 1970 however, there was a change in the type of birth attendance of the cases. During the latter period there were 11 cases (50%) delivered

TABLE I
RACE DISTRIBUTION

Year	Chinese		Malay		Indian/ Pakistani		Others		Total	
	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*	No.	Rate*
1960	5	11.12	1	9.45	—	—	—	—	6	9.70
1961	7	16.26	1	9.10	—	—	—	—	8	13.30
1962	13	31.00	2	17.77	—	—	—	—	15	25.43
1963	9	21.32	1	8.64	—	—	1	88.26	10	16.80
1964	4	9.77	1	8.54	—	—	—	—	6	10.31
1965	3	7.63	1	9.08	1	22.70	—	—	5	8.97
1966	3	7.82	—	—	1	23.03	—	—	4	7.32
1967	3	8.37	1	10.15	—	—	—	—	4	9.89
1968	4	11.68	2	23.08	—	—	—	—	6	12.70
1969	6	18.25	6	80.84	1	30.53	—	—	13	29.17
1970	4	11.62	5	68.34	—	—	—	—	9	19.59
TOTAL	61	14.25	21	18.86	3	6.53	1	8.61	86	14.40

*Rate per 100,000 live births.

TABLE II
CASES BY ATTENDANCE AT BIRTH

Birth Attendance	Ethnic Group	Chinese	Malays	Ind./Pak.	Others	Total	
		No.	No.	No.	No.	No.	Rate
Govt. Hosp. or midwife/Private Doctors Private Midwives Self-attended		51	5	3	1	60	11.6
		3	14	—	—	17	21.7
		7	2	—	—	9	100.2
TOTAL		61	21	3	1	86	14.4

by private midwives. The rise in the number of private midwife cases was related to a corresponding rise in the number of Malay patients. Out of the 11 Malay cases in 1969 and 1970, 8 were delivered by private midwives. Although the number of babies in Singapore delivered by private midwives had fallen over the years from 17.4% in 1960 to 9.4% in 1970, a substantial proportion of Malay births were still attended by private midwives. In 1960, 42% of the Malay babies were delivered by private midwives, compared to 34.3% in 1970. In fact there was a gradual decline in the proportion of Malay births attended by private midwives until 1968 when there was a sudden increase again among the Malays contrary to the general trend of rapid decline of births attended by private midwives in Singapore as a whole. It is difficult to postulate the cause for the change in behaviour of Malay mothers. The increase in accouchment fees in Government institutions and the introduction of domiciliary delivery charges in the Maternal and Child Health Service could play a part.

GEOGRAPHICAL DISTRIBUTION

57 (66%) of the cases occurred within the City limits. This corresponded to the percentage of live births to parents who lived in the city, the latter was about 60% during the period under review. Of the 29 cases from the rural areas, 12 lived in farm houses in the vicinity of pig styes, chicken coups and wells. Most of the other cases were from urban slum areas or Housing Board flats.

CARE OF THE UMBILICUS AFTER DELIVERY

The majority of the cases delivered in Hospital were discharged home on the second day after birth. Home nursing by Government midwives began from the third day, and commonly lasted from three to six days. As long as the umbilical cord was on, the midwife would home visit the mother and baby. In many cases this was continued for a day or two after the cord had dropped. There were 3 cases in which the clinic Domiciliary-after-care service was not informed by the family. These cases only came to the notice of the clinic after they had received the birth notification from the Registrar of Births and Deaths Office.

Two babies developed tetanus while still in hospital, and in one case, a day after discharge from hospital. Thus, these were not exposed to the domiciliary after-care service, and one could also assume that there was little interference to the umbilicus. Cases delivered by private midwives were looked after by them until the cord had dropped off.

All mothers were told not to meddle with the umbilical cord. The majority of the mothers denied any interference with the umbilicus. History of self-medication on the umbilicus was only available in 7 cases; 4 of the mothers applied Chinese medicine powder bought from the Chinese drug stores and 2 applied powdered cockroach's faeces on to the umbilicus and in one case saffron powder was used. All the others applied cord powder supplied by the midwives or used talcum powder.

