nation with some barbiturates may have even more dramatic effects on respiration and could be dangerous when prescribed to sedate patients who are not watched closely after administration of the drug.

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CLINICAL REPORTS


Emergency Coronary Artery Bypass Surgery Following Intracoronary Streptokinase

MARC GOLDBERG, M.D.,* PIETRO COLONNA-ROMANO, M.D.,† NOAH A. BABINS, M.D.‡

Acute myocardial infarction is associated with coronary artery (CA) thrombosis in 80–90% of patients.1–4 Thrombi can be lysed with intracoronary streptokinase, thus relieving angina, reverting ECG signs of ischemia, and improving left ventricular function.1,2,5 Clot lysis, or percutaneous transluminal coronary recanalization (PCTR) with streptokinase is most effective when performed within 4–6 h after onset of angina.1,6 Fixed atherosclerotic lesions predispose to CA thrombosis; following acute clot lysis, significant CA occlusion may remain. Combined PCTR and percutaneous transluminal coronary angioplasty (PCTA) has been attempted in several centers.1,4,5 Emergency coronary artery bypass grafting (CABG) following PCTA and intracoronary streptokinase may be necessary, but experience with such cases is limited. We describe one such case in which a severe coagulopathy resulted.

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tube never clotted during the entire case. Additional heparin, 15,000 units, was given to elevate the activated clotting time (ACT) to 636 s. Fifteen minutes after heparin administration, the ACT was 488 s and cardiopulmonary bypass (CPB) was begun. CABG of the RCA was performed; total bypass time was 48 min and crossclamp time was 12 min. During CPB, cimetidine 300 mg and diphenhydramine 50 mg was administered in anticipation of possible transfusion reaction, since we felt that unusually large amounts of blood products would be needed after CPB. CPB was discontinued without the assistance of vasoactive drugs, and protamine sulfate 200 mg was given iv over 10 min. The ACT decreased to 154 s, but after an additional 100 mg of protamine, the ACT remained at 164 s. The prothrombin time (PT) was 19.4 s, control 11.9 s, and the partial thromboplastin time (PTT) was 98.6 s, and control 32.4 s. The platelet count was 54,000 mm³, and no blood clotting was seen in the field. Table 2 correlates coagulation studies with perioperative events.

A right femoral artery repair controlled bleeding from the groin, but approximately 7,000 ml of blood was lost from the chest and leg over the next 4 h, while eight units of packed erythrocytes, five units of whole blood, 2,000 ml of washed and spun autotransfused blood, eight units of fresh frozen plasma, 16 units of platelets, and 30 units of cryoprecipitate were given. Epsilon amino-caproic acid 5 g was given iv over 20 min, followed by 1.0 g per hour for the next 5 h. The ACT remained at 160 s, but 16 h after streptokinase infusion (4 h after completion of CPB), sufficient hemostasis developed to allow chest closure. At the end of the procedure, the PT was 12.2 s (11.1 s control), the PTT 54.8 s (32.7 s control), and the platelet count was 60,000 mm³. The patient was hemodynamically stable while in the operating room and in the postoperative period. Two days after surgery, both aspirin and dipyridamole therapy was reinstituted, and she was discharged 8 days later.

DISCUSSION

Intracoronary administration of streptokinase is often (90%) successful in achieving luminal patency, relief of angina, increase in left ventricular ejection fraction, lower total CPK isoenzymes, and decreased mortality. Several centers have reported performing PCTA after PCTR. Meltzer et al. reported a case of successful PCTA after PCTR, and Meyer et al. reported a series of 21 patients with successful dilation in 81%. No complications occurred during PCTR-PCTA, but Meyer et al. anticipated the need for emergency surgery if acute coronary occlusion or dissection had occurred.

Sammil et al. described a patient who underwent CABG immediately after PCTR but failed to discuss the intraoperative course. Lolley et al. reported that, of five patients taken directly from PCTR to the operating room, only one had “excessive postoperative bleeding” requiring EACA and cryoprecipitate. Krebber et al. also reported early (within 8 h) CABG after PCTR but failed to note whether there were significant intraoperative problems with hemostasis.

Streptokinase is a proteolytic enzyme derived from streptococci. It acts by forming an activator complex with plasminogen, which produces plasmin, which then degrades fibrin thrombi and fibrinogen. The effective dose of streptokinase varies, depending on the patient’s preexisting levels of antistreptococcal antibodies.

