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Original Article

Retrospective evaluation of children immunized against rabies in a pediatric emergency department

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ABSTRACT

Objective: Rabies is a fatal disease of the central nervous system. This study aimed to evaluate post-exposure rabies prophylaxis practices in a tertiary pediatric emergency department.

Materials and Methods: In this retrospective observational study, the characteristics of patients aged 0-18 years who presented to the pediatric emergency due to a rabies-risk exposure and received rabies vaccination between March 1, 2023 and March 1, 2025 were examined. Patients whose first dose of rabies vaccine was administered at another center were excluded. Data were obtained by reviewing the hospital information management system and the rabies vaccination registry in which rabies vaccines were recorded. The patient's demographic and clinical characteristics and data regarding risky exposures were recorded in the data collection form as study parameters.

Results: A total of 2155 patients who received post-exposure prophylaxis were included in the study. The mean age of the patients was 105.7±60.7 months. Of the patients, 74.7% presented after contact with a cat and 24% after contact with a dog. The most common site of risky exposure was the upper extremity (56.8%), and the most common type of injury was scratching (69.7%). Head and neck injuries were significantly more frequent in exposures occurring at home ($p<0.001$) and differed significantly across age groups ($p<0.001$), decreasing with increasing age. Exposures most commonly involved animals that were stray (83.8%), unvaccinated (91.1%), and unobservable (83.2%). It was observed that 49.3% of patients completed the rabies vaccination schedule as recommended. Rabies immunoglobulin was administered to 12.7% of patients, local wound care to 6.9%, tetanus vaccine to 30.4%, antibiotics to 13.4%, and suturing was performed in 1.5%.

Conclusion: Rabies-risk exposures most commonly occur with unowned stray animals. Injuries to high-risk regions such as the head and neck may be more common, particularly in young children and in exposures involving household animals.

Keywords: Cat, child, dog, rabies, vaccine

Introduction

Rabies is a fatal viral disease of the central nervous system caused by the rabies virus, which belongs to the genus *Lyssavirus*. The disease continues to be an important public health problem, particularly in developing countries (1). The virus is found in the saliva of infected animals and is mostly transmitted to humans through bites. Contact of contaminated saliva or tissue fluids with open wounds or mucous membranes can also cause transmission (2). The clinical course of the disease begins when the virus reaches the central nervous system via the peripheral nerves and is characterized by the development of encephalitis. Clinically, it begins with prodromal findings such as fever, malaise, and irritability, and progresses with hydrophobia, aerophobia, convulsions, and coma. If left untreated, the mortality rate is nearly 100% (3).

Animals carrying a risk of rabies are primarily domestic animals such as dogs, cats, cattle, sheep, goats, horses, and donkeys, as well as wild animals such as wolves, foxes, jackals, wild boars, bears, martens, skunks, and weasels. According to current data, transmission of rabies to humans has not been demonstrated following contact with mice, rats, squirrels, hamsters, guinea pigs, gerbils, rabbits, or wild rabbits. Therefore, unless animal health authorities report specific data to the contrary, prophylaxis is not required for bites from such animals (4). Children constitute a high-risk group for post-exposure prophylaxis (PEP) due to their close contact with domestic animals and their vulnerability (5). PEP is of critical importance in preventing the infection that may develop after the rabies virus enters the body. PEP is applied by wound care immediately after the injury, administration of the rabies vaccine, tetanus prophylaxis, and, if necessary, rabies immunoglobulin (6).

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This study aimed to evaluate post-exposure rabies prophylaxis practices performed in a tertiary pediatric emergency department.

Materials and Methods

This retrospective observational study was conducted in the Pediatric Emergency Department of Ankara Bilkent City Hospital, a tertiary care center in Ankara, Türkiye. The demographic and clinical characteristics of patients aged 0-18 years who presented to the pediatric emergency due to a rabies-risk exposure and received rabies vaccination between March 1, 2023 and March 1, 2025 were examined. Patients whose first dose of rabies vaccine was administered at another center were excluded from the study. Data on patients with rabies-risk exposure were retrospectively obtained by reviewing the hospital information management system and the rabies vaccination registry in which rabies vaccine administrations were recorded. The patient's age, sex, body region affected by the risky exposure, type of exposure, setting of exposure, time to emergency department presentation, seasonal distribution of exposures, species of the animal involved, ownership status, vaccination and observation status of the animal, treatment applications (local wound care, rabies vaccine, rabies immunoglobulin, tetanus vaccine, antibiotics, suturing), need for consultation or hospitalization, and whether a forensic case report was filed were recorded on the data collection form as study parameters.

