Journal of Tropical Pediatrics, 2016, 62, 55–62
doi: 10.1093/tropej/fmv072
Advance Access Publication Date: 28 October 2015
Original Paper

Animal Bites and Rabies Prophylaxis in Rural Children: Indian Perspective

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ABSTRACT

A prospective observational study was conducted in a tertiary care hospital to study clinicoepidemiological profile of potentially rabid animal bite cases from rural India. Total of 308 children (median age 6 years) admitted to hospital, were recruited over 1 year and followed up till completion of antirabies vaccine course. Dog was the commonest (77.27%) offending animal. Of the exposures, 66.88% were scratches, 88.96% were unprovoked and 27.27% were categorized as Class III. The median times to wound toileting and reporting to health facility were 1 and 6 h, respectively. Majority received prompt PEP in hospital, and RIG was administered in 34.55% of Class II and 90.48% of Class III exposures. Compared with their older counterparts, children aged <5 years suffered more bites on face and trunk and more Class III exposures. The rabies prophylaxis scenario is encouraging, when compared with earlier studies, but there are gaps to be addressed.

KEYWORDS: animal bite, dog, rabies, rabies vaccine, postexposure prophylaxis

INTRODUCTION

Every year innumerable people are exposed worldwide to animal bites of which >95% of cases are attributable to dogs. In India, about 15 million people are bitten by animals every year and need postexposure prophylaxis (PEP) for rabies, a universally fatal disease, which represents the main concern with animal bites [1]. The whole of the country, except the territories of Andaman and Nicobar and Lakshadweep islands, is endemic for rabies [2]. Deaths attributable to rabies are in excess of 20 000 annually [2]. This imposes a substantial burden on healthcare delivery services and makes animal bite an important public health problem in the country.

Although rabies survey has been carried out in India [3], the epidemiology of animal bites in Indian children is still relatively unexplored. The dog remains the most common offending animal, but there is also risk of exposure to other potentially rabid animals like cat and even wild animals like fox, mongoose and monkey. Rabies is preventable through vaccination of pet animals, proper wound management in case of animal bites, adequate PEP and community participation for control of stray animals. However, in India, stray animals are a perennial problem, vaccination rate of pet animals is low and especially in rural India it is almost negligible, and timely PEP is ignored in a substantial proportion of potentially rabid animal exposure [4–7].

Various kinds of myths persist in the community regarding animal bite wound management, like application of chili powder, turmeric, lime, oil or neem leaves. Presently, an estimated 50–60% of rabies-exposed people take one of the modern cell culture vaccines [1, 2, 7]. However, there is often nonadherence to the full course of PEP, and use of rabies immunoglobulin (RIG) is low.

In this observational study, we aimed to explore the epidemiological and clinical profile of children presenting with adverse animal exposure to a tertiary care hospital predominantly serving a rural population.

METHODS

A prospective observational study was carried out in North Bengal Medical College and Hospital, which is a tertiary care medical center managing animal bites and providing PEP [antirabies vaccine (ARV) and RIG] to people residing in six adjoining districts of North Bengal. The study was approved by the institutional ethics committee, and written informed consent was obtained from the attending parent in all recruited cases.

All children admitted to pediatric ward from 1 June 2012 to 31 May 2013 with history of animal exposure were screened for inclusion in the study. Those with secondary exposure to rabid animals were excluded. Those whose parents refused to give informed consent were not enrolled, but given therapy according to the standard protocol. Detailed history was taken, including the offending animal, nature (scratch or bite, provoked or unprovoked) and time of bite, post-bite wound toilet and traditional management if any and time taken to seek and receive formal medical attention. The location and category of bite was recorded after due examination. Data regarding animals involved, pet or stray, immunization status if known and availability of animal for observation were collected. Socioeconomic stratification of study subjects were done as per modified Kuppuswamy scale [8]. All children were treated free in the hospital on day care basis for immunization and wound management according to World Health Organization (WHO) guidelines [9]. For active immunization as part of PEP, ARV was administered intradermally as per updated Thai Red Cross regimen [10, 11]. Where indicated, RIG was administered systemically and by local infiltration around wound site. Tetanus toxoid was administered as per requirement. Management details were included in the case report form. All children were followed-up for complete course of immunization and development of complications if any.

Numerical variables have been summarized by mean and standard deviation and categorical variables by counts and percentages. Median and interquartile ranges have been provided for numerical variables that are skewed in distribution. The 95% confidence interval (CI) has been calculated wherever deemed relevant. Normally distributed numerical variables were compared between subgroups by Student's independent samples *t*-test or one-way analysis of variance (ANOVA). Mann Whitney U-test or Kruskal–Wallis ANOVA was used to compare wound toilet latency, reporting time and vaccine administration latency between subgroups. Pearson's chi-square test, chi-square for trend or Fisher's exact test, as appropriate, was used for comparing independent proportions. All comparisons were two-tailed, and $p < 0.05$ has been taken as statistically significant. Statistica version 6 (Tulsa, Oklahoma: StatSoft Inc., 2001) and MedCalc version 11.6 (Mariakerke, Belgium: MedCalc Software, 2011) software were used for statistical analysis.

