Heparins from Bovine and Porcine Mucosas: Are They a Similar Drug?

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Heparin is an animal sulfated glycosaminoglycan that has been used for more than 50 years as an anticoagulant and antithrombotic drug. Commercial manufacture of heparin relies on either porcine intestinal mucosa or bovine lungs tissue. The advent of bovine spongiform encephalopathy has limited the use of bovine heparin in Europe, United States and others. In Brazil, bovine heparin preparations are still in use. Surprisingly, the bovine heparin preparations present in the Brazilian market are not extracted from lung tissue, but from intestinal mucosa. Recently, higher hates of reoperations due to bleeding and postoperative blood dyscrasia after the administration of heparin has been observed in the Brazilian health system. The presence of new heparin preparations, and the recent increase of heparin related surgery complications, raises intriguing questions concerning the anticoagulant activity of bovine heparin. To elucidate this subject we conducted a comparative analysis of heparins extracted from bovine and porcine intestinal mucosa. Both heparin preparations were submitted to structural analyses by nuclear magnetic resonance (NMR) and anticoagulant activity analyses by activated partial thromboplastin time (APTT), anti-Xa and anti-IIa assays. NMR analyses indicated an important structural difference between both heparins: the partial absence of O-sulfation at position 6 of the glucosamine residue in bovine heparin. Differences at anticoagulant activity were also observed. Compared to porcine, bovine heparin showed only 45% anticoagulant activity in the APTT assay. Purified anticoagulant enzymes assays using bovine heparin showed even lower anticoagulant activity: only 20% and 15% activity in anti-IIa and anti-Xa assay, respectively. Therefore, our results evidenced important structural and anticoagulant differences between heparins extracted from bovine and porcine intestinal mucosa.