INCUBATION PERIOD

It may reasonably be assumed that in neonatal tetanus, infection by *Clostridium tetani* took place at or soon after birth and that the age of the patient at the time of onset represented the incubation period. Infection of the umbilicus could also occur at any time before healing. In most of the cases the first symptoms occurred in the first week of life though the range was from 4-18 days. The average incubation period had remained approximately the same over the years (Table III). The length of the incubation period was the same in cases delivered in hospital and at home.

TABLE III

INCUBATION PERIOD

Incubation Period in Days	Hospital Delivery	Home Delivery	Total Cases
4	3	2	5
5	8	2	10
6	23	5	28
7	8	7	15
8	0	1	1
9	6	3	9
10	3	1	4
>10	3	5	8

Fatality was much higher in the group with short incubation period. 84% of the group with incubation period of less than 8 days died compared to 44% of those whose incubation period was more than 8 days. The overall fatality rate was 77%.

PRESENTING SYMPTOMS

The usual presenting symptoms were inability to open the mouth, to suck, or refusal to feed. Of the 86 cases 55% had such presenting symptoms. A significant number of patients (38%) presented with fits, spasm or stiffness. All these cases died. Such cases might have very short onset interval, so that the tetanic spasm was taken to be the first symptom. A small number presented with fever.

CONDITION OF THE UMBILICUS AT ONSET OF ILLNESS

Evidence of umbilical infection was only present in 28 cases (32.6%). In the 11 cases (12.8%), the umbilicus was noted to be slightly moist. All the others (54.6%) were recorded as dry. The cord had dropped off in most of the cases when first seen in hospital. Therefore the condition of the umbilicus is no guide to the possible development of tetanus neonatorum.

Diagnosis was clinical. Umbilical swab for the organism was only done in isolated cases. Bacteriological Culture showed mainly *Staphylococcus aureus* and *Proteus*.

ADMISSION TO HOSPITAL

There was no delay in seeking treatment in most of the cases, and the seriousness of their symptoms warranted admissions. The majority of the cases were admitted on the day after the onset of the disease.

Of the fatal cases, 80% of the deaths occurred within the first week of illness. Those who survived were warded in hospital on an average of 3-5 weeks.

PATHOGENESIS

While trauma of all kinds is common in childhood, the one inevitable wound experienced by all infants is that produced by the severing of the cord after birth. The commonest source of infection is undoubtedly the instrument used to cut the cord at the time of birth. But the mere fact that the organism is introduced by the instrument at birth does not necessarily mean that tetanus will develop; local condition in the wound must be suitable. The organisms will only proliferate in the presence of an oxidation reduction potential far lower than that existing in normal living tissue. Dressings and bindings of the abdomen will make the umbilicus an ideal nidus for infection.

In those cases with short incubation period it was most likely that infection occurred at birth. The fact that the umbilicus was septic in only 32% of cases might indicate the mildness of the infection. This could also account for the relatively good survival rate as compared to reports⁷ from other developing countries where cases occur mainly in self-attended deliveries.

LOCAL CUSTOM OF TREATING THE UMBILICUS

Tetanus in the newborn is known colloqually among the Chinese as "Lock throat" or "Seven-day

wind." Both terms referring to the symptoms of trismus and spasm. Spasm is traditionally believed to be due to wind entering the body through the umbilicus. Thus, it is customary to cover the cord and umbilicus with various form of powder known as "sealing umbilicus powder"—obtainable in Chinese Medical Stores. The active ingredient in such powders in present time is mainly talcum. The soot of burnt ginger and joss sticks are also believed to take away the "wind" when applied on the abdomen, while pounded cockroach's faeces is supposed to have an antiseptic action. Such practices are now rare, except in the very small minority who refused to avail themselves to modern maternity care. However, the belief that "wind" is responsible for tetanus neonatorum and that this wind can pass through the umbilicus is still prevalent. Consequently, although the great majority of mothers do not persist in such unhygienic custom as placing soot and cockroach's faeces on the umbilical stump, the sprinkling of talcum powder or Chinese face powder on the umbilicus, and the use of abdominal binding are still widely practiced.

The Malays believe that the yellow ginger and gambier (a form of sيره) assist in drying up the cord when applied to it. Such practices however, are rarely performed now.

