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ACVECC-Veterinary Committee on Trauma (VetCOT) Registry Report 2013-2017

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Abstract

Objective—To report summative data from the American College of Veterinary Emergency and Critical Care Veterinary Committee on Trauma (VetCOT) registry.

Design—Multi-institutional veterinary trauma registry data report

Setting—VetCOT identified veterinary trauma centers (VTCs)

Animals—Dogs and cats with evidence of trauma presented to VTCs with data entered in the VetCOT trauma registry September 1, 2013 – March 31, 2017

Interventions—VetCOT created a standardized data collection methodology for dog and cat trauma. Data was input to a web-based data capture system (REDCap) by data entry personnel trained in data software use and operational definitions of data variables. Data on demographics, trauma type (blunt *versus* penetrating), pre-admission care, hospitalization and intensive care requirement, trauma severity assessment at presentation (e.g., modified Glasgow coma scale

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[MGCS] and animal trauma triage [ATT] score), key laboratory parameters, necessity for surgical intervention and case outcome were collected. Summary descriptive data for each species are reported.

Measurements and main results—Twenty-nine VTCs in North America. Europe, and Australia contributed information from17,335 dog and 3,425 cat trauma cases during the 42-months reporting period. A large majority of cases presented directly to the VTC after injury (80.4% dogs, 78.1% cats). Blunt trauma was the most common source for injury in cats (56.7%); penetrating trauma was the most common source for injury in dogs (52.3%). 43.8% of dogs and 36.2% of cats were reported to have surgery performed. The proportion surviving to discharge were 92.0% (dogs) and 82.5% (cats).

Conclusions—The VetCOT registry proved to be a powerful resource for collection of a large dataset on trauma in dogs and cats seen at VTCs. While overall survival to discharge was quite high, further evaluation of data on subsets of injury types, patient assessment parameters, interventions and associated outcome are warranted.

Introduction

Trauma is a common reason for dogs and cats to present to veterinary hospitals, and has been identified as a leading cause of death in dogs across age groups.[2,3] Despite this, the epidemiology of trauma in dogs and cats remains poorly understood. The veterinary trauma literature is dominated by single center studies, the majority of which are retrospective, and/or focus on a single mechanism of trauma. The largest study of veterinary trauma patients includes 1000 dogs, but was published in 1974, prior to the establishment of veterinary emergency medicine and critical care as a specialty.[4] There is an urgent need for large, multi-center, prospective studies to better understand the epidemiology of all-cause trauma in dogs and cats. An improved understanding of epidemiology can help guide efforts at improved prevention and management of trauma in these patients.

The American College of Veterinary Emergency and Critical Care Veterinary Committee on Trauma (VetCOT) was established in 2011 "*to create a network of lead hospitals that seed development of trauma systems."* It was envisioned that "*these hospitals will work collaboratively to define high standards of care and disseminate information that improves trauma patient management efficiency and outcome*."[5] One priority identified to achieve this vision was the establishment and utilization of a veterinary trauma registry to prospectively capture trauma patient data. In early 2013, the VetCOT-Registry Subcommittee (VetCOT-RS) was formed to develop, execute and administer the trauma registry. In September of the same year, nine Veterinary Trauma Centers (VTCs) began entering data on dog and cat trauma cases presenting to their hospitals. A total of four waves of hospitals have since been identified (2013, 2014, 2015, 2016) and have been entering cases into the trauma registry. This manuscript represents a summary of data collected by all VTCs from September 1, 2013 – March 31, 2017. The objective of this report is to provide a descriptive overview of all VetCOT registry data entered over the time span of 42 months.

Materials and Methods

The VetCOT-RS was chartered to develop a small animal trauma registry that allows collation, analysis and distribution of epidemiological data on trauma in dogs and cats. To accomplish these goals the registry needed to fulfil a set of key criteria. First, the VetCOT registry data fields needed to allow for collection of pertinent data that would afford interpretation of findings in the areas of prevention, treatment, resource allocation and outcome determination. Second, data collation and reporting would allow veterinary hospitals to benchmark their own performance against the broadly based outcomes reported in the registry. Third, data variables should be detailed enough to permit meaningful inferential analysis to answer important clinical questions (eg, how does age affect survival to hospital discharge in distinct trauma severity cohorts). Fourth, registry design must facilitate time-efficient data entry, minimize data entry errors, assure data safety and protect privacy of pet owners and VTCs. Finally, registry implementation and maintenance should be low-cost and executable by volunteer contribution only. Registry content and implementation were developed by VetCOT-RS members and discussed and refined during four conference calls in 2012, with the final output reviewed and approved by the entire VetCOT.

