SEAMLESS TRANSITION
This case report involving an English Springer spaniel illustrates the importance of a good working relationship between the primary and emergency care teams.
This case report follows the diagnostic and treatment processes for recurrent hemoabdomen in a dog, weeks after she had undergone elective surgery. Teamwork between the primary care and emergency care clinics ultimately led to the diagnosis of hypofibrinogenemia and a successful outcome.

“Scout” was a 7-month-old female English springer spaniel that had undergone ovariohysterectomy on March 17, 2020, and was discharged with oral carprofen and trazadone. Six days postoperatively, she was returned to the hospital for a possible urinary tract infection. The clients stated that she was urinating frequently and noted no straining or passing of blood. Laboratory results before the ovariohysterectomy, including prothrombin and activated partial thromboplastin times, had been within normal limits.

**DIAGNOSIS AND TREATMENT**

**Primary Care**

**March 23**
Ultrasonography-guided cystocentesis at the primary care hospital revealed an incidental finding of free fluid in the abdomen. Abdominocectesis indicated hemoabdomen and, after 5 minutes, abdominal fluid collected in a plain tube had not clotted. Initial differential diagnoses included von Willebrand disease, rodenticide toxicity, hemophilia, or possible slipped pedicle. Scout was then referred to the local emergency and critical care center.

**Emergency Care**

**March 23**
Physical examination revealed a grade II/VI heart murmur, pale mucous membranes, and a distended abdomen. Peripheral venous packed cell volume (PCV) was 43% (reference range [RR] 37% to 55%) and total solids concentration was 6.7 g/dL (RR 5.7 to 7 g/dL). Abdominal fluid PCV was 23% and total solids were 5.2 g/dL (same reference ranges as peripheral blood). Total solids are representative of albumin and globulin levels combined; in patients with hemorrhage, total solids can potentially decrease sooner than PCV. Complete blood count and blood chemistry test results were within normal limits. Prothrombin time was 14 seconds (RR 11 to 17 seconds) and activated partial thromboplastin time was 81 seconds (RR 72 to 102 seconds).
Additional testing at the emergency center ruled out von Willebrand disease. Blood typing before a potential transfusion indicated that her blood type was DEA (dog erythrocyte antigen) 1.1 positive. Full abdominal ultrasonography confirmed abdominal effusion, but other ultrasonographic findings were unremarkable.

The working diagnosis at the time was thrombocytopathy. Rodenticide toxicity was ruled out. To facilitate clotting, emergency facility staff administered cryoprecipitate transfusion and Yunnan Baiyao (250 mg PO q12h). Cryoprecipitate is a plasma-derived blood product produced by thawing fresh frozen plasma, centrifuging it, and collecting the precipitate; contents include factor I (fibrinogen), factor VIII, von Willebrand factor, and fibronectin. Unfortunately, this treatment did not fully correct the hemoabdomen. The clients were advised to keep Scout on strict cage rest and to return with any concerns, especially if Scout’s gum color became pale.

**Primary Care**

**March 25**
Scout was returned to the primary care clinic due to an episode of heavy panting for approximately 10 minutes and because she was sleeping more frequently. PCV was 38%, total solids were 5.5 g/dL, and buccal mucosa bleeding time (ability of platelets to form a platelet plug) was 1 minute and 30 seconds (RR up to 4 minutes). Brief ultrasonography indicated free fluid in her abdomen. No other physical abnormalities were found at this visit. Blood was submitted to a reference laboratory for a hemophilia panel and results were received on March 30 (TABLE 1).

**March 31**
One week after receiving the initial cryoprecipitate transfusion, Scout was returned to the primary care clinic because the clients noted pale gums. Physical examination confirmed the pale mucous membranes and included distended abdomen with a fluid wave and slight tachycardia (160 beats/min). Ultrasonography-guided abdominocentesis indicated continued hemoabdomen. Differential diagnoses at this time included possible acquired hypofibrinogenemia and fibrinolytic condition, which would require aminocaproic acid (inhibits fibrinolysis) to control bleeding. Scout was transferred back to the emergency care facility for additional transfusions and monitoring.

**Emergency Care**

**March 31**
Peripheral PCV was 21% and total solids were 5.1 g/dL. Abdominal effusion PCV was 21% and total solids were 4.4 g/dL. A second transfusion of cryoprecipitate was administered. During the transfusion, Scout vomited and angioedema developed; maropitant citrate, ondansetron, and diphenhydramine were administered. During the evening, Scout received fresh frozen plasma transfusions (270 mL over 6 hours) to aid coagulation. No further vomiting was noted. PCV increased to 24% and total solids decreased slightly to 5 g/dL.

