

Claims

1. A pulmonary vascular tone maintaining composition to maintain pulmonary vascular tone in a patient undergoing cardio-pulmonary bypass surgery for a cardiac defect comprising:
 - (a) an effective amount of a citrulline bolus formulated to be administered to the patient at the initiation of the surgery;
 - (b) an effective amount of citrulline added to the hemoconcentration replacement fluid used during cardiopulmonary bypass formulated to be administered to the patient during the surgery;
 - (c) a post-surgery citrulline bolus of about 10-30 mg/kg formulated to be administered about 15-45 minutes after decannulation from cardiopulmonary bypass; and
 - (d) an effective amount of citrulline formulated to be infused into the patient after the surgery,wherein the patient's plasma citrulline level is raised above 100 $\mu\text{mol/L}$.
2. The composition of claim 1, wherein the cardiac defect is selected from the group consisting of a cardiac defect associated with excess pulmonary blood flow, an atrial septal defect, ventricular septal defect, and single ventricle lesion.
3. The composition of claim 1 or 2, wherein the surgery is selected from the group consisting of arterial switch procedure and Glenn and Fontan procedures.
4. The composition of any one of claims 1-3, wherein the bolus of citrulline is 100-300 mg/kg of citrulline.
5. The composition of any one of claims 1-4, wherein 100-300 $\mu\text{mol/L}$ citrulline is added to the hemoconcentration replacement fluid used during cardiopulmonary bypass.
6. The composition of anyone of claims 1-5, wherein the effective amount of citrulline formulated to be infused into the patient after the surgery is 5-15 mg/kg/hour of citrulline.

7. The composition of any one of claims 1-6, wherein the effective amount of citrulline is sufficient to raise a patient's plasma citrulline level above 100 $\mu\text{mol/L}$.
8. The composition of any one of claims 1-7, wherein the effective amount of citrulline is insufficient to raise the patient's plasma citrulline level for up to 48 hours postoperatively.
9. The composition of any one of claims 1-8, wherein the patient is less than about 6 years old.
10. The composition of any one of claims 1-8, wherein the patient is less than about 10 days old.
11. The composition of any one of claims 1-8, wherein the patient is at risk for persistent pulmonary hypertension of the newborn (PPHN).
12. The composition of any one of claims 1-11, wherein the period between the initiation of surgery and the administration of the post-surgery bolus is 4 hours or less.
13. The composition of any one of claims 1-11, wherein the citrulline infusion is started within 5-10 minutes of the post-surgery citrulline bolus.
14. The composition of any one of claims 1-11, wherein the composition further comprises a citrulline bolus formulated to be administered prior to the surgery.
15. The composition of any one of claims 1-11, wherein the patient achieves a sustained citrulline level of 100 $\mu\text{mol/L}$ or above for up to 48 hours starting with the administration about 100-300 mg/kg citrulline to the patient at the initiation of the surgery.