RESULTS

A total of 308 children were enrolled in this study, of whom 4 (1.30%) required admission longer than a day for wound management. Children with animal bite comprised 4.6% of total pediatric admissions during the study period with male : female ratio being 2.08 : 1. Table 1 provides a profile of the

animal bite incidence stratified by gender and age groups. Table 2 provides a profile of the study participants with respect to various demographic and event-related parameters.

Evidently, stray dogs were the most common offending animals, and the majority of the victims were boys >5 years of age. Unprovoked scratches accounted for the majority of exposures, and the right arm or leg were most commonly injured. There were also 1.94% wild animal bites in this series. Stray or wild animals involved were not available for observation, and thus 89% of the cases were included in suspected rabies category. The exposure risk increased progressively with age, with the highest risk among adolescent children (≥10 years).

Before formal wound toileting was done, 32 (10.39%) of the victims had their wounds treated with various agents, including Ayurvedic formulations (6), lime (10), kerosene (8) and various other oils (8). This included four instances of application of Ayurvedic preparations and four of kerosene application among the 40 scratches or bites to the face. However, 168 (54.55%) subjects gave history of proper wound care of which 95% resorted to immediate therapy within 1 h of exposure. Around three-fourth of the cases reported to a health care center within 12 h of exposure, median time being 6 h. Median time to first vaccine dose was also 6 h. There were no statistically significant differences in the time to report, wound toilet latency or time to first vaccine dose depending on whether the bites were from pet or stray animals. Follow-up revealed that 73% of cases completed their full course of immunization. RIG was used in 34.55% of Class II and 90.48% of Class III exposures. Only one child in this series succumbed to clinically suspected rabies.

The data were analyzed further by categorizing into gender- and age-based subgroups. There were no appreciable gender differences in the type of exposure, site or class of bite, time to report to a health facility, wound toilet latency and time to first vaccine dose. The age subcategories were comparable with respect to gender distribution, type of exposure (scratch or bite) and nature of bite (provoked or unprovoked). However, there were some interesting differences in other respects, which are depicted in Table 3.

Children <5 years old suffered significantly greater number of bites on the face and trunk and more Class III exposures than their older counterparts. The bites in their case were overwhelmingly from stray dogs, although they suffered a number of monkey bites too. These younger children were, however, given more prompt medical attention, including PEP prophylaxis.

DISCUSSION

There are multiple studies regarding epidemiology of animal bite and rabies from various parts of India, but none are focused exclusively on children. Majority of earlier studies have been on adverse

Table 1. Bite incidence in the study population

Categories	Total 1 year out patient department (OPD) attendance	Number of bite cases admitted and studied	Percentage of total bite cases	Incidence per 1000 with 95% CI	*p* value
Gender					
Female	13 164	100	39.29	9.19 (3.27–15.11)	<0.001
Male	30 408	208	60.71	6.15 (1.30–10.99)	
Age group					
0–4 years	22 712	96	31.17	4.23 (0.21–8.25)	<0.001
5–9 years	15 060	141	45.78	9.36 (3.39–15.33)	
10–12 years	5800	71	23.05	12.24 (5.43–19.06)	
Combined	43 572	308	100	7.07 (1.88–12.26)	–

p value in the last column is from Pearson's chi-square test for gender distribution and chi-square test for trend for age distribution.

Table 2. Demographic and event-related profile of the study subjects

Parameter	$n = 308$ (238 dogs)
Age (years)	
Range	2.0–12.0
Mean ± SD	6.5 ± 2.7
Median (IQR)	6.0 (4.0 – 9.0)
Sex	
Male	208 (67.53%)
Female	100 (32.47%)
Socioeconomic status	
Social class 2	10 (3.25%)
Social class 3	144 (46.75%)
Social class 4	154 (50.00%)
Offending animal	
Dog	238 (77.27%)
Cat	42 (13.64%)
Monkey	24 (7.79%)
Rat	4 (1.30%)
Animal status	
Stray	264 (85.71%)
Pet	38 (12.34%)
Wild	6 (1.95%)
Vaccination status of the animal (dog only)	
Not known	220 (92.44%)
Unprotected	12 (5.04%)
Partially vaccinated	2 (0.84%)
Vaccinated	4 (1.68%)
Whether animal could be kept under watch	
No	274 (88.96%)
Yes	34 (11.04%)
Exposure type	
Scratch	206 (66.88%)
Bite	102 (33.12%)
Bite status	
Unprovoked	274 (88.96%)
Provoked	34 (11.04%)
Bite location	
Right lower limb	98 (31.82%)
Right upper limb	54 (17.53%)
Left lower limb	72 (23.38%)
Left upper limb	16 (5.19%)
Trunk	28 (9.09%)
Face	40 (12.99%)
Bite class	
Class I	114 (37.01%)
Class II	110 (35.71%)
Class III	84 (27.27%)
Time to first wound toilet (hours)	
Range	1.0–6.0
Mean ± SD	1.1 ± 0.57
Median (IQR)	1.0 (1.0–1.0)
Time to report to a health facility (hours)	
Range	2.0–72.0
Mean ± SD	9.7 ± 11.01
Median (IQR)	6.0 (4.0–12.0)
Time to first vaccine dose (hours)	
Range	3.0–72.0
Mean ± SD	11.7 ± 11.57
Median (IQR)	6.0 (6.0–12.0)
Use of RIG	
No	194 (62.99%)
Yes	114 (37.01%)

