A nine-year facility-based review of the pattern and outcome of neonatal tetanus in Ondo State, Nigeria

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Abstract

Tetanus is an infection caused by the *Clostridium tetani*; a ubiquitous Gram-positive, motile, spore-forming, and toxin-producing anaerobe. It is the only vaccine-preventable infection that is not communicable and which is still causing regrettable morbidity and mortality in newborns in Nigeria. The objective of this study was to review the pattern of neonatal tetanus infection and to document its outcome in a secondary health care level in South-west Nigeria. This was a hospital-based prospective study. Questionnaires were also administered to collect information from the parents. Out of a total of 4,277 out-born babies, 23 had Neonatal Tetanus (NNT). The mean incubation period was 6.62±2.2 days; the period of onset was less than 24 hours in 9 (39.1%) of the babies and greater than 24 hours in 14 (60.9%) babies. Four babies (17.4%) died, 4 (17.4%) left against medical advice, and the mean age at death was 11.7±3.5 days. Other clinical records showed that 56.5% of mothers did not receive antenatal care or tetanus toxoid, 65.2% had non-hospital deliveries, cord care was sub-optimal in the majority of cases, and the case fatality ratio was 17.4%. The study reveals that NNT still contributes to morbidities and mortalities among Nigerian neonates. The incidence per year, though, waxes and wanes with no particular pattern; the disease still has the tendency to dip the neonatal indices.

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Introduction

Tetanus is a Greek word derived from the term "teinein", meaning "to stretch".[1] Tetanus is a non-communicable disease caused by a motile, Gram-positive, spore-forming anaerobic bacillus. It is a disease which is completely preventable by good hygiene at the delivery of the newborn, immunization of women of reproductive age before or during pregnancy, aseptic severance of the umbilical cord, and proper hygienic care of the same in the days following birth and, at the same time, staying away from harmful traditional practices.[1]

Globally, 7% of neonatal deaths were a result of tetanus, but the incidence can be up to 20% in Nigeria.[2] The World Health Organization (WHO) initiative on Maternal and Newborn Tetanus (MNT) Elimination has, however, been able to eliminate Neonatal Tetanus (NNT) in 47 out of 59 at-risk-countries, but Nigeria is still lagging behind, being one of the 27 countries which account for over 90% of the global burden of Neonatal Tetanus.[3-5]

Elimination of NNT was defined as less than 1 case of NNT per 1000 live birth in every district.[6] The incidence of NNT in Nigeria is still up to 20%, and out of the 5 million babies born annually in Nigeria, 240,000 (4.8%) die in the neonatal period, with NNT being a part of this.[2]

The easiest, quickest, and most cost-effective preventive measure against NNT is the vaccination of women of reproductive age with the Tetanus Toxoid (TT) vaccine, as well as health education to encourage delivery in a health facility or delivery to be supervised by trained birth attendants under hygienic conditions. The vaccination of women protects the newborn during the first two months of life, but in Nigeria, various socio-demographic and clinical patterns of this disease are observed in our practice, including the non-vaccination of pregnant women. This study, therefore, sets out to investigate the pattern and outcome of NNT in a secondary care level health facility which also runs at the level of primary health care, secondary as well as a referral center.

Materials and Methods

The study used a prospective design, and it was carried out in the Mother and Child Hospital, Akure (MCHA), Nigeria, from January 2012 to December 2020. The study was approved by the Research and Ethics Committee of the hospital. The hospital sited between Latitude N7^{0}255'214'' and Longitude E5^{0}182'476'' is a busy 100-bedded (60 obstetrics and 40 pediatric beds), ultra-modern public health facility which provides specialized and effective obstetric and neonatal care services to the residents of Ondo State and neighboring communities. It serves as a referral hospital to the primary health centers, private clinics, and other health facilities in the state capital and environment and provides maternal and child care to under-five children. The newborn unit of the hospital provides care for both in-born and out-born neonates. Using a semi-structured questionnaire, information on sociodemographic profile, past obstetric history, and Antenatal Care (ANC) were obtained from the mothers. The hospital registers were also used to gather more data on labour, deliveries, and babies. Information such as the age, gender, weight, incubation period, period of onset of the disease, and other clinical features were obtained as well. The babies were classified into the socio-economic classes using the parameters proposed by Ogunlesi *et al*. (2008)[7], which take into account the income, education, and occupation of the parents. There are five socio-economic classes (I to V from the highest to the lowermost). For the purpose of the current analysis, the classes were grouped as upper Socioeconomic Status (SES) comprising classes I and II, middle SES (Class III), and lower SES (classes IV and V). The data were entered into the Excel sheet of the computer as soon as the patients were admitted, follow-up was done, updated regularly, and confidentiality was maintained.