DISCUSSION

The trend of tetanus neonatorum in Singapore could be divided into two periods, the first from 1960 to 1968, and the second from 1969 to 1970. During the first period, the majority of the cases were delivered in hospital whilst in the second period only about half of the deliveries occurred in hospital. This difference is also related to a change in the racial composition of the patients. During the early period 80% were Chinese whereas in the second period only half were Chinese with a corresponding rise in the percentage of Malay patients. The change in the racial composition of the patients was only secondary to that of the change in the type of birth attendance. As had been shown the type of birth attendance was a more decisive factor in the causation of neonatal tetanus.

A significant number of the babies affected (14%) were born to agricultural workers and poultry farmers who live in close contact with their domestic animals. They were more likely to infect wounds, ulcers or abrasions with spores of *Clostridium tetani*, an organism found as a commensal in the alimentary tract of cattle, pigs, chickens and ducks and are excreted in their droppings. The number of live births born to this group of workers in Singapore is only about 2.5%.

RELATION OF NEONATAL DEATHS DUE TO TETANUS AND TOTAL NEONATAL DEATH

With the fall in neonatal mortality, deaths due to tetanus neonatorum assume greater importance. Since 1968, there has been a rise in the percentage of deaths due to tetanus. Compared to tetanus at other ages, deaths of tetanus in the newborn form quite a substantial proportion—27% of the total (Table IV).

TABLE IV

NEONATAL DEATHS AND DEATHS DUE TO TETANUS 1960-1970

Year	Neonatal Deaths	Deaths due to Tetanus Neonatorum	% of Neonatal Deaths due to Tetanus	Deaths due to Tetanus (other than Tetanus Neonatorum*)
1960	1,093	5	0.45	24
1961	1,059	8	0.75	36
1962	1,127	8	0.70	21
1963	1,097	6	0.54	20
1964	1,143	6	0.52	22
1965	995	4	0.40	24
1966	910	4	0.43	20
1967	846	4	0.47	14
1968	751	5	0.66	8
1969	644	9	1.39	12
1970	671	5	0.74	5
TOTAL	10,336	64	0.61	206

*Data from The Annual Report of Registrar of Births and Deaths 1960 - 1970.

Cord powder (Talcum alum aminacrine) was used for years in the hospital and the domiciliary after-care service. There was a remote possibility that talcum could serve as a culture medium for tetanus spores, thus it is now not recommended for use. However, because of the deeply ingrained faith on "some form of powder" for the umbilicus, cord powder had to be withdrawn in stages only by the Maternal and Child Health Service, first from the city areas, then finally in 1970 from all areas. Cord powder is however still widely used by the private doctors and midwives. At present the Domiciliary after-care midwives in their daily nursing of newborn babies only clean the umbilicus with cord spirit (75% alcohol, and $\frac{1}{1000}$ aminacrine). Should the umbilicus become wet or infected, the babies are referred to the Maternal and Child Health Clinic doctor.

Owing to the recent trend of tetanus neonatorum in Singapore, all self-attended deliveries or cases delivered by private midwives are considered to be "at risk" to the disease. They are therefore specially supervised. On the least suspicion of an unhealthy umbilicus by the Maternal and Child Health doctor, immunization with anti-

tetanus serum 400 units is given to the baby. Such babies are carefully followed up for active immunization.

In theory, tetanus neonatorum is easily preventable, though in practice this has not been found to be so. Health education, training, and supervision of private midwives are most important. Other measures against neonatal tetanus include proper health education of all mothers on the danger of umbilical infection, the likely source of infection, and the importance of keeping the umbilicus dry. Mothers should also be told of the danger of applying any form of powder on the umbilicus and the reason for not dressing the cord and umbilicus.

There seems to be very little place for routine immunization in the prevention of the disease. Those mothers who seek antenatal care and hospital confinement and therefore would be available for immunization in the Maternal and Child Health clinic would not require it. Moreover, it is not practical to do so to all antenatal mothers attending Maternal and Child Health Clinic. However, there might be a place for active immunization on antenatal mothers who expressed their desire to have home delivery by private midwives. Three injections of tetanus toxoid at monthly intervals, the last at least 4 weeks before delivery has been found to provide substantial protection to the infant against the risk of neonatal tetanus³. The immunity conferred on the infant is "passive immunity" the tetanus antibodies being able to pass transplacentally to the foetus.

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