At the center where the study was conducted, PEP practices for rabies-risk exposures are carried out in accordance with the Rabies Prophylaxis Guideline published in 2019 by the Republic of Türkiye Ministry of Health General Directorate of Public Health. Rabies-risk exposures are classified into four categories (4):

- Category 1: Touching or feeding an animal, licking of intact skin by an animal
- Category 2: Minor scratches of skin (not penetrating the dermis) or abrasions without bleeding
- Category 3: Single or multiple transdermal bites or scratches, contamination of mucous membranes or open wounds with animal saliva, or presence of a traumatic lesion in areas rich in nerve endings such as the head, neck, or fingertips
- Category 4: Risky contact with wild animal species at risk of contracting rabies

According to this guideline, patients classified under categories 2, 3, and 4 receive a total of four doses of rabies vaccine: one dose on days 0, 3, and 7, followed by one additional dose between days 14 and 28.

Statistical Analyses

Statistical analyses were performed using IBM Statistical Package for the Social Sciences, version 26.0 (SPSS Inc., Armonk, NY, IBM Corp., USA). Descriptive statistics were expressed as mean and standard deviation for continuous variables and as frequency and percentage for categorical variables. Categorical variables were compared using the Chi-square test. When a significant difference was found among more than two groups, post hoc pairwise comparisons were performed using the Chi-square test or Fisher's exact test, as appropriate, with Bonferroni correction (adjusted significance level $p<0.017$). Statistical significance was accepted as $p<0.050$.

Results

A total of 2155 patients (1096 girls, 1059 boys) who received PEP were included in the study. The mean age of the patients was 105.7±60.7 months. The distribution of patients by sex and age group, and the characteristics of the risky exposures, are given in Table I. Of the patients, 74.7% (n=1609) presented after contact with a cat and 24% (n=517) after contact with a dog. Other presentations occurred after contact with horses (n=8), monkeys (n=3), deer (n=1), goats (n=1), lion cub (n=1) and others (n=15). The most common site of risky exposure was the upper extremity (54.8%), and the most common type of injury was scratching (69.7%). The characteristics of the exposures are given in Tables II and III. Cat-related injuries were predominantly localized to the upper extremities (62.3%) and most commonly occurred in the form of scratches (89.5%). In contrast, dog-related injuries were more frequently localized to the lower extremities (41.2%) and predominantly resulted from bites (83.5%). Head and neck injuries were found to be significantly more common in children under one year of age ($p<0.001$). A statistically significant association was found between age group and head/neck injuries ($\chi^2=31.85$, $p<0.001$). Post-hoc pairwise comparisons showed that the >12 years group differed significantly from both the <1 year group ($p<0.001$) and the 1–12 years group ($p<0.001$). A significant difference was also observed between the <1 year and 1–12 years groups ($p=0.040$). The presentation time was recorded for 548 patients following exposure, with a mean time of 24 hours. Exposures most commonly involved animals that were stray (83.8%), unvaccinated (91.1%), and unable to be observed (83.2%). The vaccination rate among owned animals was found to be 53.2%. In cases where the animal could be observed, the rate of completion of the vaccination schedule was found to be significantly lower

Table I: Characteristics of patients and exposed animals

Variable	n (%)
Sex	
Female	1096 (50.9)
Male	1059 (49.1)
Age	
<1 year	24 (1.5)
1-12 years	1476 (68.5)
>12 years	655 (30.0)
Animal Type	
Cats	1609 (74.7)
Dogs	517 (24.0)
Others	29 (1.3)
Animal Ownership	
Yes	349 (16.2)
No	1806 (83.8)
Animal Vaccination	
Yes	192 (8.9)
No	1963 (91.1)
Animal Observation	
Yes	361 (16.8)
No	1794 (83.2)

Table II: Characteristics of exposures

Variable	n (%)
Exposure Site	
Upper Extremity	1181 (54.8)
Lower Extremity	333 (15.5)
Head and Neck	179 (8.3)
Body	21 (1.0)
Multitrauma	5 (0.2)
Unknown	436 (20.2)
Exposure Type	
Bite	618 (28.7)
Scratch	1502 (69.7)
Other	35 (1.6)
Exposure Setting	
Home	101 (4.7)
Social/Play Setting	257 (11.9)
Street	1797 (83.4)

Table III: Distribution of head and neck injuries by age and exposure setting

Variable	Number of Patients	Head and Neck Injury	p
Total	2155	179	
Age*			
< 1 year	24	6 (25)	<0.050
1 - 12 years	1476	148 (10)	
> 12 years	655	25 (3.8)	
Exposure Setting*			
Home	101	30 (29.7)	<0.050
Social/Play Setting	257	37 (14.4)	
Street	1797	112 (6.2)	