**Figure 1.** Admission ECG showing severe inferior ischemia.

**Table 1.** Laboratory Values when Patient Arrived in the Operating Room

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>7.2 g %</td>
</tr>
<tr>
<td>Hematocrit</td>
<td>23%</td>
</tr>
<tr>
<td>Serum sodium</td>
<td>136 mEq/l</td>
</tr>
<tr>
<td>Serum potassium</td>
<td>2.6 mEq/l</td>
</tr>
<tr>
<td>PaO₂ (FiO₂ 1.0)</td>
<td>519 mmHg</td>
</tr>
<tr>
<td>PaCO₂</td>
<td>30 mmHg</td>
</tr>
<tr>
<td>pH</td>
<td>7.46</td>
</tr>
<tr>
<td>Bicarbonate</td>
<td>22 mmol/l</td>
</tr>
</tbody>
</table>
Reported dosages of intracoronary streptokinase range from 30,000–500,000 IU. The primary benefit of intracoronary versus iv streptokinase is to limit the systemic dose. Cowley et al. reported that systemic fibrinolytic activity (>70% reduction of fibrinogen) occurred in 22 of 25 patients given an average dose of 201,000 ± 74,000 (m ± SD) IU streptokinase.13 The mean fibrinogen level after infusion was 17% of the baseline value and after 24 h had returned to only 43% of baseline. PT increased from 11.5 ± 0.8 s preinfusion to 22.0 ± 7.8 s postinfusion, and PTT was >100 s after infusion. Fibrinogen degradation products increased to >40 μg/ml in all of the patients of Cowley et al. after infusion. Unfortunately, we did not have the opportunity to obtain a full coagulation profile before our patient’s surgery.

Prolongation of the activated PTT in patients given intracoronary streptokinase reflects the effect of systemic heparinization required to prevent recurrent thrombus formation. Elevation of the PT, though, reflects a major fibrinogen reduction.2,12 The only putative means of "reversal" of streptokinase action (i.e., for emergency surgery) is by replacing fibrinogen and plasminogen (cryoprecipitate), inhibiting fibrinolysis (epsilon amino caproic acid), and replacement of blood and platelets as needed. Although the dose of SK our patient received was unexceptional, she required large amounts of all of the above blood products to achieve hemostasis. Perhaps the aspirin and diprymidole our patient took contributed to the coagulopathy, but hemostatic defects caused by these drugs often are controlled with more conservative measures. Because of the reinstitution of aspirin and dipyrimidole 2 days after surgery, we were unable to obtain information about the patient’s “baseline” coagulation profile.

Reported hemorrhagic complications of intracoronary streptokinase therapy include spontaneous mediastinal bleeding,13 hemorrhagic myocardial infarction,14 cerebrovascular accident,12 retroperitoneal hematoma,3 hematemesis, and bleeding at iv and other catheter sites. These nonsurgical complications resolve spontaneously with time.

Nonhemorrhagic complications of intracoronary streptokinase include a 45–90% incidence of reperfusion dysrhythmias (VF, VT, bradycardias),6 congestive heart failure,6 hypotension,6 adult respiratory distress syndrome,15 hepatic dysfunction,16 and Guillain-Barré syndrome.17 The primary nonhemorrhagic risk our patient faces is transfusion-related hepatitis, as she was exposed to >100 different blood donors in a 24-h period.

In summary, a 33-year-old patient underwent successful PCTR and PCTA complicated by a coronary artery dissection requiring emergency CABG. Despite an unremarkable amount of intracoronary streptokinase, hemostasis was difficult to obtain after CPB. Perhaps delaying PCTA for 24–48 h after PCTR would have decreased the risk of subsequent coagulopathy.

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Pulmonary aspiration of gastric contents is responsible for 30–50% of maternal deaths caused by anesthesia. The factors that predispose to this complication during pregnancy include hormonal influences, which decrease gastric motility and reduce lower esophageal sphincter (LES) tone, and mechanical changes, which increase intragastric pressure and distort gastric anatomy. As a result, the stomach may not be empty many hours after cessation of oral intake, and regurgitation and aspiration occur more frequently in pregnant than in nonpregnant patients. The severity of pulmonary damage following aspiration of gastric contents is related to the volume and acidity of the aspirate. A volume of 25 ml and a pH of 2.5 are said to be hazardous, although these values have not been validated in humans. Food or other particles in the lungs further increases the severity of both the short-term and long-term physiologic and morphologic abnormalities.

To decrease the consequences of aspiration, antacids and, more recently, H₂ receptor antagonists such as cimetidine, have been used to increase the pH of gastric contents. However, neither therapy decreases the risk posed by significant volumes of gastric contents already present in the stomach. In that respect, metoclopramide, an antiemetic agent that accelerates gastric emptying and increases LES tone, is of potential benefit to the parturient with a full stomach who requires general anesthesia. In a previous study of surgical outpatients in early pregnancy, metoclopramide, 10 mg, iv, administered shortly before anesthesia significantly decreased the volume of gastric contents. The present study was designed to ascertain the efficacy and safety of similar therapy in term parturients scheduled for elective cesarean section.

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