In the center, children with tetanus were routinely treated with a combination of three muscle relaxants (phenobarbitone, diazepam, and chlorpromazine), but only two of them (phenobarbitone and diazepam) were used for the neonates in this study. The drugs were administered initially intravenously and subsequently orally according to the standard protocol. Chlorpromazine was not routinely used in neonates due to its extrapyramidal side effects and the tenacious dry secretion produced, leading to airway blockage and the consequence of more episodes of apneic attacks. Parenteral crystalline penicillin was the main antibiotic of choice, (usually changed to procaine penicillin after 72 hours), and gentamicin was empirically added whenever sepsis was suspected, depending on antibiotic sensitivity reports. Anti-tetanus serum at a dose of 10,000 international units was also administered both intravenously and intramuscularly. Other supportive treatments included maintenance fluid therapy (8% dextrose-in-5th saline infusion and expressed breast milk feeding via nasogastric tubes), clearing of the nasopharyngeal secretions, and oxygen therapy as required.

Data analysis was carried out with Stata statistical software version 16. Association between route of infection/complications and outcomes was subjected to Carls Pearson's Chi-Square to test the significant difference at $p<0.05$.

Results

A total of 35,594 babies were delivered in the hospital over the nine-year period of study, out of which 6,600 (inborn) were admitted for illnesses other than NNT, and 4,277 babies were admitted from other facilities (outborn). Out of a total of 10,877 neonatal admissions, 23 babies had NNT, giving a total incidence of 2.11 per 1000 admissions. The 23 babies with NNT were all outborn, comprising 9 (39.1%) male and 14 (60.9%) female babies, giving a male-to-female ratio of 0.6:1 (Table 1).

Table 1 also shows that the majority of the babies with NNT were 7 days old or more at admission (19; 82.6%), weighed 2500

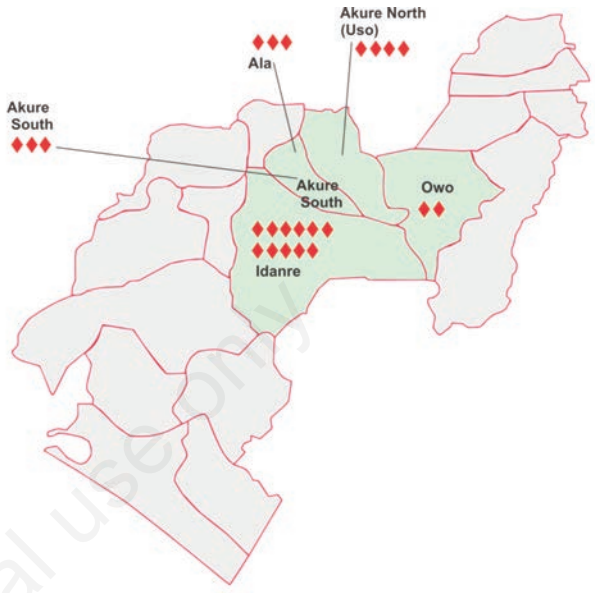

Figure 1. Map of Ondo State showing the Local Government areas to which the babies with Neonatal Tetanus belonged.

Table 1. Socio-demographic characteristics of the study subjects.

