HEMOSTATIC DEFECTS IN PATIENTS UNDERGOING CARDIAC BYPASS

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The hemorrhagic syndrome in patients operated upon for correction of cardiac defects with the aid of a pump oxygenator constitutes a significant problem. Study of this problem in over 60 patients has furnished information indicating that, as a rule, more than 1 factor is responsible for the development of this syndrome.

Preoperative studies have revealed abnormalities in clotting, prothrombin, and thrombin times. Decreased numbers of platelets have been noted in some instances as well.

Noted abnormalities occurred more frequently in cyanotic patients.

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At no time was the fibrinogen or plasminogen concentration found to be decreased preoperatively. The blood of some of these patients, not on heparin at the time of examination, showed marked antithrombin activity. The anticoagulant was neutralized in the test tube by small amounts of polybrene.

These pre-existing defects, if severe, undoubtedly contribute to postoperative hemorrhage, especially in instances where the surgical procedure has been formidable.

Other factors, however, play a significant role. During cardiac bypass blood is exposed to considerable trauma. The effect of the trauma on blood was experimentally determined by recirculating fresh human blood through a DeWall-Lillehei oxygenator. A considerable number of platelets and red cells were found to be destroyed. Simultaneously, significant shortening of recalcification and thrombin generation times was noted. It was concluded that the alteration of blood cells resulted in a development of a hypercoagulability state since no abnormalities in clotting time were noted when plasma instead of whole blood was used for recirculation.

Changes similar to the ones observed during in vitro experiments were also noted during clinical studies. In patients, the number of circulating platelets declined. Plasma hemoglobin concentration became elevated. Fibrinogen and prothrombin concentrations declined. It could be demonstrated that the fall of these plasma proteins did not result from hemodilution, denaturation or fibrinolysis. Since fibrin can be demonstrated at times in components of the extracorporeal circuit (Milnes, et al.), one has to assume that the above noted changes in plasma protein concentration result from intravascular clotting.

Besides activation of the coagulation mechanism, activation of the fibrinolytic system was also observed. The degree of plasminogen activator released could be related to the duration of cardiac bypass. Maximum plasminogen activator activity occurred at the time of termination of cardiac bypass or shortly thereafter.

Administration of the antifibrinolytic agent Epsilon Amino Caproic Acid resulted in marked amelioration and in a few instances in dramatic cessation of bleeding. Clinical and laboratory studies demonstrated the efficacy of the drug to abolish increased fibrinolytic activity in 10 patients pretreated with E. A. C. A. In a comparable series of 10 patients not pretreated, considerable fibrinolytic activity was noted. No toxic effect has been observed with the routine clinical use of the drug.

Several other defects in the coagulation mechanism were noted during these studies. Each of these defects may enhance a postoperative bleeding tendency. Increased antithrombin activity, as a result of

the release of endogenous heparin or inadequate neutralization of residual exogenous heparin, has occasionally been noted. The anticoagulant activity has undoubtedly contributed towards bleeding tendencies.

Rise in bleeding time was noted. This finding implicates alteration of the integrity of the vascular wall, which tends to aggravate postoperative hemorrhage.

Bleeding during or after surgery demands the use of blood. Correction of bleeding tendencies is not always achieved by blood replacement. In fact, massive blood transfusions may greatly enhance bleeding dyscrasia.

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