

1 **Factors affecting survival to discharge in fifty-three cats diagnosed with uroabdomen, a**
2 **single centre retrospective analysis.**

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26 Keywords:

27 Uroabdomen

28 Urinary tract

29 Survival to discharge

30 Prognosis

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32 Abbreviations:

33 PCV – Packed Cell Volume

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51 **Objectives:** To assess outcomes in cats diagnosed with uroabdomen at a single referral centre.

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53 **Methods:** Fifty-three cats diagnosed with uroabdomen at a veterinary teaching hospital were
54 identified between June 2003 and September 2016. Data collected included signalment,
55 presenting signs, aetiology, location of rupture, presence of concurrent injury, outcome of urine
56 culture, presence of uroliths and PCV/creatinine/potassium levels at presentation. Cats
57 managed medically and surgically were included and the use of urinary catheters, cystotomy
58 tubes and abdominal drains were recorded. It was determined if patients survived to discharge,
59 and if they were euthanised or died.

60

61 **Results:** Seventy-four per cent (n=39) of cats survived to discharge. Elevations in creatinine
62 (P=0.03) were shown to be significantly correlated with survival to discharge. Sex, age,
63 location of rupture, presence of uroliths, outcome of urine culture, presence of concurrent
64 injury, potassium at presentation and PCV at presentation were not associated with survival to
65 discharge. There was no difference in survival between cats that were medically managed and
66 surgically managed.

67

68 **Conclusions and relevance:** Cats that develop uroabdomen have a good chance of survival.
69 Electrolyte and biochemistry values should be assessed at the time of presentation, in addition
70 to the presence of concurrent injury.

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76 **Introduction**

77 Uroabdomen is defined by the presence of urine in the abdominal cavity as a consequence of
78 rupture of the urinary tract. It can lead to metabolic and multi-systemic disturbances, which
79 can be fatal if not treated. In cats the most common site of rupture is the urinary bladder (1).
80 There is no age or breed predisposition (2). A previous abstract of 110 cats with pelvic fractures
81 found that male cats were at increased risk of developing urethral rupture or uroabdomen (3).
82 Studies in dogs have indicated that males have a higher risk of developing traumatic urinary
83 bladder rupture and subsequently developing uroabdomen (1, 2). Delay in the diagnosis of
84 uroabdomen has been shown to increase mortality rates (4).

85

86 The most commonly reported cause of uroabdomen in both cats and dogs is blunt or vehicular
87 trauma (1, 4-6). Iatrogenic trauma and urethral obstruction have also been identified as causes
88 of uroabdomen (7).

89

90 Presenting signs of patients with uroabdomen will vary depending on the aetiology, location
91 and duration of urinary tract rupture. Reported clinical signs in cats include lethargy, anorexia,
92 abdominal pain, ascites, dehydration, haematuria, dysuria, vomiting, hypothermia and other
93 signs relating to trauma (2, 5, 8-10). Rupture of the urinary tract cannot be ruled out on
94 palpation of an intact urinary bladder or the patients ability to urinate normally (4, 7).

95

96 Patients with uroabdomen can present as an emergency and need be stabilised with medical
97 management. Typical issues that need addressing include azotaemia, metabolic acidosis,
98 hyponatremia, hyperphosphatemia and hyperkalaemia (4, 5, 10). Surgery may be required in
99 some cases to correct the defect in the urinary tract.

100

101 The current literature in cats focuses on the aetiology, diagnosis and treatment of patients that
102 develop uroabdomen (1, 5, 8). There is a paucity of information that identifies prognostic
103 factors associated with uroabdomen in cats. This study aims to highlight factors that are
104 associated with outcome in a retrospective population of cats.

105

106 **Materials and Methods**

107 Electronic medical records from a veterinary teaching hospital were analysed to identify
108 patients diagnosed with uroabdomen over a 12-year period between June 2003 and September
109 2016.

110 Inclusion criteria included cats of any age or sex that had been diagnosed with uroabdomen.
111 Cats were excluded if they were euthanised within two hours of presentation. Uroabdomen
112 must have been diagnosed by either comparing biochemical parameters of abdominal fluid and
113 peripheral blood or by contrast radiography, confirming extravasation of fluid from the
114 urogenital tract into the abdominal space. Clinical management of each case was at the
115 discretion of the clinician.