Variables	Frequency (%)
Gender	
Male	9 (39.1)
Female	14 (60.9)
Age on admission (days)	
<7	4 (17.4)
≥7	19 (82.6)
Admission weight (g)	
2500-3500	17 (73.9)
1700-2400	6 (26.1)
Period of onset (hours)	
<24	9 (39.1)
24-48	13 (56.5)
>48	1 (4.4)
Tribe	
Yoruba	12 (52.1)
Hausa	4 (17.4)
Ibo	3 (13.1)
Others	4 (17.4)
Religion	
Christianity	18 (78.3)
Islam	5 (21.7)
Socio-economic status	
Lower	20 (87)
Middle	3 (13)
Upper	0 (0)

Others: other tribes such as Efik, Ebira, Ogoja

g or more (17; 73.9%), and belonged to the lower socio-economic class (20; 87.0%). The period of onset ranged between 24–48 hours, with a period of onset of less than 24 hours among 9 (39.1%). The age of the babies ranged from 3 to 17 days with a mean of 7.96±3.7 days; the mean age was 7.22±3.4 days for male and 8.43±3.9 days for female babies. Similarly, the admission weight ranged between 1,700 g and 3,500 g with a mean of 3152.2±2957.7. The mean incubation period was 6.62±2.2 days, the mean age at death was 11.7±3.5 while mean hospital stay was 13.0±9.3 days. Figure 1 showed the local government areas to which the affected babies belonged, which included Idanre Local Government (11; 47.8%), Akure South Local Government (6; 26.1%), Akure North Local Government (4; 17.4%) and Owo Local Government (2; 8.7%).

Figure 2 shows the graphical representation of hospital incidence of NNT; the trend by year that 2015 recorded the highest number of NNT for admission while no infection was seen in the year 2020.

Table 2 shows the clinical records of the neonates. Mothers of 13 (56.5%) of the neonates did not attend Antenatal Clinic (ANC), while mothers of 10 (43.5%) of the neonates attended ANC. Fifteen (65.2%) babies were delivered in places like Traditional Birth Attendant homes (TBA), church mission homes, their personal houses, and on the farm (non-hospital delivery), and these were significantly higher than the 8 (34.8%) neonates who were delivered in the hospital ($p<0.05$). Neonates who had not commenced the schedule of the National Programme on Immunization (NPI); 20 (87.0%) were also significantly higher than those who had commenced ($p=0.001$). The cord was cut with scissors in 8 (34.8%) neonates, what was used to cut the cord was not known in 8 (34.8%) neonates, a kitchen knife was used in 4 (17.4%) neonates, a new blade was used for 2 (8.7%) neonates while an old blade was used for 1 (4.3%) neonate. The umbilical cord care was, however, done with a mixture of materials such as methylated spirit, powder, toothpaste, cow's dung, herbs, and hot fermentation.

Table 3 showed the route of infection, complications observed in the neonates and the outcomes. The route of infection was by the umbilical stump in all 23 (100%) babies, $p=0.000$. Sixteen (60.9%) of the babies had complications which included uncontrolled spasm (9; 39.1%), sepsis (9; 39.1%), aspiration (2; 8.8%) and apnoea (3; 13.0%). Fifteen (65.2%) of the neonates survived and were discharged alive, 4 (17.4%) Left Against Medical Advice (LAMA) and 4 (17.4%) died. Thus, the overall Case Fatality Rate (CFR) was 17.4%. The annual numbers of NNT cases and CFR are shown in Table 4; the incidence per year waxes and wanes with no particular pattern. The year 2015 had the highest incidence, and CFR fluctuated between 16.7% and 50.0%.

Discussion

NNT accounted for 0.6% of all admissions into the Special Care Baby Unit (SCBU) (outborn unit) over the nine-year period

Table 2. Clinical records of the study subjects.

Variables	Frequency (%)	p
Antenatal care / TT immunization		
Yes	10 (43.5)	0.062
No	13 (56.5)	
Place of delivery		
Non-hospital	15 (65.2)	0.024
Hospital	8 (34.8)	
Baby commenced NPI immunization schedule		
Yes	3 (13.0)	0.001
No	20 (87.0)	
Cord severance		
Scissors	8 (34.8)	0.043
New blade	2 (8.7)	
Old blade	1 (4.3)	
Don't know	8 (34.8)	
Kitchen knife	4 (17.4)	
Cord care**		
Methylated spirit	11 (47.8)	0.723
Powder	9 (13.0)	
Herbs	6 (26.1)	
Hot fermentation	12 (52.2)	
Others	8 (34.8)	

Others: toothpaste, cow's dung. Non-Hospitals: Traditional Birth Attendants (TBA), Mission houses, home, farm. **Many of the mothers used several methods for cord care, for example methylated spirit + hot fermentation, Dustin powder + hot fermentation. NPI, National Programme on Immunization; TT, Tetanus Toxoid.