**April 2**
After little improvement, exploratory surgery was planned to determine the cause of the abdominal bleeding and rule out bleeding from the uterine stump. Aminocaproic acid (100 mg/kg IV q8h) was started and Yunnan Baiyao continued (PO q12h). Fentanyl was delivered at a constant rate of infusion (CRI), and 200 mL of packed red blood cells (RBCs) was delivered over 3 hours. PCV had decreased to 15%, but after the packed RBC transfusion, it increased to 25%. Cryoprecipitate was administered before surgery in conjunction with aminocaproic acid to aid clotting. Cefazolin was administered at 20 mg/kg q8h and continued for an additional 72 hours. During surgery, 3.5 L of blood and clots were removed from the abdomen by suction. Both ovarian pedicles were intact and not actively bleeding. Although the uterine stump sutures were intact, arterial bleeding was detected and additional ligatures were applied. No other sources of bleeding were found. During recovery, Scout’s PCV decreased to 14%. Fentanyl CRI was continued, and an additional transfusion of packed RBCs (200 mL) was administered over 3 hours, after which PCV increased to 28%. Scout was then discharged to home on April 3, with Yunnan Baiyao (250 mg PO q12h).

**April 6**
Clients noted leaking from the incision. At this time, aminocaproic acid (500 mg tablets, ¼ tablet PO q8h) was started in conjunction with Yunnan Baiyao.

**Primary Care**

**April 14**
Two weeks after discharge from the emergency center,
Scout was returned to the primary care clinic for follow-up. Her PCV was 27% and total solids were 7 g/dl. She was bright and alert but had pale mucous membranes and a persistent abdominal fluid wave. Ultrasonography-guided abdominocentesis revealed continued hemoabdomen with frank blood (PCV 22%); Scout was transferred to the emergency center.

### Emergency Care

**April 14–16**

Fresh frozen plasma was transfused at 270 mL over 6 hours and aminocaproic acid was increased to 500 mg PO q8h. During the past week, the clients had discontinued giving Yunnan Baiyao, and whether that contributed to rebleeding is unclear. Blood was collected for a coagulation panel before and 8 hours after the transfusion (TABLE 1). Results indicated increased D-dimer (a protein produced as mature fibrin clots are degraded by plasmin, a fibrinolytic enzyme). Desmopressin nasal spray was prescribed (1 drop in eye q12h, alternating the eye for each dose). Scout’s fibrinogen level was low-normal at 159 mg/dL (RR 150 to 490 mg/dL) before transfusion of fresh frozen plasma. After transfusion, her fibrinogen level increased to 230 mg/dL. Aminocaproic acid was switched to tranexamic acid (140 mg PO q8h) because of availability and cost.

**April 19**

Three days after medication changes, Scout’s PCV increased to 33% and total solids were 8 g/dL. Abdominal distention was mild and ultrasonography indicated less effusion. Flow cytometry test results for Scott syndrome were negative. Scout was also negative for fibrinogen receptor defect, and platelet fibrinogen receptor expression and platelet procoagulant activity were within normal limits.

### Primary Care

**April 28**

One week later, Scout’s PCV was 27% and total solids were 6.5 g/dL. She was bright and alert with clear heart and lungs. Factor XIII testing results were within normal limits. Iron supplementation was recommended.

**May 1**

Three days after the recheck examination, severe lethargy and abdominal distension returned. Abdominal ultrasonography revealed marked free fluid. The only change in Scout’s medication was discontinuation of desmopressin 1 week earlier; therefore, treatment with desmopressin was resumed.

**May 12**

Scout had been doing better; she was energetic, with PCV of 43%, total solids of 8.5 g/dL, and electrolytes

<table>
<thead>
<tr>
<th>TEST</th>
<th>REFERENCE RANGE</th>
<th>MARCH 30</th>
<th>APRIL 15</th>
<th>APRIL 16</th>
<th>JUNE 2</th>
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<tbody>
<tr>
<td>Fibrinogen, mg/dL</td>
<td>150–490</td>
<td>72 (before transfusion and cryoprecipitate)</td>
<td>159 (2 weeks post-packed RBC transfusion, pre-FFP transfusion)</td>
<td>230 (8 hours after FFP transfusion)</td>
<td>186 (7 weeks post-transfusions, receiving desmopressin)</td>
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<td>Activated partial thromboplastin time, seconds</td>
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<td>10.3</td>
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<tr>
<td>Prothrombin time, seconds</td>
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<td>14.3</td>
<td>11.4</td>
<td>12</td>
<td>11.8</td>
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<td>Thrombin clotting time, seconds</td>
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<td>7</td>
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<td>3345</td>
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FFP=fresh frozen plasma; ND=not done; RBC=red blood cell.
within normal limits. Tranexamic acid was decreased to q12h and desmopressin continued at q12h.

May 27
Two weeks later, the distended abdomen and pale mucous membranes returned; peripheral PCV was 27% and total solids were 5 g/dL. The only medication change in the past 72 hours was the clients’ switch from proprietary to compounded desmopressin. The clients were advised to go back to using the proprietary form.

