Case Report

jfms OPEN REPORTS

Journal of Feline Medicine and Surgery Open Reports
1–5

DOI: 10.1177/20551169231172439
journals.sagepub.com/home/jfmsopenreports

This paper was handled and processed by the European Editorial Office (ISFM) for publication in *JFMS Open Reports*.

Sage

Successful autologous transfusion from the subcutaneous space in a domestic shorthair cat with suspected anticoagulant rodenticide toxicity

Katherine J Nash, Amanda Yeo and Katherine Munce

Abstract

Case summary A 6-month-old female entire domestic shorthair cat was presented with a 4-day history of progressive swelling over the dorsal cranium. Subsequent diagnostics revealed a large haematoma, a secondary haemostatic defect and a moderate anaemia. The owner disclosed access to multiple brodifacoum bait stations. The anaemia and haematoma progressed despite treatment with fresh frozen plasma and phytonadione and the cat developed signs of haemorrhagic shock. Allogenic transfusion was declined due to cost and 18 ml of blood was aspirated from the haematoma and transfused. The cat stabilised quickly and was discharged the next day with oral phytonadione.
Relevance and novel information Autologous transfusion from the subcutaneous space has not been previously reported. It was well tolerated and life-saving in this case.

Keywords: Autotransfusion; blood transfusion; brodifacoum; coagulopathy

Accepted: 5 April 2023

Introduction

Historically, first-generation anticoagulant rodenticides, such as warfarin, were commonly used for the control of rodent populations. With time, warfarin-resistance became more common in rats, and second-generation anticoagulant rodenticides (SGARs), such as brodifacoum, were developed. These SGARs are both more potent and more slowly metabolised, leading to increased risk to non-target species.[1] SGAR toxicity is common in companion animals in Australia where SGARs are approved for domestic rodent control. The clinical features of SGAR toxicity in cats include lethargy, inappetence, tachypnoea, respiratory distress, melaena, haematochezia, aural bleeding, pleural effusion, suspect mediastinal bleeding and haematoma formation.[2]

Autologous transfusions, or autotransfusions, have been infrequently described in the feline literature and have been suggested for consideration in cats experiencing significant haemorrhage into a body cavity.[3,4] A retrospective study of 12 autotransfusions in eight cats found that autotransfusion was well tolerated, although all cats in that study received their transfusions from the peritoneal cavity.[5] Blood donation and subsequent perioperative autotransfusion have also been described in a series of cats undergoing planned craniectomy and appeared safe in that setting.[6] An autotransfusion from the

School of Veterinary Science, The University of Queensland, Gatton, QLD, Australia

Corresponding author:
Katherine J Nash BVSc, MS, DACVECC, School of Veterinary Science, The University of Queensland, Main Drive & Outer Ring Road, Gatton, QLD 4343, Australia
Email: k.nash1@uq.edu.au

subcutaneous space has not been previously reported in the veterinary literature.

Case description

A 6-month-old female entire domestic shorthair weighing 2 kg was presented in July 2021 to the University of Queensland Small Animal Hospital emergency department for a 4-day history of a progressive swelling on the dorsal cranium and a wide-eyed appearance. The cat was kept predominantly indoors with access to an outside aviary along with a littermate and an adult cat. The cat was historically healthy since acquisition 1 month prior and had not previously received veterinary care.

On presentation the cat was bright and alert with pale pink oral mucous membranes and a large fluctuant swelling over the dorsal cranium extending towards the upper eyelids, the right of which was retracted superiorly (Figure 1). The cat resented gentle palpation of the fluctuant area. A small amount of subconjunctival haemorrhage, haemorrhagic ocular discharge and lagophthalmos were noted oculus uterque (OU). The remainder of the general physical examination was unremarkable. Venous blood gas analysis (ABL90 FLEX Plus, Radiometer Pacific) showed a mild metabolic acidosis without respiratory compensation (pH 7.224, PCO_2 43.9 mmHg, HCO_3 16.2 mmol/l, reference interval 20.0–24.0), mild hyperglycaemia (8.8 mmol/l, reference interval 4.0–7.0), mild hyperlactataemia (2.6 mmol/l, reference interval 0.0–2.5 mmol/l) and mild anaemia (haematocrit 24.9%). A brief ultrasound of the dorsal head showed a clearly demarcated hypoechoic structure in the subcutaneous space. Aspiration of the swelling yielded red fluid with a packed cell volume (PCV) of 12% and total protein (TP) of 60 g/l. In-house cytology showed a large number of erythrocytes and the occasional mature neutrophil. A point-of-care brief focused abdominal and thoracic ultrasound did not show evidence of body cavity effusion.