: n(%) (Chi-square test)

(p=0.006). Exposures most commonly occurred on the street (83.4%). Head and neck injuries were found to be significantly more common in exposures involving household animals (p<0.001). A statistically significant association was found between the exposure settings and head/neck injuries (χ^2=83.37, p<0.001). Post-hoc pairwise comparisons revealed significant differences between all locations: home vs. social/play area (p=0.001), home vs. street (p<0.001), and social/play area vs. street (p<0.001). Lower extremity injuries were significantly more common in children older than 12 years (23.2%, n=152/655) than in those aged 1–12 years (12.1%, n=178/1476) and younger than 1 year (12.5%, n=3/24) (p<0.001), with the difference arising between the >12 years and 1–12 years groups in post hoc analysis. Upper extremity injuries were observed in 33.3% (n=8/24), 56.2% (n=830/1476), and 52.4% (n=343/655) of children <1 year, 1–12 years, and >12 years, respectively (p=0.027); however, no pairwise difference remained significant after Bonferroni correction. Trunk injuries did not differ between age groups (0%, 1.2%, and 0.5%, respectively; p=0.227). No significant relationship was found between the exposure settings (home, social/play setting, street) and upper extremity (48.5%, 51.8%, and 55.6%; p=0.220), lower extremity (9.9%, 15.2%, and 15.8%; p=0.277), or trunk injuries (0%, 1.9%, and 0.9%; p=0.162). Seasonal distribution rates were found to be 38.8% in spring, 35% in autumn, 15% in summer, and 11.2% in winter, respectively.

Of the patients, 87% were classified as Category 2 according to the rabies risk category. It was observed that 49.3% (n=1062) of patients completed the rabies vaccination schedule as recommended. The completion rates were 37.5% (n=9) in children younger than 1 year, 48.0% (n=709) in those aged 1–12 years, and 52.5% (n=344) in those older than 12 years; no significant difference was found between age groups (p=0.082). Rabies immunoglobulin was administered to 12.7% of patients, local wound care to 6.9%, tetanus vaccine to 30.4%, antibiotics to 13.4%, and suturing was performed in 1.5%. Consultation with other departments was required for 3.3% of patients, and 0.3% required hospitalization. It was found that a forensic case report was filed for only 1.3% of the patients who presented to the emergency department due to rabies-risk exposure.

Discussion

Animal bites are a common type of injury in both adults and children, and the emergency department is frequently the first point of presentation for these patients (7,8). In this retrospective study, a large group of patients who received rabies prophylaxis after risky exposure in a tertiary pediatric emergency department was evaluated. The results of the study showed that risky exposures most commonly occurred with unvaccinated stray animals.

There appear to be conflicting findings in the literature regarding the sex distribution of patients with risky animal exposures. In a study of 48166 cases in the United States, the majority of cases were male, whereas in another study of 9772 cases in China, the majority of cases were female (9-11). In our study, the sex distribution of the participants was found to be similar. Studies have shown that risky exposures occur particularly in preschool and school-age groups. This has been explained by the fact that children spend more time outdoors, such as on the street, during this period (9,12,13). In our study, the mean age of patients was approximately 9 years, which is consistent with other studies. To prevent such injuries, educational activities on safe contact with animals and recognition of signs of animal aggression could be emphasized in these age groups.

Studies have shown that dogs and cats are the most commonly involved animal species in patients presenting after risky exposure (7,12,13). In our study, the most common risky exposure was with cats (74.7%). In our study, risky animal exposures were most common in the spring and autumn months, and least common in winter and summer. Our findings are inconsistent with the literature, which reports that exposures are most common in summer (11). In the city where the study was conducted, the population decreases markedly during the summer months due to the holiday season. This may explain the higher number of exposures in spring and autumn. Another study conducted in the same city also showed that exposures were most common in spring (7). In our study, exposures were found to occur mostly with unowned and unvaccinated animals in street settings. This finding is supported by other studies in the literature (7,13-15). Uncontrolled proliferation of stray animals and the lack of animal vaccination programs may increase the risk of rabies in the community, leading to an increased patient burden and resource use in the health system due to risky exposures. The low vaccination rate

among owned animals in the study is also notable. From this perspective, pet owners' awareness regarding vaccination of their domestic animals is important for public health.

