

# Animal injury characteristics following the 2020 ammonium nitrate explosion in the Port of Beirut

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## Abstract

**Purpose:** To describe the characteristics and veterinary management of animal casualties after an ammonium nitrate explosion in the Port of Beirut.

**Methods:** Retrospective evaluation of medical records from multiple veterinary organizations.

**Results:** Veterinary care was administered to 298 cats and 103 dogs, with 101 animals (25%) undergoing surgical procedures under general anesthesia. Glass injuries prevailed, with suturing performed in 98 animals (24.4%). Surgery was used to treat 31 animals (7.7%) with extremity fractures and 52 animals with tendon injuries (13.3%). Bodily burns were encountered in 19 animals (4.7%). Six animals (1.5%) lost their hearing entirely, while another 6 (1.5%) lost an eye.

**Conclusion:** The joint coordinated work of veterinary groups and nongovernmental animal organizations reduced the number of injured animal fatalities. Of animals documented as having undergone treatment, 355 (88.5%) survived their initial injury assessment, and 46 (11.5%) died.

## KEYWORDS

ammonium nitrate, animals, blindness, deafness, disaster, emergency management, explosion, fracture, hematoma

## 1 | INTRODUCTION

On August 4, 2020, an explosion occurred in the Port of Beirut at the warehouse facility storing ammonium nitrate, killing 218, wounding 14,000,<sup>1</sup> and leaving around 300,000 residents homeless.<sup>2</sup> The explosion sent a white mushroom cloud over the Lebanese city and is regarded as the worst anthropological disaster of the decade, with a financial loss of more than 15 billion USD.<sup>1-4</sup> The Beirut Port explosion traumatized both the human and animal populations and sharply

accentuated the existing political unrest, COVID-19 outbreak, security challenges, and especially the unprecedented severe economic collapse that was transforming Lebanon from a leading nation to a failing one.<sup>2-4</sup>

The majority of the literature on nuclear or nonnuclear disasters has focused on human physiological damage and economic consequences, with no mention of animal suffering.<sup>1-8</sup> This report focuses on the explosion-related injuries of animals that were presented for veterinary care in the aftermath of the Beirut explosion.

**TABLE 1** Comparison of animal and human injuries and deaths associated with the Beirut Port ammonium nitrate blast.

Beirut Port ammonium nitrate blast	Animal	Human
Total city population	200,000	2 million
Number of admissions to the emergency department	401 (298 cats, 103 dogs)	8643
Laceration (skin and soft tissue), %	101 (25)	>7000 (>81)
Fracture, %	31 (8)	198 (2.3)
Tendon repair, %	52 (13)	107 (1.2)
Eye laceration, %	7 (2) <sup>a</sup>	75 (0.9)
Burn, %	19 (5)	1 (0) <sup>b</sup>
Hearing loss, %	6 (1)	NA
Fatality inside center, %	46 (11)	93 (1)
Total fatality, %	(>11)	218 (3)
Injury site (excluding soft tissue and skin)		
Head and neck, %	16 (4)	125 (1.4)
Thorax and abdomen, %	1 (0.3)	9 (0.1)
Extremities, %	84 (21)	213 (2.5)

<sup>a</sup>Six animals had enucleation of 1 eye, and 1 animal had repair of ocular lacerations bilaterally, with removal of intraocular glass and subsequent resolution of intraocular hemorrhage and recovery of vision.

<sup>b</sup>Most burn victims died before or during transportation to the hospital.

## 2 | METHODS

Two weeks after the blast, the President of the Lebanese Order of Veterinary Physicians sent emails to its 264 registered veterinarians and allied animal organizations, asking them to complete a structured survey detailing the site, severity, and surgical management of the various animal injuries managed inside their premises during the first week after the blast. Photographic documentation was requested. The respondents were again contacted (via email, phone call or office visit, or combination) to provide 1-month follow-up clinical and photographic data. All veterinarians and animal health organizations followed international, national, and institutional guidelines for humane animal treatment and complied with relevant legislation.