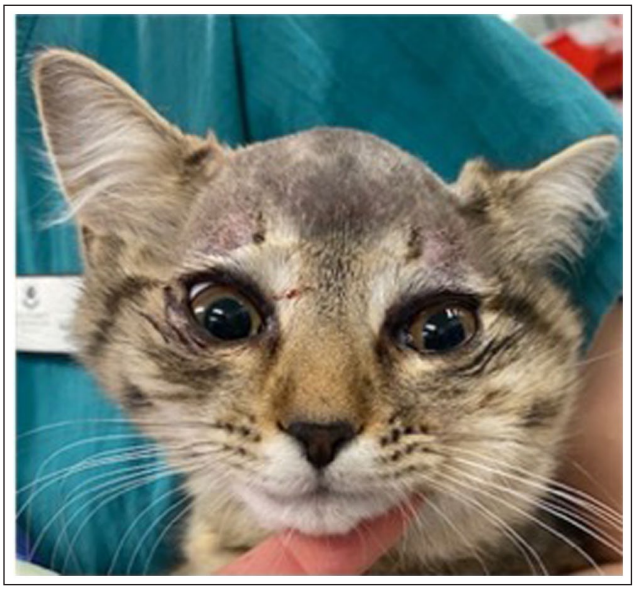

Figure 1 Dorsal cranial swelling, bruising and lagophthalmos in a 6-month-old female entire domestic shorthair cat. Note the deviation of the upper eyelids, which is more pronounced on the right

In-house prothrombin time (PT) and activated partial thromboplastin time (aPTT) (Coag Dx Analyser, IDEXX Laboratories) were prolonged beyond the analysers measurable range (>100 s and >350 s, respectively). A peripheral blood smear showed 8–12 platelets per high-powered field. An in-house blood typing kit showed the cat was type A (Alvedia Feline QuickTEST A+B, Alvedia). The cat's PCV was 24% and TP was 62 g/l.

The presence of prolonged PT and aPTT, adequate platelet count and haematoma formation were concerning for a congenital or acquired coagulation factor defect although spurious test results and unwitnessed trauma were also considered. On further questioning, the owner described the presence of multiple brodifacoum-containing bait stations within the cat's immediate environment and consented to empiric treatment for SGAR toxicity.

The cat was treated with feline blood type A fresh frozen plasma (10 ml/kg, 20 ml total, IV over 60 mins) followed by Plasmalyte-A (6 ml/h IV), phytonadione (2.5 mg/kg SC once followed by PO q12h) and lubricating ophthalmic gel (Optifresh, Petrus Pharmaceuticals; 1 drop OU q2–4h). Six hours after plasma transfusion, the swelling on the cat's forehead was larger, the conjunctival membranes were swollen and bruised OU, lagophthalmos was more pronounced (Figure 2), oral mucous membranes were white and the cat became lethargic, tachycardic (256 bpm) and tachypnoeic (44 bpm). The repeat PCV was 10%, TP 58 g/l and PT with the same analyser as previously was prolonged out of range. There was insufficient sample to repeat the aPTT. Ongoing bleeding resulting in haemorrhagic shock was suspected and an allogenic blood transfusion recommended. The owner declined the allogenic transfusion due to cost but consented to attempted autotransfusion from the haematoma, which in our facility carries charges associated with collection and administration without the cost of a blood unit being applied.