116 Data collected from medical records included signalment, presenting signs, aetiology, location
117 of rupture in the urinary tract, the method of diagnosis, if contrast was used, concurrent injury
118 (musculoskeletal or soft tissue), presence and type of uroliths, if the case was managed
119 medically or surgically, surgical procedure performed if relevant, bacterial culture results, and
120 time until discharge. The use of abdominal drains, urinary catheters and cystotomy tubes were
121 also recorded. Records also identified potassium, creatinine, packed cell volume (PCV) and
122 total solids (TS) at presentation. For analysis, age was classified using previously published
123 life stage guidelines in cats (11). PCV was categorized; low (<29), normal (29-48), high (>48)
124 using published reference ranges (12). Aetiology was categorised into the following sub-
125 groups; external trauma (road traffic accident, other blunt trauma or dog fight), iatrogenic

126 (cystocentesis, urinary catheterization, or manual bladder expression or post-surgery), urethral
127 obstruction, and unknown. For cats to be considered medically managed, no surgical
128 intervention was performed, and they were managed with either an indwelling urinary catheter
129 or abdominal drain. Survival to discharge was noted; if the patient did not survive to discharge
130 the reason for euthanasia or cause of death was identified.

131

132 **Statistical analysis**

133 All non-normally distributed continuous data was described using the median with a range.
134 Non-parametric continuous data was analysed using the Mann Whitney Test. Categorical data
135 was analysed using either Pearson's Chi-squared Test or Fishers Exact; the former used when
136 cells were larger than five; p values <0.05 were considered significant.

137

138 **Results**

139 Fifty-three cats met the inclusion criteria. Of these 68% (n=36) were male and 32% (n=17)
140 were female. The median age of cats in this study was 4 years (range 0.75 to 12 years). The
141 median body weight was 4.5kg (range 2.4kg to 7.0kg).

142

143 The most common presenting signs included inappetence 36% (n=19), lethargy 28% (n=15),
144 abdominal pain 23% (n=12), dysuria 19% (n=10) and vomiting 15% (n=8). The most common
145 cause of uroabdomen in this study was urethral obstruction 21% (n=11), followed by hit by car
146 19% (n=10) (Figure 1).

147

148 **Survival to discharge**

149 Seventy-four per cent (n=39) of cats survived to discharge; 19% (n=10) were euthanized, and
150 8% (n=4) died. The causes of death and euthanasia in cats managed medically and surgically

151 are represented in Figure 2. Sex, age, location of rupture, presence of uroliths, outcome of urine
152 culture, presence of concurrent injury, potassium at presentation and PCV at presentation were
153 not associated with survival to discharge (Table 1.). Whether a patient was medically or
154 surgically managed had no correlation with survival to discharge.

155

156 Elevations in creatinine on presentation ($P=0.03$) were shown to be significantly associated
157 with failure to survive to discharge in a univariate analysis.

158

159 Five patients had pelvic fractures, of these four survived to discharge. All pelvic fractures were
160 caused by blunt trauma; 4 of which were road traffic accidents.

161

162 **Medical management**

163 Twenty-four per cent ($n=13$) of cats with uroabdomen received only medical management; of
164 these 62% ($n=8$) survived to discharge. Abdominal drains were placed in six medically
165 managed cats, of which two survived. Urinary catheters were placed in six cats, of which six
166 survived. One cat, which did not survive had both a urinary catheter and abdominal drain.

167

168 **Surgical management**

169 Seventy-five per cent ($n=40$) of cats underwent surgery to manage their uroabdomen, of these
170 78% ($n=31$) survived to discharge. Contrast imaging was used to determine the location of
171 rupture in 85% ($n=34$) of cats managed surgically. Four cats had pre-operative abdominal
172 drains placed, 3 of these survived to discharge. Post operatively 5 cats were managed with a
173 urinary catheter, all of these survived. Fifteen cats had post-operative cystotomy tubes; of these
174 12 survived. Ten cats had abdominal drains post-operatively; of these, six survived. Two cats
175 had both a cystotomy tube and abdominal drain, one survived. In two cats that died due to

176 cardiac arrest, one died during recovery from anaesthesia and one died 5 hours after recovery
177 from anaesthesia. Two cats were euthanised intraoperatively due to intra-operative findings
178 suggesting a poor prognosis.

