SUMMARY Consumption coagulopathy and microangiopathic hemolytic anemia occurred as a complication of insertion of an axillofemoral, preclotted dacron graft. Treatment with heparin followed by dipyridamole and aspirin normalized the hematologic and coagulation abnormalities over a two month period. The mechanism of consumption coagulopathy associated with prosthetic grafts is discussed and a possible role for treatment with antiplatelet agents is suggested.

CONSUMPTION COAGULOPATHY is a recognized complication of a wide variety of diseases. Microangiopathic hemolytic anemia (MAHA) has been frequently associated with consumption coagulopathy as well as other entities. The following case records the occurrence of consumption coagulopathy and MAHA in a patient with an axillofemoral dacron graft prosthesis.

Case Report

On June 13, 1975, a 73-year-old male received an axillofemoral and crossed-femoral bypass with a preclotted, microknit dacron graft for peripheral vascular disease. Preoperative laboratory studies included a hematocrit of 46%, white cell count 6500/mm³, platelet count 248,000/mm³, prothrombin time 11 sec and partial thromboplastin time 29 sec. Intraoperatively two units of packed red cells were given and a postoperative hematocrit was 38%. The postoperative course was uncomplicated. During the hospitalization he received cefazolin, cephalothin, hydroxyzine, diphenhydramine, meperidine and diazepam. On the third postoperative day his hematocrit was 34% and a platelet estimate was normal. No further laboratory studies were obtained. He was discharged on the ninth day without medication.

Eleven days later, 20 days postop, he was readmitted for left groin suture breakdown. Physical examination revealed petechia on the soft and hard palate, palpable petechial lesions over both shins and ankles and bilateral ankle edema. Laboratory findings included a hematocrit of 26%, platelet count 23,000/mm³ and corrected reticulocyte count 3%. Coagulation studies revealed a prothrombin time of 14 sec, partial thromboplastin time 36 sec, thrombin time 34 sec (normal 14–23), fibrinogen level 80 mg% (normal 200–500), fibrin split products 1/32 (normal less than 1/4), factor V 100% and factor VIII 75%. Trace amounts of hemoglobin were found in the urine. A direct and indirect Coombs test was negative. Stool hematests were negative. The bilirubin, lactate dehydrogenase, iron, B12 and folic acid studies were normal. A peripheral smear showed microspherocytes, fragmented erythrocytes and helmet cells (fig. 1). A bone marrow aspirate revealed normal cellularity with erythroid hyperplasia and adequate megakaryocytes and iron.

The diagnosis of chronic consumption coagulopathy and MAHA was made and the patient was treated with heparin 4000 units intravenously every four hours for 12 days. The petechia on his shins promptly cleared and the laboratory studies improved (table 1). Upon discharge on July 15 treatment with dipyridamole 25 mg three times a day and aspirin 0.6 gm a day was begun. As shown in table 1 his laboratory studies slowly returned to normal over the next two months. The dipyridamole was discontinued after one month and the aspirin after two months. Subsequently the patient’s hematologic and coagulation studies have remained normal and the graft has maintained good function.

Comments

This patient developed chronic, low-grade consumption coagulopathy with microangiopathic hemolytic anemia (MAHA) following the insertion of a preclotted, dacron axillofemoral graft. Three mechanisms have been shown to trigger consumption coagulopathy: 1) release of tissue thromboplastin activating the extrinsic coagulation system, 2) contact of blood with a nonendothelialized surface, activating the intrinsic system and 3) red cell or platelet injury, releasing procoagulant phospholipids.

Preclotted prosthetic grafts are allowed to have blood clot on their loose dacron mesh during insertion at surgery. Contact of blood with this foreign surface produces clotting through three sequential stages: 1) adsorption of a protein film layer including fibrinogen and factor XII, 2) platelet adhesion and aggregation to the adsorbed layer, and 3) fibrin-thrombus-red cell complex formation. The flow surface of a prosthetic graft becomes highly thrombogenic because of this fibrin-thrombus complex. Thrombus will continue to form on the graft surface unless the velocity of blood flow exceeds a critical level (thrombotic threshold velocity), which can dislodge activated clotting factors, platelets and fibrin monomers from the graft wall. Since the length and surface area of most prosthetic grafts are small, coagulation factor production compensates for mild increases in utilization on the graft and clinical consumption coagulopathy is not apparent. However, if the surface area is sufficiently large, consumption will surpass replacement and clinical consumption coagulopathy may result, as in the present case.

Other clinical states with vascular endothelial disruption or foreign surfaces have been associated with consumption...
These include ruptured or dissecting aortic aneurysm,\textsuperscript{14} giant hemangioma,\textsuperscript{15} malignant hemangioendothelioma\textsuperscript{16} and cardiopulmonary bypass.\textsuperscript{2}

The consumption coagulopathy in the present case persisted for weeks. Theoretically, with the precollapsed graft, the thrombus lining of the flow surface will be readily organized and covered with endothelium.\textsuperscript{8} However, studies of arterial prostheses in man have shown incomplete organization, with a persistence of fibrin on the flow surface even after several years.\textsuperscript{4,17} Sauvage et al.\textsuperscript{18} have suggested that persistent thrombotic deposition is prevented by a conversion of the fibrin lining to a fibrin of less thrombogenicity when the thrombotic threshold velocity is established.

Active thrombogenesis on large prosthetic grafts can also be associated with microembolization.\textsuperscript{19} In the present case the palpable petechial lesions located on the lower extremities were compatible with microembolic lesions.

Microangiopathic hemolytic anemia occurs frequently with both localized or generalized consumption coagulopathy.\textsuperscript{2,4} The condition develops when fibrin-attached red cells are fragmented by the shearing force of the blood stream.\textsuperscript{3,4} Crenated and echinocytic red cells enmeshed in fibrin strands have been found in prosthetic grafts.\textsuperscript{6} Microangiopathic hemolytic anemia may perpetuate consumption coagulopathy through release of red cell procoagulant phospholipids.\textsuperscript{8}

Effective treatment with heparin of both consumption coagulopathy\textsuperscript{1,2} and MAHA\textsuperscript{19} is recognized. Reduced platelet survival in patients with aortofemoral grafts has been demonstrated.\textsuperscript{20,21} Dipyridamole alone or dipyridamole with aspirin have normalized the platelet survival time with these grafts.\textsuperscript{20,21} The present case suggests that antiplatelet agents may prevent perpetuation of thrombus formation and consumption coagulopathy in a graft by blocking continued platelet deposition and procoagulant phospholipid release.

### References

Consumption coagulopathy and microangiopathic hemolytic anemia with an axillo-femoral graft.
T J Myers and D H Hild

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