The VetCOT registry data were collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted by the Clinical and Translational Science Institute of the University of Minnesota. REDCap is a secure, web-based application designed to support data capture for research studies, that provides an intuitive interface for validated data entry, includes automated export procedures, and while it requires licensing and server infrastructure, is free of cost to academic institutions.[1]

Identified VTCs were required to enter all dog and cat trauma cases into the VetCOT registry. To facilitate standardized data entry into REDCap, VTCs are provided with a printable case report form and instructions for the use of the electronic database (Appendices 1 & 2). For the purposes of the registry, trauma was defined as any tissue injury that occurs suddenly as a result of an external force, including but not limited to, blunt force injury, penetrating injury, acceleration/deceleration injury, and crushing injury. For the purposes of the registry, environmental emergencies such as burns, electrocution, and drowning were not considered trauma.

Trauma registry data entry fields included animal variables (eg, species, age, breed, sex), trauma event variables such as type of trauma (eg, blunt versus penetrating), injury source (eg, struck by vehicle, fall from height), injury severity scores (ATT and MGCS scores) [6,7], and type of injuries sustained. Diagnostic variables included key blood work results (eg, lactate, base excess, glucose, PCV, TS) as well as abdominal (AFAST) or thoracic (TFAST) focused assessment with sonography findings, when these diagnostics were performed.[8] Since there is no funding available to hospitals for involvement in the VTC network all diagnostic tests are performed at the discretion of the primary clinician and paid for by the client. As such, these variables are not available for all cases included in the registry. Treatment variables described the requirement for surgery, admission to ICU, or blood product transfusion. Time variables (eg, date and time of injury, presentation, death or

discharge alive) were recorded. Outcome was captured as survival to hospital discharge, death despite treatment, or euthanasia. Euthanasia was further specified as due to either grave prognosis or financial limitation or both. Effective July 2014, data fields on pre-hospital care (eg, provider and nature of pre-hospital care) were included into the registry.

Statistical methods

Cases are included in this report if the respective record was denoted as completed in REDCap. Participating VTCs are not identified by name in this report, but are categorized as either university or private practice. Records with incomplete species designation are excluded. Additionally, a decision was made by the VetCOT-RS not to remove outliers. Data are summarized with standard descriptive methodology: continuous data are presented as median and quartiles (Q1, Q3) and proportions are presented as percentages.

Results

A total of 20,774 trauma case records were created at 29 VTCs in North America, Europe, and Australia, during the study period. Fourteen records were excluded for lack of information on species. The median age of dogs was 4.1 years (IQR: 1.5, 8.0) and for cats 3.4 years (IQR: 1.00, 8.00). The median weight of dogs was 12.6 kg (IQR: 5.7, 26.4) and for cats 4.4 kg (IQR: 3.4, 5.4). Admission data (ie, data collected within the first 6 hours of presentation) and outcome data (i.e., data collected during the entire patient visit) are summarized in Tables 1 and 2, respectively. Injury severity scores, biochemical and hematologic data are collated in Table 3. Table 4 summarizes the number of cases contributed by hospital type.

Discussion

This report represents a summary of the largest dataset on dog and cat trauma patients to date. The data were amassed over a 42-month period in a multi-institutional collaborative effort between large private and university-based hospitals that have been identified by the ACVECC-VetCOT as VTCs. These data are expected to benefit both the individual hospitals that have contributed, and the wider veterinary community, with the goal of ultimately improving trauma patient outcomes. Participating VTCs have access to their own case data on a continual basis through REDCap and quarterly reports are disseminated by the VetCOT-RS, to help inform hospital-specific performance improvement programs and publications. The report of these data was purposefully descriptive in nature. It allows the VTC network to share with the medical community an overarching view of what information is in the registry, and allows clinical and translational researchers an opportunity to determine additional questions that could be answered utilizing the database. In doing so, this report serves one of the aims of the trauma initiative to "*enhance and promote research collaborations*" in an effort to expand the veterinary trauma literature and allow for development of best practices and/or evidence-based recommendations for improving patient outcome.[5]

Further analysis of the data to answer specific epidemiologic questions, while not a purpose of this report, is an implied objective of the VetCOT registry. Access to data from the entire

database is available through an application process facilitated by the VetCOT-RS (materials available at: vetcot.org). At the time of manuscript submission, requested data has been provided to investigators for four VetCOT-RS approved projects, one of which has been recently published.[9] The VetCOT-RS elected to report only summary data in this (and future) reports to encourage and enable investigators to utilize the data for specific projects.