## 3 | RESULTS

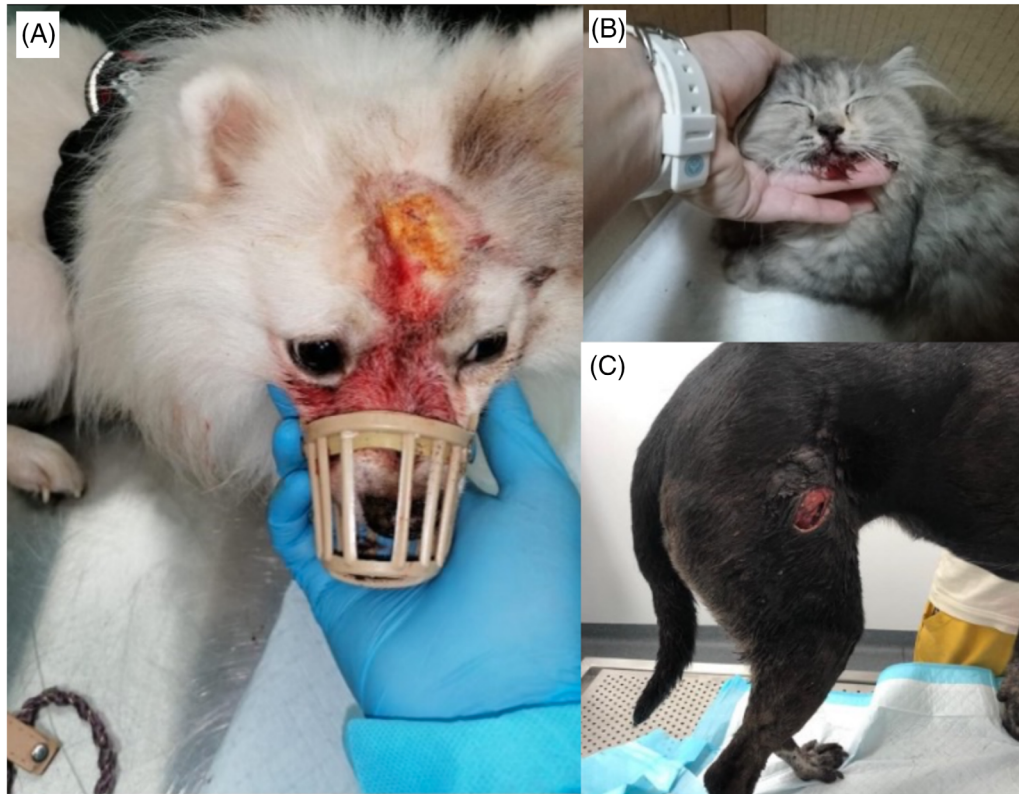
Six veterinarians responded to the email request. These 6 respondents covered most of the veterinary activities in Beirut. The area surrounding the port warehouse was predominantly residential, and 2 neighboring veterinary facilities were destroyed in the blast. The total number of injured animals included 298 cats and 103 dogs managed inside the veterinary clinics, with half of the cases having serious injuries (Table 1). The most common encounters included, in decreasing order, superficial or deep lacerations involving muscle tissue, extremity tendon repair or fractures, burns, ocular lacerations, and total hearing loss.

Thirty-six pet owners brought their pets for treatment. The remaining animals were brought in by international and local organizations (Four PAWS International, Animals Lebanon, and Beirut for the Ethical Treatment of Animals). In general, the animals that did not present with external injuries had presumed posttraumatic stress disorders (eg,

panic, fearfulness, clinging to their owners, refusal to eat), probable traumatic brain injury (eg, ataxia, blood in the ears, circling) (Figure 1), or evidence of lung damage from blast dust (eg, wheezing, difficulty breathing). Forty-six animals died inside the centers. One hundred and one animals with lacerations were mostly injured by pieces of flying glass (Figures 1 and 2). One dog had a 2-hour surgery that required 92 sutures for multiple, extensive deep lacerations (Figure 2). General anesthesia was required in 101 animals. Extremity fractures were treated surgically in 31 animals (Figure 3), tendon injuries in 52, and ocular lacerations in 7. No apparent difference in the injury pattern was noted between cats and dogs. Six cats had total hearing loss, and 6 cats lost an eye from extensive ocular lacerations (Table 1). A female Shepherd-mix dog with pieces of glass penetrating both eyes was brought to the veterinary clinic on the night of the explosion. The sight in both eyes was restored after suturing of corneoscleral wounds and glass removal, followed by medical treatment. All procedures followed the veterinary precautions set by the National Association of State Public Health Veterinarians ([www.nasphv.org](http://www.nasphv.org)). From 6:27 p.m. on the day of the disaster (20 min after the explosion) until 5:00 a.m. the next day, the veterinarians (A.H., C.T., M.Y., N.H., J.H.) operated on animals.

It is presumed that a majority of animals and people at ground zero died, but no records were kept during the dismantling of hundreds of collapsed buildings and disposal of nonhuman bodies. Most injuries resulted from shattered glass, and several animals were injured while walking on glass debris-covered streets 5 km around the explosion site or trapped under rubble.