The cat was given buprenorphine (0.01 mg/kg IV once) and 18 ml of blood was aspirated from the haematoma using a 21 G, 0.75 inch butterfly catheter (Surflo Winged Infusion Set, Terumo Corporation). The PCV of the aspirated fluid was 35%. The blood was transfused intravenously by hand using an 18 micron in-line filter (Hemo-Nate Syringe Filter, Mila International) over 10 mins. Tachypnoea and tachycardia resolved during transfusion (hazard ratio 180, relative risk 24) and the cat appeared bright and comfortable (Figure 3). The cat's

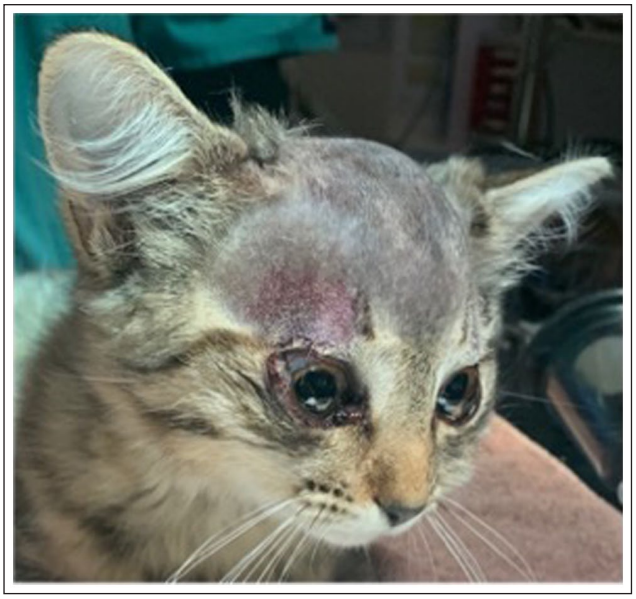

Figure 2 Progressive dorsal cranial swelling with progressive bruising, lagophthalmos and haemorrhagic ocular discharge in a 6-month-old female entire domestic shorthair cat that developed signs of haemorrhage

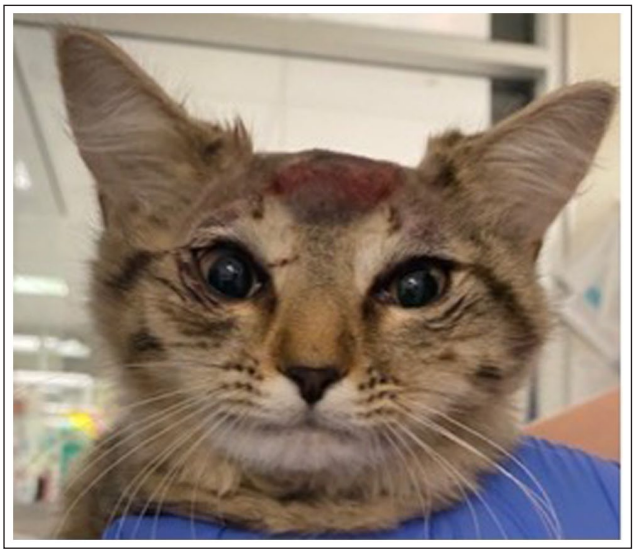

Figure 3 Appearance of a 6-month-old female entire domestic shorthair cat after aspiration of 18 ml of haemorrhagic fluid from the dorsal cranial subcutaneous space and subsequent autotransfusion

temperature increased to 39.9°C immediately after transfusion and normalised within 2 h without intervention. Its vital signs remained normal overnight and the cat was brighter and ate well. Petechiation was noted on the buccal mucosa, as well as significant bruising around previous phlebotomy sites. Follow-up testing the next morning showed a PCV of 14%, TP of 68 g/l, clear serum, PT of 17 s and aPTT of 86 s. The cat was discharged with oral phytonadione (5 mg PO q12h for 28 days) and lubricating eye drops OU with instructions for follow-up testing 48 h after finishing treatment. The owner did not present the cat for follow-up testing but reported that it was doing well 3 months later when they presented their dog for bleeding associated with brodifacoum ingestion. The cat was still doing well according to the owner on a follow-up telephone call 18 months later.