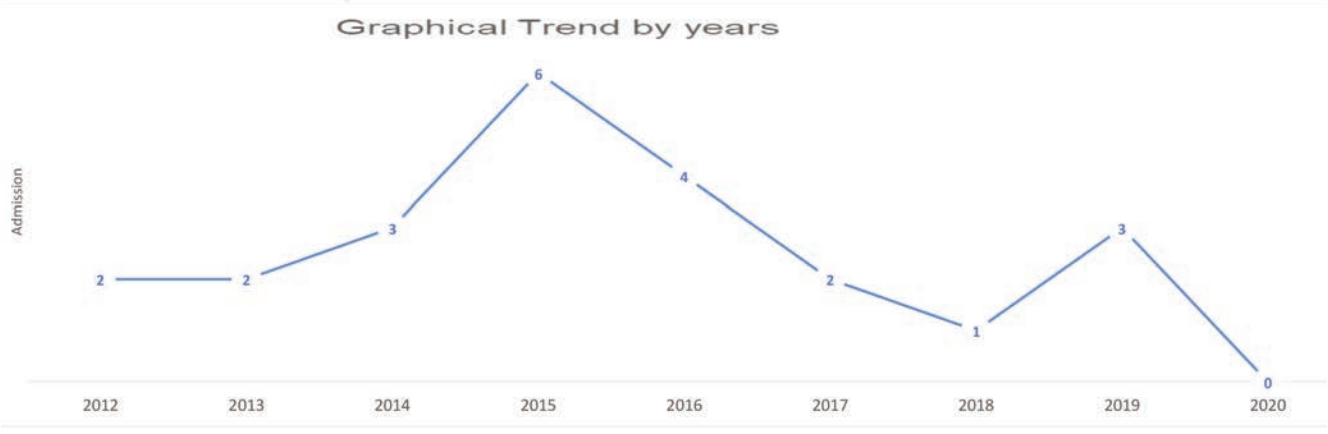

Figure 2. Graphical trend of patients' infection by year (year 2012 to 2020).

under study, with an overall case fatality rate of 17.4%. The male:female ratio was 0.6:1. Though the disease neither has sex nor racial predilection,[6] the current study reports a female preponderance; earlier studies in Nigeria have, however, reported male predominance.[8-11] The reason for female preponderance in this study is not exactly known, as females are usually said to be more protected from infections since they are doubly endowed with the protective gene carried by their X-chromosome. However, it is also common knowledge that males may receive preferential care after birth, and the probability that the mother or another person would handle the umbilical stump incorrectly is less. The current study also revealed that female babies also had a higher mean admission age, age at death, and duration of hospital stay, while males had higher admission weight and incubation period.

The overall case fatality rate of 17.4% in the study is lower than the report of 52.6% from Ekiti state,[11] 66.7% reported in Maiduguri,[12] 63.7% reported from Ogun state,[10] 56.7% reported from Zaria [13] and 33.3% in Lagos;[6] notwithstanding this, any case of NNT is important because NNT is completely preventable by immunization, clean delivery and post-natal hygienic practices.[14,15]

Cases were mainly concentrated in four contiguous Local Government Areas of the State, namely Akure South, Akure North, Owo, and Idanre. The home addresses registered in the hospital records were from the interior farm settlements of these local government areas. The families were predominantly farmers, with rising poverty levels, and lower socioeconomic status, who lived in remote and rural areas, lacking ready means of transportation to the next town.