179

180 **Discussion**

181 In this study, the mortality rate of cats diagnosed with uroabdomen was 26% (n=14). Other
182 recent studies had similar mortality rates of 25% in cats that developed urethral ruptures (13),
183 and 38.5% in a study of 26 cats with uroabdomen (5).

184

185 The most common reason for euthanasia in this study was acute kidney injury in three cats and
186 deteriorating clinical status in three cats. In the cats with acute kidney injury, elevations in both
187 urea and creatinine above reference range were noted post operatively. Although none of the
188 clinical records noted financial reasons for euthanasia, it is difficult to ascertain whether this
189 played a role in the decision to euthanise cats within this study. The owner of one cat that was
190 medically managed declined surgery for unknown reasons, this cat was euthanised due to
191 clinical deterioration.

192

193 Male cats were overrepresented in this study with similar findings in other studies (5) (14).
194 Male cats have longer, and narrower urethras compared to females; previously it has been
195 discussed that this may make bladder rupture more likely as it cannot adapt to sudden increase
196 in urinary tract pressure (1). Although this study included more male cats, this study did not
197 show that survival to discharge was associated with sex.

198

199 Trauma (external and iatrogenic) was the most common cause of uroabdomen in 53% of cats.

200 This was in consensus with other studies; a retrospective study of 26 cats with uroperitoneum

201 found trauma was associated with 85% of cases (5). A more recent study looking into urethral
202 rupture in 63 cats found trauma was the cause in 56% of patients (13). There was no correlation
203 between trauma and survival to discharge in this population of cats.

204

205 The most common location of rupture in this study was the urinary bladder, 43% (n=23),
206 followed by the urethra, 30% (n=16), a study of 26 cats also had similar findings (5). No
207 correlation between location of rupture and survival were made.

208

209 In this population of cats, a correlation between elevations in creatinine and not surviving to
210 discharge were shown to be statistically significant. When patients develop uroabdomen,
211 potassium from the urine is reabsorbed through the peritoneal membrane leading to
212 hyperkalaemia (15). Creatinine is similarly reabsorbed, but being a larger molecule, this
213 process occurs more slowly than potassium, therefore elevations in creatinine may suggest the
214 presence of uroabdomen may be more prolonged, leading to a poorer outcome. All cats that
215 did not survive to discharge within this study had creatinine levels above the normal reference
216 range on presentation. Given the small cohort and low death rate, clear conclusions cannot be
217 made between outcome and creatinine levels on presentation.

218

219 In this study, there was no statistically significant difference in survival between cats that were
220 managed surgically or medically. Surgery was aimed at correcting a defect in the urinary tract
221 or providing urinary diversion, and therefore further stabilizing patients. This study did not
222 identify whether patients developed intraoperative or postoperative complications. Causes for
223 euthanasia in cats that did not have surgery included deteriorating clinical status, development
224 of anuria and poor prognosis. All cats that had only urinary catheters placed survived to

225 discharge; small tears of the bladder or urethra can heal without surgery with urinary catheter
226 placement (7, 16).

227

228 In this study, 25% of cats had concurrent injury, however this was not shown to correlate with
229 survival. Uroabdomen patients can have a variety of concurrent conditions such as fractures,
230 neurological dysfunction, abdominal organ damage, among others. Other studies have shown
231 that concurrent injury negatively impacts survival. Feline trauma patients with multiple injuries
232 were shown to have an increased mortality rate (17). Patients that had diaphragmatic hernias
233 with concurrent soft tissue and orthopaedic injury were shown to have a lower survival rate
234 (18). This study had a small cohort with a low death rate with a small proportion having
235 concurrent injury, which may limit our interpretation of the data.

236

237 Due to the retrospective nature of this study, it was not possible to collect all desired data for
238 each patient. There was variability between clinician techniques and records.

239

240 In conclusion, this study indicated that cats that develop uroabdomen have a good chance of
241 survival. Patients should have their electrolyte and biochemistry values assessed on
242 presentation and concurrent injury identified. Although primarily a surgical condition, in which
243 defects in the urinary tract should be surgically managed, sole medical management can be
244 successful in appropriate cases.

