Introduction: Animal-inflicted injuries continue to be a major health problem worldwide. In developing countries, the outcome of such injuries, especially in children may be poor.

Aim: The study aimed to evaluate the diversity of spectrum and management of animal-inflicted injuries in the pediatric age group.

Materials and Methods: This was a prospective study on animal-inflicted injuries in children between 1 to 15 years of age over a period of 12 months. Data on various parameters such as age and sex, animal species involved, provoked/unprovoked, mechanism of injury, time of injury, prehospital care, injury-arrival interval, pattern and type of injury, trauma score, body region injured, treatment given and complications were collected and analyzed.

Results: Fifty-two children with animal-inflicted injuries were included, constituting <1% of all trauma cases seen during the study period (male:female = 2:1). The mean age of the cohort was 9.65 years. Domestic animals were responsible in 41 children (78.84%) and wild animals in 11 children (21.16%). Dog bite was the most common (57.69%). Penetrating injury was observed in 40 (76.9%) and blunt injury was observed in 12 (23.1%). The musculoskeletal system was the most common organ-system injured affecting 36 children (69.23%). Thirty-five children (67.3%) after minor treatment were discharged. Seventeen children (32.7%) required admission. Thirty-four children (65.38%) underwent surgical procedures. Wound debridement was the most common procedure performed. Wound infection was observed in 20 children (38.46%) and was significantly higher ($P < 0.01$) in delayed presenters. The length of hospital stay for the admitted children ranged from 3 to 28 days.

Conclusion: Animal-inflicted injuries are rare in children and have a wide spectrum of presentation. Severe injuries require extensive resuscitation and expert surgical care. Mild injuries can be managed conservatively with the use of proper dressings, antibiotics, and analgesics.

Keywords: Animal-inflicted injuries, children, dog bite, domestic animals, injury patterns, rural, wild animals
leading to high incidence of animal related injuries. As the ecosystem changes and human encroaches previous wildlands, man–animal conflicts are increasing day-by-day.\(^{[4,5]}\)

Animals can cause injuries by various mechanisms that include bites, sting, crush, gore, stomp, buck off, fall on, peck or scratch and in addition transmit numerous zoonotic infections.\(^{[6,7]}\) It is estimated that the mortality from endemic canine rabies is around 55,000 annually with more than 31,000 deaths in Asia alone with the majority being children.\(^{[8-11]}\) About 40% of victims who are bitten by rabid animals are kids.\(^{[8-11]}\) It is unfortunate that the population who is vulnerable and at higher risk of animal-related injuries do not have adequate information about the disease and practices that should be adopted in case of animal-related injuries.\(^{[12]}\) It is also very unfortunate that many such injuries remain undocumented and many people die, especially in developing countries before receiving adequate medical care.\(^{[13]}\)

Animal bite wounds are considered to be dirty and contaminated and hence difficult to manage because of higher risk of infection.\(^{[14-17]}\) In developing countries, the outcome of such injuries may be poor due to various reasons such as delayed presentation, lack of prehospital care and poor transportation.\(^{[18]}\) There are limited data on animal-related injuries in children in a developing country like India where greater emphasis has been placed on injuries related to road traffic accidents that are more common. Given the close proximity of this institution to Chambal and Yamuna rivers that has plenty of livestock and where farming and animal husbandry is a major occupation, several children are affected by this type of injury.

**Aim**

The study aimed to evaluate the diversity of spectrum and management of animal-inflicted injuries in the pediatric age group.

**Materials and Methods**

This was a prospective study on animal-inflicted injuries in children over a period of 12 months from the lead author’s institution. This institution is one of the largest referral centers in Uttar Pradesh and caters to the millions of people of neighboring rural areas where human–animal conflicts are common.

The study included children of both sexes between the age of 1–15 years who presented to the casualty of the institute with a history of animal-related injuries during the study period. Parents of the patients who met the inclusion criteria were explained about the study and written informed consent was obtained before enrolling the patient. Ethical clearance was obtained from the Institutional Ethical Committee (IEC) (IEC no 2019/33).

Patients with severe injuries were first resuscitated in the casualty according to advanced trauma life support protocol. The severity of injury was determined using Kampala Trauma Scale II (KTS II).\(^{[19]}\) Data on various parameters were collected. Observation parameters included age and sex, animal species involved, reason of injury (provoked/unprovoked), mechanism of injury, time of injury (morning, afternoon, evening, and night), prehospital care, injury-arrival interval, admission hemodynamic parameters (pulse, systolic blood pressure), pattern and type of injury, trauma score, body region injured, treatment given, complications and outcome.

