

Title: Perioperative Management of Severe Pulmonary Hypertension with Inhaled Nitric Oxide and Oral Sildenafil (ViagraTM) During Orthotopic Liver Transplantation. Case Presentation.

Authors: Angel Jose deLeon Vaca, M.D.†, Earl M. Strum, M.D.†, Janos Szenohradzki, M.D. Ph.D.†, Linda Sher, M.D.‡, Robert Selby, M.D.‡

Affiliation: *Departments of Anesthesiology† and Surgery‡, Keck School of Medicine, University of Southern California, Los Angeles, CA 90033*

Introduction: Pulmonary hypertension (PHT) is a life-threatening disease leading to right heart failure. It often occurs along with cirrhosis (hepatopulmonary syndrome), which often necessitates liver transplantation. The combination of inhaled nitric oxide (iNO) and oral sildenafil, a phosphodiesterase-5 inhibitor, has been used recently (2000-2005) to treat severe PHT.^{1,2} We diagnosed severe PHT during anesthesia induction after pulmonary artery catheter insertion on a patient scheduled for orthotopic liver transplantation for cirrhosis. After urgent consultation among the cardiologist, anesthesiologist, and surgeon, a decision was made to proceed with the surgery.

In this case presentation, we describe the perioperative management of severe PHT.

Case presentation: A 36-year old Caucasian male with hepatitis C cirrhosis, which apparently was obtained from blood transfusion, end-stage liver disease, and hepatopulmonary syndrome, was admitted for liver transplantation on May 27, 2005 to the University Hospital, Keck School of Medicine at the University of Southern California, Los Angeles. Past medical history: hepatitis C cirrhosis, type II diabetes mellitus, Crohn's disease, and distal colostomy that was followed by reversal. The patient was diagnosed with pulmonary hypertension and had been treated preoperatively with 100 mg sildenafil tid for approximately one year. The physical examination included jaundice, 2+ ascites, and spider angiomas on the chest and abdomen. The patient's systemic arterial blood pressure ranged between 90/45 and 100/50 mmHg. Induction of general anesthesia was with oxygen, etomidate, fentanyl, ketamine, succinylcholine and cisatracurium. Maintenance was with oxygen, air, isoflurane, versed, fentanyl, sufentanyl, cisatracurium and nitric oxide. Immediately after the placement of the pulmonary artery catheter, the pulmonary artery pressure was 93/36(50) mmHg. Since severe PHT presents an extremely high mortality risk, an emergency consultation among anesthesiology, cardiology, and surgery was called. The surgical team then consulted with the patient's family, who asked that they proceed with the surgery. The decision was made to proceed with the case. The transesophageal echocardiography showed mild tricuspid regurgitation and good right ventricle ejection fraction with contraction. His right ventricle wall motion was good. To lower the high pulmonary artery pressure, inhaled nitric oxide (iNO) was added to the inhalation agent 90 min after the induction of anesthesia and was continued until the end of surgery. 150 min after the induction of anesthesia 100 mg sildenafil was administered sublingually. Pulmonary artery pressure decreased and was stable throughout the remainder of surgery. The average value was 86/34(46) mmHg. The patient had supraventricular tachycardia intermittently throughout the surgery, which improved after IV lidocaine, amiodarone and magnesium administration. Postoperatively, the patient was digitalized and received lasix. The pulmonary and systemic blood

pressure remained stable. In the early postoperative period the patient continued to receive oral sildenafil 100 mg tid.

Conclusion: According to recent publications, the combined intraoperative administration of inhaled nitric oxide and oral sildenafil may make it possible to proceed with liver transplantation that is complicated by severe pulmonary hypertension. We have shown in this case report that the continuous inhalation of nitric oxide significantly decreased the very high pulmonary artery systolic pressure during the orthotopic liver transplantation. The hemodynamic variables were stable throughout the surgery. We cannot demonstrate, however, that there was an additional beneficial effect of the sildenafil given one hour after the start of inhaled nitric oxide administration. It is not known how the chronic preoperative sildenafil treatment influences the effect of intraoperatively administered sildenafil on pulmonary hypertension.

References:

1. HA Ghofrani, R Wiedemann, F Rose, H Olschewski, RT Schermuly, N Weismann, W Seeger, and F Grimminger: Combination Therapy with Oral Sildenafil and Inhaled Iloprost for Severe Pulmonary Hypertension. *Annals of Internal Medicine* 136: 515-522, 2002.
2. E Michelakis, W Tymchak, D Lien, L Webster, K Hashimoto, S Archer: Oral Sildenafil Is an Effective and Specific Pulmonary Vasodilator in Patients With Pulmonary Arterial Hypertension. Comparison with Inhaled Nitric Oxide. *Circulation*. 105:2395-2400, 2002.