Perioperative Management of a Patient with Congenital Antithrombin III Deficiency

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Thromboembolism associated with congenital antithrombin III (AT III) deficiency was first reported by Egeberg in 1965[1]. AT III deficiency leads to a hypercoagulable state[2] characterized clinically by venous thrombosis of the lower limb and pulmonary embolism. The onset of venous thrombosis is associated with pregnancy or surgery[2–4]. Reports in the anesthesia literature regarding the perioperative management of AT III deficiency are rare. We describe the perioperative management of a patient with congenital AT III deficiency using AT III concentrate and intraoperative monitoring of the end-expiratory P_{CO_2} ($P_{ET_{CO_2}}$) to monitor for pulmonary embolism.

Case History

A 19-year-old male had a venous thrombosis of right lower extremity 2 years prior to admission. One year before admission he developed dyspnea, and digital subraction angiography revealed right pulmonary artery embolism. The serum AT III activity was low and he was diagnosed with a congenital AT III deficiency because of a familial history. He was admitted with a left lower bone fracture and underwent open reduction and internal fixation. AT III activity prior to surgery was 64.9% as measured functionally. Four thousand units of AT III was given intravenously on preoperative day[1]. Three thouosand units was administered 2 hours prior to surgery. The AT III activity increased to 129%. Anesthesia was induced with thiopental 300 mg iv, and the trachea was intubated after neuromuscular blockade with vecronium bromide, 8 mg iv. Anesthesia was maintained with N_2O (67%) and isoflurane in oxygen. The $P_{ET_{CO_2}}$ was monitored continuously with a capnogram (Cardiocap, Datax, Helsinki). The minute ventilation was kept constant by mechanical ventilation. The operation was completed in 30 min. During sugery, the $P_{ET_{CO_2}}$ was unchanged. After surgery 1500 units of AT III was administered daily for 2 weeks. The serum AT III activity was maintained above 80%. Beginning on the eleventh postoperative day, warfarin 8 mg per os was administered. AT postoperative day fourteen, AT III administration was discontinued. There was no evidence of venous thrombosis or of pulmonary embolism.

Discussion

AT III deficiency is inheritated as an autosomal dominant trait. Incidence

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estimates have varied from one in 2000 to one in 20000[2]. The major clinical signs and symptoms of AT III deficiency are young age at onset, idiopathic venous thrombosis, family history of venous thromboembolism, recurrent venous thromboembolism, and thrombosis of the cerebral or mesenteric veins[2]. Thrombosis with pulmonary embolism has been reported during pregnancy, infection, trauma and surgery[2-4]. AT III has been found to play an important role in coagulant as a protease inhibitor[5]. AT III as a circulating antigoagulant inactivates thrombin as well as activated factor X. Moreover, AT III is reported to exert an inhibitory effect on serine proteases, factors IXa and XIa, plasmin and kallikrein[5]. AT III activity is increased by complexing with heparin[5]. A marked decrease in AT III activity during the perioperative period leads to a hypercoagulable state and venous thromboembolism[6,7]. Prophylactic replacement with AT III concentrate in the perioperative period is needed. AT III activity can be increased by approximately 1.4%·unit^{-1}·kg^{-1}. The biological half-life is estimated to be 2.6 days using labeled AT III[6]. Based on these observations, we can maintain plasma AT III activity at more than 80% of normal by the administration of AT III concentrate. A marked decrease in AT III activity less than 60% of the normal was found in postoperative period. This postoperative decrease may be due in part to the consumption of AT III in achieving hemostasis at the surgical site during the healing process[7]. For this reason, we kept the plasma AT III activity between 100 and 130% in the operative period and between 80 and 100% in the postoperative period.

The daily infusion of AT III concentrate was effective in preventing postoperative thrombosis. AT III concentrate was administered for 2 weeks.

During anesthesia, we monitored the $P_{ET}CO_2$. Pulmonary embolism leads to a progressive reduction in lung perfusion due to the development of an increased physiological dead space. This increased dead space has the effect of diluting the expired carbon dioxide and result in a reduction of the $P_{ET}CO_2$[8]. If pulmonary embolism occurs, respiratory support with positive end-expiratory pressure and cardiovascular support is needed[8].

In summary, AT III concentrate was administered to a patient with congenital AT III deficiency undergoing orthopedic surgery. Thrombosis with pulmonary embolism did not occur during surgery or in the postoperative period. The plasma AT III activity was kept above 80% in the perioperative period and thromboembolism was thus prevented.

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