Patients with minor injuries (small lacerations, scratches, etc.,) were treated in casualty and then discharged. Treatment for such patients in casualty included wound cleaning, antibiotic, analgesic, antirabies vaccine immunoglobulin and in some cases, primary wound closure. The four-dose regimen with human rabies immunoglobulin (HRIG) in both categories II and III was followed. Postexposure prophylaxis consisted of a dose of HRIG and rabies vaccine given on the day of the rabies exposure, and then, a dose of vaccine was given again on days 3, 7, and 14. Patients with major injuries were transferred to the surgical wards from where necessary investigations were done and treatment was instituted. Surgical intervention was considered on a case-to-case basis such as in case of evisceration of bowel and abdominal visceral injuries. Routine investigations such as hematological, biochemical, and radiological imaging (X-ray, ultrasound, and computed tomography) were performed on admission.

**Statistical data analysis**

Data were analyzed using the SPSS software (Statistical Package for the Social Sciences, version 17.0, SPSS Inc., Chicago, IL, USA). Data were summarized in form of proportions and frequent tables for categorical variables. \(P\) values were computed for categorical variables using the Chi-square test and Fisher’s exact test depending on the size of the data set. Multivariate logistic regression analysis was used to determine the predictor variables that are associated with outcome. \(P < 0.05\) was considered statistically significant.

**Results**

A total of 52 children with animal-related injuries were recruited in the study which constituted <1% of all trauma cases reported at the institute during the study period (52 out of 5526). Of 52 children,
35 were male (67.3%) and 17 were female (32.7%) (male:female = 2:1). The mean age of the cohort was 9.65 years (range: 3–15 years). Out of 52 children, 40 (76.9%) were school-going and 38 (73.07%) were from adjoining rural areas.

Forty children (76.9%) had a penetrating injury and the remaining 12 (23.1%) had blunt injury. Domestic animals including bull, cat, cow, dog, donkey, goat, and horse were accountable for injuries in 41 (78.84%) children whereas wild animals were accountable for injuries in 11 children (21.16%). Of all the animal-inflicted injuries, dog bite was the most common and seen in 30 children out of 52 (57.69%) [Table 1].

History of provocation was obtained in 15 children out of 52 (16.64%). We tried to segregate the injuries in relation to the time of the day: morning: 16 of 52 (30.76%); afternoon: 18 of 52 (34.62%); evening: 8 of 52 (15.39%); and night: 10 of 52 (19.23%). History of prehospital care was not elicited in any of the children.

The musculoskeletal system (extremities) was the most common organ-system injured affecting 36 children out of 52 (69.23%) [Table 2]. Open wounds (bruises, abrasions, lacerations, puncture, avulsion, etc.) were seen in 43 children out of 52 (82.69%) and were the most common type of injuries sustained. Visceral abdominal injuries were noted in six children (11.53%), and abscesses due to the delayed presentation were noted in three children (5.78%). According to KTS II, 50 children (94.33%) sustained mild injuries (KTS II = 9–10). Moderate injuries were recorded in two children (KTS II = 7–8). There was no severe injury recorded.

Forty-two children out of 52 (80.76%) reported within 24 h of injury. Out of 10 children who presented after 24 h, nine children developed wound infection. Out of the ten delayed presenters, three patients had abscess and cellulitis and seven patients had open wounds. The time interval between the injury and arrival to the hospital ranged from 2 h to 6 days. Most of the animal-related injuries, 35 out of 52 (67.3%) were so mild that after minor treatment (wound dressing, primary closure of clean lacerated wound, antibiotics, analgesics, tetanus toxoid injection, anti-rabies treatment, etc.) at the casualty, the patients were discharged home. A total of 17 children out of 52 (32.7%) required admission which mainly included children with visceral abdominal injuries, open chest wounds, abscesses and cellulitis. Antibiotics of various types and analgesics were given to all children in the casualty. Forty-eighth children out of 52 (92.3%) were administered tetanus toxoid injection. Forty-two children out of 52 (80.76%) were given antirabies vaccine. Thirty-four children out of 52 (65.38%) underwent surgical procedure (exploratory laparotomy, wound debridement, primary wound closure, incision and drainage). Wound debridement was done in 16 children out of 34 (47.05%) and was the most common procedure performed [Table 3]. Primary wound closure was done in 11 children out of 34 (32.35%). Exploratory laparotomy was done in 4 children out of 34 (11.76%) and incision and drainage of abscesses were done in 3 children out of 52 (8.82%).