Limitations of this report include potential bias introduced by missing data, large numbers of cases in the “other” category for trauma type, the potential for inclusion of biologically implausible data, varied duration of case entry by individual VTCs, and the inability to ensure that individual VTCs have captured all trauma cases presented to their hospitals (selection bias). In an attempt to address some of these limitations, the VetCOT-RS tracked challenges and feedback from VTCs and the veterinary trauma community, and implemented updates to the VetCOT trauma registry effective April 1, 2017. These changes include improved quality assurance and quality control measures (i.e., limit warnings, radio buttons, drop-down menus), expanded options to reduce the large “other” categories, updates to wording for clarification and added questions regarding operational canines (OpK9s) and mechanical ventilation.

Funding for a database manager to provide reports to hospitals, to aid in further refinement of the registry, and to continually assess data quality is being sought. Moving forward, the VetCOT-RS will target publishing summary data on an annual basis.

Conclusions

Multi-institutional (private and university based) collaboration to amass large volumes of data on dog and cat trauma cases in a relatively short period of time has been realized. While survival to discharge in traumatic injury is favorable, trauma patterns are not the same in dogs and cats. Further analysis of cohorts within the database is required to further expand the veterinary medical community’s understanding of predictors of outcome based on patient variables and interventions. Additionally it is hoped that these data and the VTC network will encourage and facilitate future interventional clinical studies designed to improve trauma patient outcomes in dogs and cats.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Portions of this data have been presented at the International Veterinary Emergency and Critical Care Symposium (IVECCS) 2015 in Washington, DC; IVECCS 2016 in Grapevine, TX; IVECCS 2017 in Nashville, TN and the American College of Veterinary Emergency and Critical Care Veterinary Committee on Trauma (ACVECC-VetCOT) Veterinary Trauma Critical and Care Conference in Las Vegas, NV 2016, 2017, 2018.

Abbreviations

ACVECC-VetCOT	American College of Veterinary Emergency and Critical Care Veterinary Committee on Trauma
AFAST	abdominal focused assessment with sonography for trauma
ATT	animal trauma triage
MGCS	modified Glasgow coma scale
TFAST	thoracic focused assessment with sonography for trauma
REDCap[1]	Research Electronic Data Capture
VetCOT–RS	Veterinary Committee on Trauma – Registry subcommittee
VTC	veterinary trauma center

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TABLE 1:

Admission data (collected within the first 6 hours of presentation) of dogs and cats sustaining trauma from the ACVECC-Veterinary Committee on Trauma registry 2013–2017

	Dogs	Cats
Species (% total)	17,335 (83.5%)	3425 (16.5%)
Sex (entries)	17,330	3412
Male (%)	9368 (54.1%)	1947 (57.1%)
Sex – Male intact	3120	406
Sex – Male castrated	6248	1541
Female (%)	7902 (45.6%)	1407 (41.2%)
Sex – Female intact	2099	337
Sex – Female spayed	5803	1070
Unknown (%)	60 (0.3%)	58 (1.7%)
Presentation to other veterinarian (entries)	17,323	3421
Yes (%)	3402 (19.6%)	749 (21.9%)
Pre-hospital care by non-DVM (entries)	16,163	3178
Yes (%)	860 (5.3%)	71 (2.2%)
Type of trauma (entries)	17,323	3416
Blunt (%)	7788 (45.0%)	1938 (56.7%)
Penetrating (%)	9064 (52.3%)	1334 (39.1%)
Both (%)	471 (2.7%)	144 (4.2%)
Type of blunt trauma (entries)	8259	2082
Struck by vehicle (%)	3616 (43.8%)	644 (30.9%)
Fall from height (%)	1831 (22.2%)	456 (21.9%)
Ejected from vehicle (%)	94 (1.1%)	7 (0.3%)
Injured inside vehicle (%)	68 (0.8%)	5 (0.2%)
Struck by weapon (%)	70 (0.8%)	5 (0.2%)
Crushed by falling object (%)	248 (3.0%)	117 (5.6%)
Other (%)	2332 (28.2%)	848 (40.7%)
Type of penetrating trauma (entries)	9533	1478
Bite (%)	6797 (71.3%)	788 (52.6%)
Ballistic (%)	88 (0.9%)	27 (1.8%)
Impalement (%)	179 (1.9%)	14 (0.9%)
Laceration from knife (%)	34 (0.4%)	7 (0.5%)
Laceration from glass (%)	163 (1.7%)	31 (2.1%)
Laceration from metal (%)	538 (5.6%)	100 (6.8%)
Other (%)	1734 (18.2%)	521 (35.3%)
Hospitalization in the ICU (entries)	17,319	3417
Yes (%)	3716 (21.5%)	804 (23.5%)
Evidence of head injury (entries)	16,144	3162
Yes (%)	2159 (13.4%)	523 (16.5%)
Evidence of spinal trauma (entries)	16,143	3160
Yes (%)	983 (6.1%)	274 (8.7%)
AFAST performed (entries)	15,370	3019
Yes (%)	3478 (22.6%)	840 (27.8%)
TFAST performed (entries)	15315	3006
Yes (%)	2690 (17.6%)	697 (23.2%)