Discussion

In this case, SGAR toxicity was not high on the initial differential diagnosis list. Aspiration was performed for diagnostic purposes, and the haemorrhagic fluid found prompted coagulation testing. This initial aspiration may have contributed to the ongoing bleeding seen in this case, although external bleeding from the aspiration site was not seen. With confirmation of haematoma formation and coagulopathy, we feel SGAR toxicity is the most likely diagnosis. The cat presented with compatible clinical signs and reported access during a period of increased incidence in companion animal SGAR toxicity cases associated with the 2020–2021 Eastern Australian mouse plague.[7,8] Another animal in the household was subsequently treated for SGAR toxicity as there was ongoing access to bait. The cat was doing well according to the owner at 3 and 18 months after discharge from hospital.

Autotransfusions supply an immunologically identical biological product, removing the risk of acute and delayed transfusion reactions associated with immunological incompatibilities. While there are no reports of adverse reactions associated with autotransfusion in cats to date, theoretical concerns include the risk of non-immunological transfusion reactions such as non-immunologic haemolysis, circulatory overload, citrate toxicity or transfusion transmitted infection (in this case, via dissemination of infectious agents previously limited to a discrete location) and dissemination of neoplastic cells.

There is a lack of consensus regarding whether the addition of an anticoagulant to aspirated blood is required before transfusion.[4] In a retrospective study of cats receiving autotransfusions from their peritoneal cavity, anticoagulant was used in 5/12 transfusions, although no complications were reported in either group.[5] In a similar retrospective study of canine autotransfusions, an anticoagulant was added in 13/25 cases and use of the anticoagulant was not associated with survival.[9] The reported complications in this study included hypocalcaemia in four of 16 dogs, all of whom received anticoagulated autotransfusions but also received stored allogenic whole blood. The haemolysed serum colour was noted post-autotransfusion in five of 19 dogs in which it was measured. Time to defibrination of blood in contact with the peritoneal surface is reported to be <1 h.[4] No data could be found regarding the time to defibrination with haemorrhage into fascial planes.

Bleeding in this case was suspected to have both an acute and chronic component with the 4-day history of swelling and acute progression; however, we chose not to add anticoagulant to the aspirated blood as coagulation times remained prolonged at the time of collection.

The ideal blood collection and administration method for feline autotransfusion is unknown. Cell-saver devices used in canine and human autotransfusion are impractical in cats due to small collection volumes. In this case, blood was aspirated using a 21 G butterfly catheter and 20 ml syringe and administered manually using the same syringe and an in-line 18 micron filter. In one experimental study of autotransfusion in healthy cats, biotinated anticoagulated whole blood had similar short- and long-term survival whether given by standard blood-giving set and gravity flow or by syringe pump with an 18 micron microaggregate filter.[10] In-line 18 micron filters are commonly recommended for removal of microaggregates during autotransfusion, and are small enough to remove platelets and leukocytes.[4] Red cell survival associated with manual administration through an 18 micron filter has not been investigated in cats.

The cat in this case report had a temperature increase >39°C and >1°C from baseline immediately after transfusion without evidence of underlying infection, transfusion-related acute lung injury or transfusion transmitted infection. Based on these findings, a febrile non-haemolytic transfusion reaction (FNHTR) was deemed probably but not definitely imputable to the transfusion based on published criteria.[11] Hyperthermia associated with buprenorphine administration was also deemed possible.[12] An acute haemolytic transfusion reaction was deemed unlikely as the patient had an increase in PCV in line with the calculated expected rise for the volume and PCV of its autotransfusion, had normal vital signs other than temperature and the serum was clear when checked the next morning. Underlying infection or bacterial contamination of the haematoma were deemed unlikely as the fever was transient and the patient was otherwise well. If this was an FNHTR, it is the first to be described after autotransfusion in a cat. These reactions have been reported after autotransfusions in human medicine. In one study of autologous transfusions in people, transfusion reactions were uncommon, being reported in 16/13,653 of all autotransfusions with FNHTRs, representing 75% of reported reactions.[13] The proposed mechanisms include the presence of circulating antileukocyte antibodies interacting with leukocytes in transfused blood, leading to the release of endogenous pyrogens and/or accumulation of pro-inflammatory cytokines from leukocytes during storage (in this case, cytokine accumulation would have had to occur within the haematoma itself).[14] Regardless of the cause, the temperature normalised rapidly without intervention and the cat was bright, appetent and able to be discharged the next morning without apparent ill effect.