Over the next 7 weeks, checkups every 2 weeks indicated continued improvement: increased energy, increased PCV, and minimal abdominal effusion. At week 5, tranexamic acid administration was decreased to q24h and desmopressin continued at q12h.

At her most recent recheck, Scout’s PCV was 54% and total solids were 6.2 g/dL; at this time tranexamic acid was discontinued but desmopressin was continued q12h until Scout was cleared for slow decrease in dose. Rechecks were planned for every 3 months, with desmopressin frequency slowly decreasing to q72h. After desmopressin doses were reduced and Scout’s electrolyte values remained within normal limits, routine electrolyte checks were discontinued.

DISCUSSION
The presumed diagnosis for Scout is acquired fibrinogen deficiency, a diagnosis of exclusion as multiple tests ruled out other bleeding disorders. Although not specific to springer spaniels, hypofibrinogenemia is more prevalent among dogs of this breed. The same laboratory that processed Scout’s blood work reported having noted similar scenarios with 2 other spaniels. No age or sex predilection has been reported.

Reports state that human patients with congenital hypofibrinogenemia remain generally asymptomatic unless they experience trauma or undergo surgery.1 Recurrent and delayed bleeding after surgery have been associated with hereditary and acquired hyperfibrinolysis, which is believed to have affected Scout’s ability to maintain fibrin for proper clot formation. Dysregulated plasmin activation results in clot lysis before wound healing and proper revascularization occur.

For Scout, the trigger for acquired hypofibrinogenemia is believed to be the ovariohysterectomy. After the surgery, Scout’s fibrinogen levels were within reference range only after transfusion. Prognosis for dogs with acquired hypofibrinogenemia can be good to excellent, as long as precautionary measures are taken before the patient undergoes any surgical procedures.

Fibrinogen is the most abundant clotting factor in the body (RR 150 to 490 mg/dL in adult dogs). The half-life for fibrinogen is approximately 4.2 days. As the soluble precursor of fibrin, fibrinogen is a key coagulation factor involved in primary and secondary hemostasis, promoting platelet aggregation and clot formation.2 Fibrinogen is produced by the liver; however, Scout’s liver values were within normal limits before and after surgery.

D-dimer values are elevated with disseminated intravascular coagulation (DIC) syndrome. However, for Scout, DIC was ruled out because no other criteria (i.e., low platelet count, prolonged clotting times) were met and because her complete blood count remained within normal limits except for the lower PCVs and total solids concentrations.

When hypofibrinogenemia is detected, first exclude possible preanalytic error and confirm the fibrinogen value by using another method such as Millar’s method.2 If decreased concentration is confirmed, explore all other causes of decreased fibrinogen production or increased fibrinogen consumption before considering a diagnosis of congenital hypofibrinogenemia.2

The initial treatment of choice for hypofibrinogenemia is cryoprecipitate because it delivers high concentrations of fibrinogen in a lower volume of fluid than that required for fresh frozen plasma (the alternative product if cryoprecipitate is unavailable or the patient is not responding). However, for patients with active hemorrhage and markedly decreased PCV, the transfusion of packed RBCs should be considered before cryoprecipitate or fresh frozen plasma.

Tranexamic acid and aminocaproic acid are used to treat and prevent hemorrhage in syndromes such as hyperfibrinolysis. These drugs block plasmin’s ability to bind to and degrade fibrin fibrils. Desmopressin is a vasopressin analog used in human medicine for patients with von Willebrand disease. However, the mechanism of action is complex and not fully understood. For
Scout, desmopressin was used in an effort to achieve hemostasis. Electrolytes were monitored early during use of desmopressin because it was started at higher-than-recommended therapeutic doses. Other monitoring for patients with hypofibrinogenemia involves checking RBC and platelet counts every 3 to 4 months.

As of the writing of this article, Scout continues to do well. The clients are aware that she is at a high risk for bleeding and for the rest of her life should not undergo surgery without extra precautions, appropriate medications, and potentially preoperative transfusions.

TAKE-HOME POINTS

- Routine surgery can lead to hemorrhage in patients with bleeding disorders.
- Clients should consult with the veterinarian before switching from proprietary drugs to compounded formulations or discontinuing medications.
- A good working relationship between primary and emergency care is always valuable, but especially when diagnosing and treating rare conditions.
- Informed clients can contribute to good patient outcomes.

References


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Jamie is a certified veterinary technician working and living in Pittsburgh. She has previously worked as a licensed veterinary technician in Rochester, New York, for 11 years and has been with a privately owned general practice for 5 years, 4 of which were as head technician. Jamie earned a BS degree in veterinary technology from Medaille College in Buffalo, New York. She has many professional interests including nutrition, surgery, radiology, dentistry, and client education. Jamie currently resides with her husband, toddler, and 4 cats.