

Effect of unfractionated heparin during pediatric cardiac catheterization

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Introduction: Unfractionated heparin (UFH) reduces thrombotic risk related to catheterization but the effects of UFH on the coagulation system in children, especially on thrombin generation, and the proper monitoring of UFH remain unclear. The purpose of our study was to assess the strength of thrombin formation and to determine the effects of UFH in pediatric patients during cardiac catheterization. We also wished to assess the extent of heparinization using a new method, prothrombinase-induced clotting time (PiCT).

Methods: We studied 42 patients (aged 3-12 years) undergoing cardiac catheterization. Twenty-seven patients undergoing percutaneous closure of atrial septal defect or patent ductus arteriosus received a UFH bolus of 100 IU/kg (group A), and 15 patients undergoing venous catheterization did not receive UFH (group B) during the procedure. Thrombin formation was assessed by measuring plasma prothrombin fragment F1+2, thrombin-antithrombin complexes (TAT), and D-dimer. UFH was monitored by activated partial thromboplastin time (APTT), anti-FXa, and PiCT.

Results: Markers for thrombin generation remained low during catheterization in group A. In group B, both F1+2 and TAT increased significantly ($p < 0.05$) by the end of the procedure when compared with the respective preoperative levels or with the respective levels in group A. D-dimer levels remained low in both groups. In both groups, F1+2, TAT and D-dimer increased by the first postoperative day as compared to the respective baseline levels. In group A, 15 minutes after heparinization, APTT was over 180 s, anti-FXa in median 1.5 U/ml (range, 1.1-2.4 U/ml), and PiCT in median 1.6 U/ml (range, 1.3-2.4 U/ml), and there was a correlation between anti-FXa and PiCT ($R = 0.84$, $p < 0.0001$). No thrombotic or bleeding complications were observed in either group.

Conclusions: Thrombin generation was enhanced in patients who did not receive UFH, which may increase the risk for thrombotic complications. In patients who received UFH, routine heparinization seemed excessive by all monitoring methods, greatly exceeding recommended therapeutic levels of heparinization. PiCT seems to be a viable method of monitoring heparinization in pediatric patients. Further studies are needed to clarify the adequate heparin dosing for children during cardiac catheterization to prevent thrombotic complications without predisposing the patient to bleeding complications.