Two thirds of the operated cats and dogs were seen at the 1-month follow-up, with around half of the previously treated cats and dogs continuing to show signs of anxiety and stress. The animal fauna is limited in Beirut. Farm animals such as cattle, small ruminants, and chickens are

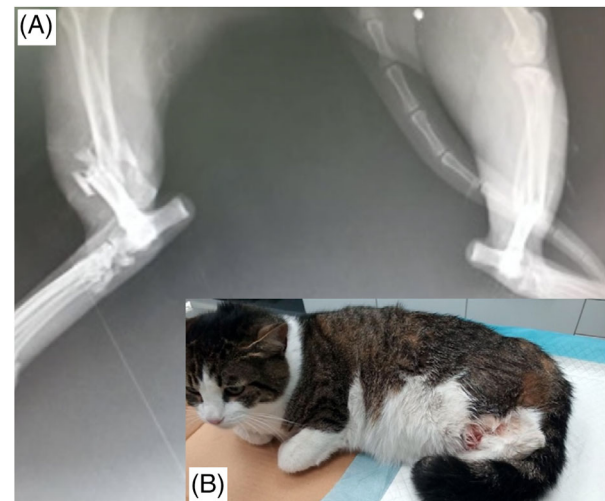


**FIGURE 1** (A) A 5-year-old Pomeranian dog suffered from facial wounds that were sutured. (B) Traumatic brain injury and oral wounds in a 1.5-month-old kitten. One month later, the kitten had recovered well. (C) A 2-year-old Labrador Retriever suffered a deep hind extremity glass cut and fully recovered after the muscle layer and the skin were sutured.



**FIGURE 2** Extensive superficial and deep lacerations necessitating 2 hours of general anesthesia and 92 sutures. The dog was at home on a floor facing the port and survived the innumerable glass shreds.

not present inside Beirut due to municipal regulations. There are about 20,000 stray dogs in Lebanon, mostly in rural areas. Most dogs live in historic houses located near the city port, and many of these ancient iconic buildings collapsed. The city has no dog parks, and its narrow streets, with their absence of any greeneries, offer few opportunities



**FIGURE 3** A 2-year-old cat treated for bilateral, multiple tibial fibula fractures of the back extremities with open fracture reduction using pins and locking plates. (A) Radiographs at the completion of surgery. (B) At presentation.

for dog survival. On the contrary, street cats are in every corner of the city, with domestic cats comprising 5% of the total cat population (200,000) (Table 1). The city harbors 2 million inhabitants, half of which are Lebanese, and the rest are Syrian and Palestinian refugees.



## 4 | DISCUSSION

Around one quarter of the cats and dogs underwent surgery, another quarter sustained moderate to severe nonsurgical injuries, and one-half had noncritical bodily injuries. The cats' and dogs' injuries paralleled that of people (Table 1), with most surgical cases being superficial to deep lacerations, followed by bone fractures and tendon injuries. The eye was the most susceptible sense organ because it had no protection against flying fragments of sharp glass. A major difference is the high fatality rate in the veterinary centers versus human hospitals, and this relates to the absence of animal ICUs and the delayed presentation of injured animals (veterinarians were initially treating human casualties; rescue teams began with human casualties and ended with injured animals).

The explosion seriously devastated the health infrastructure. Three neighboring hospitals were totally inoperable, with another 3 severely damaged (a total of 400 hospital beds lost); similarly, 2 large animal care institutions were severely damaged. A government directive to care for animals, particularly in calamities, was almost nonexistent. However, there was much enthusiasm in Lebanon to prepare for animal care in both peace and disaster, with nongovernmental organizations, animal activists, and local volunteers all being active, enthusiastic, and dedicated to help, self-deploy, and operate on their own or within the group directive. Additional physicians and assistance staff joined in helping with triage and first aid delivery as the animals were directed to the working clinics.

It is worth noting that veterinarians were initially called in to treat human casualties in their facilities because all of the local hospitals were overflowing with injured patients. Cats and dogs were treated for several hours after that, until late at night. Because of the extraordinarily rapid tragedy occurring around sunset, with streets made dark and perilous as a result of power outages and flying glass from tall buildings, detailed records of the animals' injuries and their management were unavailable.

Ammonium nitrate piles can easily detonate if there is a nearby fire. There were numerous such disasters throughout the 20th century, and 19 such incidents in the 21st century.<sup>5</sup> Most reported incidents had a small number of human and animal casualties because warehouse storage facilities were located outside of major cities, while the present tragedy occurred inside the capital of Lebanon.

Ammonium nitrate explosions generate a supersonic overpressurization shock wave capable of shattering glass doors and windows for a dozen kilometers. There is a circumferential injury pattern<sup>3</sup> in people and animals, depending on the explosive power and the distance from the blast. In order of proximity, this injury pattern will be death,

then primary blast injury (lung and brain injury), and then other injury patterns, such as lacerations and fractures.<sup>1</sup>

In the last decade, several large-scale disasters have raised awareness of the needs of animals in disasters. Veterinarians are uniquely qualified for disaster intervention by virtue of their extensive medical training.<sup>6-8</sup> Veterinary medical education encompasses a vast knowledge of pharmacology, microbiology, physiology, and biochemistry.<sup>8</sup> The experiences of veterinary clinicians and the challenges faced in Lebanon can guide the improvement of disaster animal care on a global level. The joint coordinated work of veterinary groups and nongovernmental animal organizations reduced the injured fatalities to 46, while 355 animals were treated and recovered. Attention to animal welfare should be a priority in the management of large-scale disasters.

### CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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