IQR = interquartile range; SD = standard deviation.

animal exposure in urban population [6, 7, 12], and hence, a study of animal exposure in children from rural India was perhaps necessary, taking into consideration the relatively higher disease burden in rural setting [5].

Studies conducted in different parts of India suggest an annual incidence of animal bite ranging from 2 to 19 per 1000 persons per year. Relatively high incidence of animal bites in children is considered to be a behavioral risk phenomenon because of the natural curiosity of children, their lack of inhibition, limited knowledge and experience about dog behavior and inability to protect themselves from an attack [13, 14]. Goel *et al.* [15] reported that most dog bite cases occurred in the age-group of 6–15 years, and Shetty *et al.* [16] have corroborated that more than half of animal bite victims were children of age <14 years. In our series, 68.83% of the victims came from age group ≥5 years. Male children were found to be twice as commonly bitten as females, which is also in conformity with the findings in previous studies

Table 3. Comparison between age categories

Parameter	Age <5 years ($n = 96$)	Age 5–9 years ($n = 142$)	Age 10–12 years ($n = 70$)	p value
Offending animal				0.012
Dog	74 (77.08%)	106 (74.65%)	58 (82.66%)	
Cat	8 (8.33%)	26 (18.31%)	8 (11.43%)	
Monkey	14 (14.58%)	8 (5.63%)	2 (2.86%)	
Rat	0	2 (1.41%)	2 (2.86%)	
Animal status				<0.001
Stray	90 (93.75%)	108 (76.06%)	66 (94.29%)	
Pet	2 (2.08%)	34 (23.94%)	2 (2.86%)	
Wild	4 (4.17%)	0	2 (2.86%)	
Whether animal could be kept under watch				<0.001
No	94 (97.92%)	112 (78.87%)	68 (97.14%)	
Yes	2 (2.08%)	30 (21.13%)	2 (2.86%)	
Bite location				<0.001
Right lower limb	20 (20.83%)	48 (33.80%)	30 (42.86%)	
Right upper limb	22 (22.92%)	26 (18.31%)	6 (8.57%)	
Left lower limb	6 (6.25%)	38 (28.76%)	28 (40.00%)	
Left upper limb	4 (4.17%)	10 (7.04%)	2 (2.86%)	
Trunk	12 (12.50%)	12 (8.45%)	4 (5.71%)	
Face	32 (33.33%)	8 (5.63%)	0	
Bite class				<0.001
Class I	24 (25.00%)	62 (43.66%)	28 (40.00%)	
Class II	30 (43.66%)	54 (38.03%)	26 (37.14%)	
Class III	42 (40.00%)	26 (18.31%)	16 (22.86%)	
Whether wound toilet done				0.014
No	32 (33.33%)	74 (52.11%)	34 (48.57%)	
Yes	64 (66.67%)	68 (17.89%)	36 (51.43%)	
Whether RIG required				<0.001
No	40 (41.67%)	102 (71.83%)	52 (74.29%)	
Yes	56 (58.33%)	40 (28.17%)	18 (25.71%)	
Time to first wound toilet (hours)				0.061
Range	1.0–1.0	1.0–2.0	1.0–6.0	
Mean ± SD	1.0 ± 0.00	1.1 ± 0.29	1.3 ± 1.16	
Median (IQR)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)	
Time to report (hours)				0.002
Range	2.0–24.0	2.0–72.0	2.0–72.0	
Mean ± SD	7.1 ± 4.80	12.3 ± 13.07	8.0 ± 11.52	
Median (IQR)	6.0 (4.0–8.0)	6.0 (4.0–14.0)	6.0 (4.0–6.0)	
Time to first vaccine dose (hours)				<0.001
Range	3.0–28.0	3.0–72.0	3.0–72.0	
Mean ± SD	8.9 ± 5.42	14.7 ± 13.70	9.6 ± 11.71	
Median (IQR)	6.0 (6.0–12.0)	12.0 (6.0–18.0)	6.0 (6.0–12.0)	

IQR = Interquartile range; SD = Standard deviation.
p value in the last column is from chi-square test for categorical variables and Kruskal–Wallis test for continuous variables.