There was a wide spectrum of injuries ranging from small scratch wound to gastric perforation with diaphragmatic rent. The severest was gore injury inflicted by a pig on an 8-year-old male child. In this child, there was left thoracoabdominal laceration with gastric perforation and diaphragmatic rent, both of which were repaired primarily on exploration [Figure 1]. There was another anterior gastric wall perforation in a 6-year-old male

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### Table 1: Distribution of animal-related injuries according to animal species

| Animal species | Mechanism of injury | Number of patients (%) |
|---------------|---------------------|------------------------|
| Domestic animals | 41 (78.84) |
| Bull | Attacking with horns and fall | 5 (9.61) |
| Cat | Bite and scratches | 2 (3.84) |
| Cow | Attacking with horns | 1 (1.92) |
| Dog | Bite and scratches | 30 (57.69) |
| Donkey | Kick and fall | 1 (1.92) |
| Goat | Attacking with horn | 1 (1.92) |
| Horse | Kick and fall | 1 (1.92) |
| Wild animals | 11 (21.16) |
| Blue bull | Knocking over | 1 (1.92) |
| Hyena | Bite and scratch | 1 (1.92) |
| Monkey | Bite and scratches | 5 (9.61) |
| Pig | Bite and scratches | 4 (7.69) |

### Table 2: Site of injuries among victims

| Site of injury | Number of patients (%) |
|---------------|------------------------|
| Musculoskeletal | 36 (69.25) |
| Lower limbs | 24 (46.15) |
| Upper limbs | 12 (23.08) |
| Abdomen | 10 (19.23) |
| Chest | 3 (5.76) |
| Face | 2 (3.84) |
| Head | 1 (1.92) |

### Table 3: Type of surgical procedures performed (n=34)

| Type of surgical procedure | Frequency (%) |
|----------------------------|---------------|
| Wound debridement | 16 (47.05) |
| Primary wound closure | 11 (32.35) |
| Exploratory laparotomy | 4 (11.76) |
| Incision and drainage | 3 (8.82) |
child inflicted by a dog. There were multiple puncture marks on the abdomen and free air in the abdomen on the X-ray in this child [Figure 2]. This child also underwent primary repair of gastric perforation. Another noteworthy injury was jejunal perforation due to gore injury inflicted by a bull on a 12-year-old female child. The jejunum was primarily repaired in this case. In another child, there was a deep laceration over the abdominal wall with evisceration of the bowel. The victim, in this case, was a 15-year-old female and the injury was inflicted by a bull. Repositioning of the bowel in the abdomen and primary wound closure was done in this case.

Wound infection was observed in 20 children out of 52 (38.46%). According to the multivariate regression analysis, wound infection was statistically significantly higher in children who presented late to the hospital ($P < 0.01$). Ninety percent of delayed presenters (>24 h) had wound infection. Only 26% of early presenters (<24 h) had wound infection. The length of hospital stay for the admitted children ranged from 3 to 28 days with a median of 5 days.

**DISCUSSION**

In the present study, animal-related injuries were observed in 52 children which constituted <1% of all trauma cases reported at U.P.U.M.S during the study period. This is because other modes of injuries like fall from height and road traffic accidents are more common modes of injury in children.[20,21] Furthermore, animal-related injuries are the most common in third decade of life and not in children.[18,22,23] Rate of these injuries may also be underestimated due to unreported patients or who received treatment for minor injuries at local hospitals and private clinics.