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250 **References**

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296 **Tables**

297 Table 1. Characteristics of cats diagnosed with uroabdomen associated with survival to
298 discharge.

299

300 **Figures**

301 Figure 1. Aetiology of cats in this study diagnosed with uroabdomen.

302 Figure 2. Causes of death and euthanasia of cats in this study that did not survive to
303 discharge.

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308 **Conflict of Interest:**

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313 this article.

314 **Ethical Approval:**

315 This work involved the use of non-experimental animal(s) only (owned or unowned), and
316 followed established internationally recognised high standards ('best practice') of individual
317 veterinary clinical patient care. Ethical approval from a committee was not necessarily
318 required.

319 **Informed Consent:**

320 Informed consent (either verbal or written) was obtained from the owner or legal custodian of
321 all animal(s) described in this work for the procedure(s) undertaken.

322 **Informed Consent for Publications:**

323 No animals or humans are identifiable within this publication, and therefore additional
324 Informed Consent for publication was not required.

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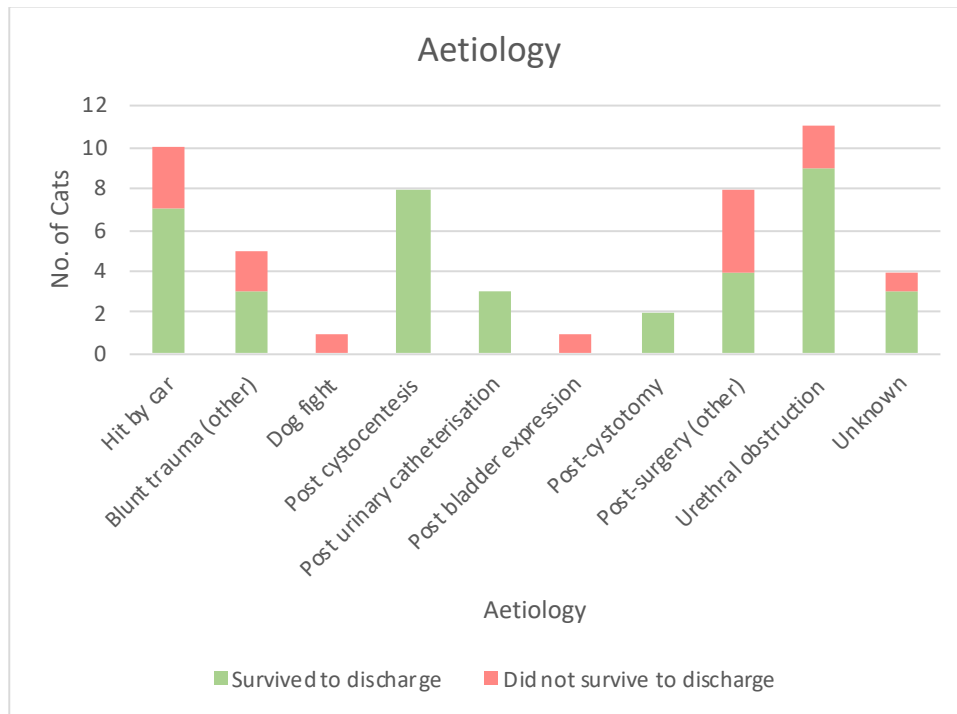
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343 *Figure 1. Aetiology of cats in this study diagnosed with uroabdomen.*