TABLE 2:

Outcome data collected during entire patient visit of dogs and cats sustaining trauma from the ACVECC-Veterinary Committee on Trauma registry 2013–2017

	Dogs	Cats
Species (% total)	17,335 (83.5%)	3425 (16.5%)
Surgical procedure performed (entries)	17,115	3383
Yes (%)	7492 (43.8%)	1224 (36.2%)
Where (select all that apply)? (entries)	7029	1142
Emergency room (%)	4507 (64.1%)	546 (47.8%)
Operating room (%)	2523 (35.9%)	592 (51.8%)
Referring veterinarian (%)	106 (1.5%)	20 (1.8%)
Blood product administered (entries)	17,113	3383
Yes	263 (1.5%)	87 (2.6%)
Outcome (entries)	17,116	3385
Survived to discharge	15,750 (92.0%)	2791 (82.5%)
Died	227 (1.3%)	46 (1.4%)
Euthanized	1139 (6.7%)	548 (16.2%)
Euthanized – reason (entries)	1127	543
Grave prognosis	421 (37.4%)	213 (39.2%)
Financial limitation	272 (24.1%)	102 (18.8%)
Both	388 (34.4%)	202 (37.2%)
Not applicable	46 (4.1%)	26 (4.8%)

TABLE 3:

Injury severity scores, biochemical, and hematologic data of dogs and cats sustaining trauma from the ACVECC-Veterinary Committee on Trauma registry 2013–2017[**]

	Dogs		Cats	
Category (units)	**Total Entries**	**Median (Q1, Q3)**	**Total Entries**	**Median (Q1, Q3)**
MGCS cumulative score	17,276	18 (18, 18)	3387	18 (18, 18)
ATT cumulative score	17,286	1 (1, 2)	3390	2 (1, 4)
Lactate (mmol/L)	4588	2.3 (1.5, 3.8)	996	2.0 (1.3, 3.2)
Base Excess (mmol/L)	3683	-4.5 (−6.7, −2.7)	794	-6.2 (−8.2, −4.5)
iCa (mmol/L)	4263	1.26 (1.19, 1.32)	949	1.22 (1.11, 1.30)
PCV (%)	6011	48 (42, 53)	1306	36 (30, 41)
TS (g/dL)	5709	6.6 (6.0, 7.2)	1234	6.95 (6.1, 7.6)
Glucose (mg/dL)	5931	112 (95.45, 134)	1282	170.4 (126.33, 227)

[**] Note: Biochemical data measurements are not funded by the project; therefore, are not required data for every patient

TABLE 4:

Veterinary Trauma Center (VTC) case entry distribution from the ACVECC-Veterinary Committee on Trauma registry 2013–2017. Note that not all VTCs contributed cases for the entire review period of this report.

Cases entered	Number of VTCs	Practice type
>1500	3	2 private practice, 1 university
1200–1499	3	2 private practice, 1 university
900–1199	1	1 university
600–899	8	5 private practice, 3 university
300–599	6	4 private practice, 2 university
< 300	8	7 private practice, 1 university