[14, 17]. This could be because of the fact that boys engage more in outdoor activities than girls.

Overall in our study, the extremities were the commonest site of animal bite, which is in accordance with previous studies [18–20]. However, expectedly, children <5 years had significantly greater incidence of bites on face and trunk than children >5 years of age. In older children, the right lower leg represented the commonest bite location followed by the left lower leg. This is probably because of the fact that older children might use a leg to tease or abuse animals, separate fighting dogs or defend against dog attacks, resulting in more bites on the extremities. Significantly higher incidence of Class III bites was seen in preschool children. Again, the possible reason could be that these children show an explorative and playful behavior with animals, but are unwary about bite risk and cannot defend themselves when attacked, resulting in more severe injury [21].

Our findings match previous studies with respect to the dog being the most common offending animal by far. However, the incidence (77.27%) is lower in contrast to some studies where much higher proportion of cases had exposure to dog [12, 22, 23]. This might be because of the fact that children in rural India are exposed to other potentially rabid animals (e.g. cats, jackals, mongoose and monkeys) to a greater extent than city dwellers. Though stray and wild animals accounted for majority of bites, in children between 5–9 years age, there were considerable number of bites (23.94%) by pet animals. Unfortunately, the majority of the pet animals appeared not to have been adequately vaccinated against rabies.

Bhargava *et al.* [22] reported different practices of treating bite wounds, including application of chili paste, which only serves to increase local irritation. The WHO-supported Indian rabies survey found local application of Ayurvedic remedies and various household substances to be popular in nearly equal measure [3]. We encountered local applications in a relatively smaller proportion (10.39%), but these included irritant substances like lime. Previous studies have reported low incidence of local wound toilet—Shetty *et al.* [16] reported lowest incidence of 3.6%, Vyas *et al.* [16] reported 6%, Sharma *et al.* [5] reported 23.5% and Sudarshan *et al.* reported 39.5 % in their 2004 survey. However, in our study, 54.53% received wound toilet with soap and water with interval between toilet and actual exposure being within 1 h for the majority of cases. This is encouraging reflection on increasing awareness in the community.

We also noted a striking difference compared with earlier Indian studies regarding the time interval between animal exposure and reporting to a healthcare facility. Vyas *et al.* [16] reported that majority did not report immediately to health care facilities after animal bites, and the mean interval between the animal bite and receipt of PEP was 1.3 days. Shetty *et al.* [16] revealed that only 63.2% of cases reported within 24 h of the bite. In our study, we found that 75% cases reported within 12 h of exposure. Most cases received ARV within 1–2 h of reporting to healthcare facility, and on follow-up, 73% completed immunization course as per updated Thai Red cross regimen. RIG was administered in 37.01% cases in consonance with the WHO-recommended protocol. However, it was not used in nearly 10% of Class III exposures owing to reasons of nonavailability, financial constraints or refusal of administration by the parents. This is a dangerous gap that needs to be closed.

Children <5 years received more prompt medical attention, including PEP prophylaxis. This is probably the combined reflection of a greater proportion of more severe bites in these younger children and greater concern on the part of parents and neighbors. Concern, however, needs to be equally shared for all children because age offers no protection against rabies.

As stated earlier, through this study, we have attempted to build up a profile of adverse animal exposure and rabies prevention awareness in a rural community reporting to a tertiary care hospital. Prospective observation of a relatively large sample is the major strength of this study and recall bias is likely to be minimal. Because the sample is geographically circumscribed, we cannot claim that the results are applicable to the whole of rural India. However, apart from variations in public health awareness and local stray animal control measures, there should not be too many factors that will tend

to cause deviations from the findings of the present study. Time, however, can cause variations in the findings, and we have ourselves observed shorter latencies in wound toileting and reporting to health facilities compared with earlier Indian studies. The National Guidelines on Rabies Prophylaxis of the Government of India [10] was published after data collection in this study was over. This document succinctly lays down the practical approach to managing potentially rabid animal bites, and, if followed, should serve to improve the rabies prophylaxis scenario in the country. Alternative approaches to rabies vaccination are also being explored to shorten the current intradermal regimen, and this may help to improve vaccine adherence rates in future [24]. Bringing down the incidence of animal bites however is a more difficult proposition, particularly in rural areas, and will require concerted efforts in controlling stray and wild animal movement with local community participation.

CONCLUSIONS

The profile of animal bites in children is broadly comparable with earlier Indian studies in the general population. The rabies prophylaxis scenario is encouraging, when compared with earlier studies, but there are gaps to be addressed.

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