Conclusions

Autotransfusion from the subcutaneous space was technically straightforward, well tolerated and life-preserving in this case. Further investigation is needed to determine best practices for collection and administration of autotransfusions in cats.

Conflict of interest The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding The authors received no financial support for the research, authorship, and/or publication of this article.

Ethical approval The work described in this manuscript involved the use of non-experimental (owned or unowned) animals. Established internationally recognised high standards ('best practice') of veterinary clinical care for the individual patient were always followed and/or this work involved the use of cadavers. Ethical approval from a committee was therefore not specifically required for publication in *JFMS Open Reports*. Although not required, where ethical approval was still obtained it is stated in the manuscript.

Informed consent Informed consent (verbal or written) was obtained from the owner or legal custodian of all animal(s) described in this work (experimental or non-experimental animals, including cadavers) for all procedure(s) undertaken (prospective or retrospective studies). For any animals or people individually identifiable within this publication, informed consent (verbal or written) for their use in the publication was obtained from the people involved.

ORCID iD Katherine J Nash https://orcid.org/0000-0003-4116-993X

Amanda Yeo https://orcid.org/0000-0001-9619-1937

References

1 DeClementi C and Sobczak BR. **Common rodenticide toxicoses in small animals.** *Vet Clin North Am Small Anim Pract* 2012; 42: 349–360.

2 Kohn B, Weingart C and Giger U. **Haemorrhage in seven cats with suspected anticoagulant rodenticide intoxication.** *J Feline Med Surg* 2003; 5: 295–304.

3 Barfield D and Adamantos S. **Feline blood transfusions. A pinker shade of pale.** *J Feline Med Surg* 2011; 13: 11–23.

4 Taylor S, Spada E, Callan MB, et al. **2021 ISFM consensus guidelines on the collection and administration of blood and blood products in cats.** *J Feline Med Surg* 2021; 23: 410–432.

5 Cole LP and Humm K. **Twelve autologous blood transfusions in eight cats with haemoperitoneum.** *J Feline Med Surg* 2019; 21: 481–487.
6 Fusco JV, Hohenhaus AE, Aiken SW, et al. **Autologous blood collection and transfusion in cats undergoing partial craniectomy.** *J Am Vet Med Assoc* 2000; 216: 1584–1588.
7 CSIRO Media Releases | Statements. **Mouse plague in Queensland and New South Wales.** Available at: https://www.csiro.au/en/news/news-releases/2021/mouse-plague-in-queensland-and-new-south-wales (2021, accessed on 3 February 2023).
8 VIN News Service. **Australian mouse plague sparks pet poisoning crisis.** Available at: https://news.vin.com/default.aspx?pid=210&catId=615&id=10248234 (2021, accessed on 3 February 2023).
9 Higgs VA, Rudloff E, Kirby R, et al. **Autologous blood transfusion in dogs with thoracic or abdominal hemorrhage: 25 cases (2007–2012).** *J Vet Emerg Crit Care* 2015; 25: 731–738.
10 Heikes BW and Ruaux CG. **Effect of syringe and aggregate filter administration on survival of transfused autologous fresh feline red blood cells.** *J Vet Emerg Crit Care* 2014; 24: 162–167.
11 Davidow EB, Blois SL, Goy-Thollot I, et al. **Association of Veterinary Hematology and Transfusion Medicine (AVHTM) Transfusion Reaction Small Animal Consensus Statement (TRACS). Part 1: definitions and clinical signs.** *J Vet Emerg Crit Care* 2021; 31: 141–166.
12 Posner LP, Pavuk AA, Rokshar JL, et al. **Effects of opioids and anesthetic drugs on body temperature in cats.** *Vet Anaesth Analg* 2010; 37: 35–43.
13 Furuta Y, Nakamura Y, Tokida M, et al. **Pre-operative autologous blood donation and transfusion-related adverse reactions: A 14-year experience at a university hospital.** *J Trans Sci* 2018; 57: 651–655.
14 Lin JS, Tzeng CH, Hao TC, et al. **Cytokine release in febrile nonhaemolytic red cell transfusion reactions.** *Vox Sang* 2002; 82: 156–160.