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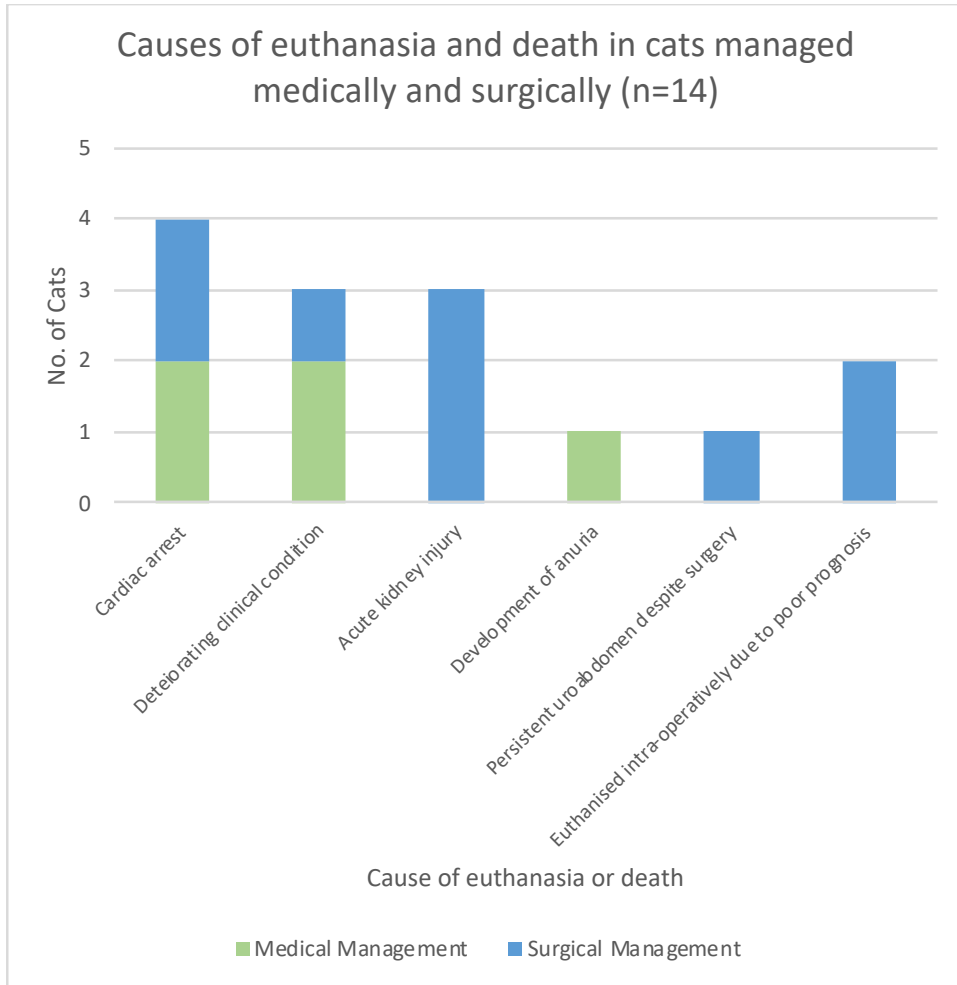
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Figure 2. Causes of death and euthanasia of cats in this study that did not survive to discharge.

Characteristics	Medically Managed (13)		Surgically Managed (40)	
	Survived to discharge (8)	Did not survive to discharge (5)	Survived to discharge (31)	Did not survive to discharge (9)
Sex				
Male	7	3	23	3
Female	1	2	8	6
Age				
Junior (7months – 2 years)	5	2	11	1
Prime Adult (3 – 6 years)	1	1	10	2
Mature (7 – 10 years)	2	2	10	6
Location of Rupture				
Bladder (n=23)	5	0	15	3
Urethra (n=16)	1	2	10	3
Ureter (n=6)	0	1	4	1
Unknown (n=8)	2	2	2	2
Aetiology				
Road traffic accident	0	2	7	1
Blunt trauma (other)	0	0	3	2
Dog fight	0	0	0	1
Post cystocentesis	4	0	4	0
Post urinary catheter placement	1	0	2	0
Post bladder expression	0	1	0	0
Post-operative (cystotomy)	1	0	1	0
Post-operative (other)	0	1	4	3
Urethral obstruction	2	1	7	1
Unknown	0	0	3	1
Concurrent injury				
No concurrent injury	8	3	23	6
Musculoskeletal	0	2	3	1
Soft tissue	0	0	3	2
Musculoskeletal and soft tissue	0	0	2	0
Uroliths				
Present	3	1	8	3
Not present	5	3	20	4
Culture performed				
Positive	3	2	5	1

Negative	3	1	15	1
Creatinine ($\mu\text{mol/L}$)	185 (86 – 905)	571 (339 – 1526)	428 (280 – 1520)	890 (253 – 1439)
Potassium (mEq/L)	4.4 (3.5 – 7.3)	6.1 (4.9 – 8.7)	5.51 (4.3 – 9.4)	6.5 (4.1-8.5)
PCV				
Low	1	0	8	1
Normal	3	4	7	4
High	1	0	5	0

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389 *Table 1. Characteristics of cats diagnosed with uroabdomen associated with survival to discharge.*

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