In agreement with other studies,[18,22-24] males were more affected than females, probably reflecting greater exposure of male to outdoor activities such as playing, going to field with parents and provoking animals. Animals can cause both penetrating and blunt injuries. Majority of children in this study, 40 out of 52 (76.9%) had penetrating injury which can be attributed to the fact that most of the children were victim of bites caused by dogs, pigs and monkeys which resulted in deep lacerations and puncture. Majority of children, 37 out of 52 (71.16%) had unprovoked attack by animals, which is contrary to our belief that children more commonly tend to provoke animals by pelting stones and teasing them. This can be attributed to the fact that their short stature and inquisitive nature make them potential targets for animals. Animal-induced injuries were commonly seen during daytime (morning and afternoon) in 34 children (65.3%). This can be related to the fact that daily outdoor activities such as going to school and playing are usually done in daytime.
The prehospital care is one of the most important factors that determine the outcome after injury.[29] In this study, none of the children had prehospital care and were brought by parents and relatives who had no knowledge of basic first aid in such type of injuries. Late presentations following injury is a common phenomenon in developing countries and usually associated with higher complication rate.[18] The majority of our children reported in <24 h of their injuries to the hospital which is in agreement with other studies.[18,20]

In the present study, majority of injuries were inflicted by domestic animals, (78.84%) which is in agreement with other studies.[27] The dog was the most common animal inflicting injury in our study group children, constituting 57.69% which again is in agreement with other studies.[20] Higher dog attacks in children can be attributed to their short stature, inquisitive nature and provocative acts.

The musculoskeletal system was the most common site of injury in our study, constituting 69.23%, which is in agreement with other studies.[28] Likely explanation for this can be that humans tend to defend themselves from animal attacks using the foot and hand. In keeping with other studies,[29,30] lower extremity (46.15%) was more commonly affected than the upper extremity (23.08%). This may be attributed to the animal’s nature of attacking moving body parts. In this study, open wounds such as bruises, lacerations, puncture and avulsion were the more common type of injuries sustained (82.69%), which is in agreement with other studies.[18,27]

In the present study, KTS II was used to determine the severity of injury. KTS has been used as a triage tool for use in low and middle-income countries. Various studies[31,32] on this scoring system have concluded that it is an effective predictor of mortality in low-resource settings. The studies also provide evidence for KTS to be used as a valid and practical tool for triage to predict the prognosis and outcomes. In the present study, as per the KTS II, 50 children (94.33%) sustained mild injuries (KTS II = 9–10). Moderate injuries were recorded in two children (KTS II = 7–8). There was no severe injury recorded.

Majority of children in the present study had mild injuries, 35 out of 52 (67.3%) and who after minor treatment (wound dressing, primary closure of small wounds, antibiotics, analgesics, tetanus toxoid injection, and antirabies treatment) were discharged home. This is comparable with other studies reported.[18,33] Due to a greater number of milder injuries, only 17 children out of 52 (32.7%) required admission which included children with visceral abdominal injuries, open chest wounds, abscesses and cellulitis due to delayed presentation.

The principles of management of animal attack wounds include cleaning and debriding the wound, administering prophylactic antibiotics, tetanus toxoid injection, and antirabies vaccine.[17,18,34] Minor wounds are treated conservatively with the use of proper antibiotics, analgesics, tetanus toxoid, cleaning of wound with normal saline and proper dressing. Extensive wounds require wound debridement and primary or delayed wound closure.

In the present study, wound debridement was the most common surgical procedure (47.05%) performed. Exploratory laparotomy was required in four patients having visceral abdominal injuries. Wound infection was a common complication (52.05%) and was significantly higher in children who presented after 24 h of injury. The length of hospital stay for those admitted ranged from 3 to 28 days. The longest stay was of the 8-year-old child having gastric perforation with diaphragmatic rent due to attack by a pig. The child in this case, developed pyothorax which was managed with the intercostal drainage tube. In general, the overall outcome of our children was good with no major complications. There was no mortality in this study.

As the data were analyzed, problems faced by a developing country like India in managing such injuries came to light. Ignorance toward such injuries by parents, plenty of unimmunized stray animals, poor transport system and lack of knowledge regarding prehospital care in case of such injuries are the major concerns. It is absolutely essential that measures be taken to prevent such injuries from occurring by using various methods like incorporating a chapter in primary and secondary school books for increasing the awareness, hoarding some posters and information materials in primary health-care centers and involving multipurpose health workers who can educate the families regarding such injuries while attending deliveries and going to immunization walks.

**Conclusion**

Animal-induced injuries are rare in children and have a wide spectrum of presentation. The injuries range from minor scratches to fatal visceral abdominal injuries. Severe injuries require extensive resuscitation and expert surgical care. Mild injuries can be managed conservatively with the use of proper dressings, antibiotics, analgesics, tetanus toxoid and antirabies vaccination. These injuries require closer observation and analysis of the decision-makers to promote health and formulate appropriate preventive measures.
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Conflicts of interest
There are no conflicts of interest.

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