Though immunization has proven to be one of the most successful public health interventions in reducing under-five morbidity and mortality, 56.5% of the mothers did not attend ANC and by extension were not immunized against tetanus. When the mothers were asked reasons for non-immunization, reasons ranged from long distance, to lack of awareness and repeated visits to the health center with no success at vaccination. This finding is in keeping with earlier studies.[16] Fifty-six and a half percent of the mothers had no form of antenatal care, and by the time of delivery, 15 (65.2%) had non-hospital deliveries; similar to the finding in Ekiti (70.0%),[11] Zaria (70.0%),[13] Maiduguri (94.1%) [12] and Sagamu (89.6%)[10]. Mothers who do not attend ANC are not likely to have immunization and would most likely end up in non-hospitals to deliver. These non-hospital outlets included the TBA homes, church mission homes, farms, and personal houses supervised by the TBAs. All these suggest that more vaccination efforts by the primary health care providers should be concentrated in these rural areas to focus on women of childbearing age, ensuring that every contact with these women provides the opportunity for vaccination. It is also pertinent that traditional birth attendants participate in tetanus toxoid vaccination activities since they have prominently featured in the scheme of things in Nigeria.

Nineteen of the babies (82.6%) presented at ≥7 days of life, which suggested a relatively long incubation period, while the period of onset (time lapse between appearance of symptoms and onset of spasm) was mainly between 24–48 hours, these usually have a direct relation to survival, this may also account for the lower CFR observed in the current study. Eighty-seven percent of affected babies were of lower socio-economic status, which is in keeping with the nature of the disease as a disease associated with poverty and ignorance, characteristic of the lower socioeconomic class as well as documentation by earlier studies [10-12]. The study also shows the graphical trend by year is in no particular pattern: the year 2015 recorded the highest number of NNT for admission, while no infection was seen in the year 2020. Without medical care, mortality from NNT is close to 100% and often exceeding 50% with hospital care[17,18] and so elimination is still the target. Elimination of NNT was defined as less than 1 case of neonatal

Table 3. Route of infection, complications, and outcomes neonatal tetanus infection.

Variables	Frequency (%)	p
Route of infection		
Umbilical stump	23 (100.0)	0.000
Ear piercing	0 (0.0)	
Circumcision	0 (0.0)	
Complications		
Yes	16 (69.6)	0.047
No	7 (30.4)	
Types of complications		
Apnoea	3 (13.0)	0.129
Aspiration	2 (8.8)	
Sepsis	9 (39.1)	
Uncontrolled spasm	9 (39.1)	
Outcomes		
Alive and discharged	15 (65.2)	0.035
Dead	4 (17.4)	
LAMA	4 (17.4)	

LAMA, Left Against Medical Advice.

Table 4. Case fatality rates by year.

Year	Number of babies admitted for NNT	NNT incidence per year (%)	Number of deaths	Case fatality rates (%)
2012	2	4.4	1	50.0
2013	2	4.4	0	0.0
2014	3	6.0	0	0.0
2015	6	12.0	1	16.7
2016	4	8.0	2	50.0
2017	2	4.4	0	0.0
2018	1	2.0	0	0.0
2019	3	6.0	0	0.0
2020	0	0.0	0	0.0
Total	23	-	4	17.4

NNT, Neonatal Tetanus.

tetanus per 1000 live birth in every district,[6] but the current study reports 2.11 per 1000 admission and a case fatality rate of 17.4%. These figures are still far away from the set targets, and so all efforts geared towards the elimination of neonatal tetanus should be sustained.

Conclusions

The suspected portal of entry of the tetanus infection for all 100% of babies in the current study was the umbilical cord. Many of the mothers had non-hospital delivery and also used non-recommended/non-conventional methods for cord care.

It would be beneficial to some of the farm settlements in Ondo State to have more of a government presence in terms of social amenities, health centers, and/or regular immunization outreaches to prevent the total reversal of the previously gained immunization coverage. They need the dedication of the health care providers to deliver good prenatal services to women of reproductive age, community outreach for health education against harmful traditional practices, and old women's fables, to which they are used. The affected local government areas are also places where community programs stressing the "three cleans" need to be emphasized, that is clean hands, clean delivery surface, and clean instruments to cut the umbilical cord.

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