Studies have shown that dogs tend to cause bite-type injuries more often in the lower extremities, whereas cats tend to cause scratch-type injuries more often in the upper extremities (8,10). In our study as well, the most common injury site was the upper extremity, and the most common type of injury was scratching. This finding is attributed to the fact that the majority of exposures involved cats. Although most animal exposures result in minor injuries, trauma to areas rich in nerves and blood vessels, such as the head and neck, can have serious consequences, particularly in young children. Studies have shown that head and neck injuries following animal exposure are particularly common in young children (14,16,17). Similarly, in our study, head and neck injuries were found to be significantly more common in children under one year of age. It was also shown as an additional finding that these injuries were more common within the home. This may be attributed both to physical characteristics of children in this age group, such as short stature and limited motor capacity, and to differences in the perception of risk attributed to the animal. The higher frequency of head and neck injuries at home has been attributed to the higher likelihood of unguarded and close contact with domestic animals. From this perspective, it may be recommended that parents avoid leaving young children alone with domestic animals.

In our study, the time to emergency department presentation after animal exposure was recorded for 25% of the patients analyzed, and the mean presentation time was found to be 24 hours. Studies have emphasized the importance of not delaying PEP, and patients were found to frequently present within the first 24 hours (14,18,19). One study showed that measurable neutralizing antibody levels were detected in 80% of vaccinated individuals even 9 years after the initial vaccination (5). Approximately half of the patients completed the recommended rabies vaccination schedule. This finding may be attributable to several reasons. First, the city where the study was conducted has many central hospitals where rabies vaccination can be administered; patients may have continued the recommended vaccination schedule at these centers. Another contributing factor is that most of the injuries in our study were scratch-type injuries. Patients or their parents may have regarded these exposures as minor injuries and not continued the vaccination schedule. In our study, most patients were classified as Category 2 according to the rabies risk category. One study showed that the rate of self-treatment and non-presentation to the hospital was significantly higher among patients classified as Category 2 (10). Adherence rates to the vaccination schedule also vary in the literature, and these rates have been found to be low, particularly in underdeveloped and developing countries (20). The findings of the present study indicate that patients and parents presenting after risky exposure need to be better informed about the risk of rabies and the importance of PEP. Adherence to the vaccination schedule was found to be significantly lower in cases where the exposed animal could be observed. This is an expected finding. The rabies guideline applied at the center where the study was conducted recommends discontinuing the rabies vaccination schedule if the animal is found to be healthy after a 10-day observation period. The decrease in adherence to the vaccination schedule after exposure to observable animals may be related to this recommendation.

In our study, wound care was documented in only a small proportion of patients presenting after a high-risk exposure. This finding appears to be inconsistent with post-exposure prophylaxis practices. The low rate of documented wound care may be attributable to inadequate documentation rather than to a failure to provide appropriate wound care.

It was found that a forensic report was filed for only a very small proportion of patients who presented to the emergency department after risky exposure. In our country, forensic reporting is legally mandatory in cases of suspected rabies exposure (7). It has been noted that rabies-risk reporting is insufficient in both developing and developed countries, and that cultural factors may play a role in this regard (1,11). It has been reported that reporting of rabies-risk exposures may be underestimated by both clinicians and families (5). This may result in low public health awareness and neglect of the burden of risky exposure cases in the health system.

Limitations

This study makes a strong contribution to the literature due to its large number of participants. Nevertheless, the study has some limitations. First, the study was conducted at a single tertiary pediatric emergency department. Some data, particularly regarding adherence to the vaccination schedule, may be misleading. Due to the retrospective design, some data, such as time of presentation, could not be obtained for all patients. The clinical experience of the physicians applying the rabies guideline was not included in the analyses.

Conclusion

Rabies-risk exposures most commonly occur with unowned stray animals. Rabies is a public health problem, and importance should be given to the control and rehabilitation of stray animal populations. It should be kept in mind that injuries to high-risk regions such as the head and neck may be more common, particularly in young children and in exposures involving household animals.

Presented
This study was presented at the 2nd AnkaraBilkent Pediatrics Congress in 2025.

Ethics committee approval
This study was conducted in accordance with the Helsinki Declaration Principles. The study was approved by Ankara Bilkent City Hospital (14.05.2025, reference number: TABED 2/1168/2025).

Contribution of the authors
Study conception and design: HCK,HA; data collection: HCK,GD,MOK,HY; analysis and interpretation of results: HCK,HA,FK,SŞ,CDK; draft manuscript preparation: HCK,HA. All authors reviewed the results and approved the final version of the article.

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Conflict of interest
The authors declare that there is no conflict of interest.

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