

Intravenous anesthesia with nitroglycerin inhalation for surgical abortion in a patient with severe congenital heart disease and low oxygen saturation

A case report

Zhengfeng Gu, MD, Lian Xin, MD*, Zhiping Wang, MD, Jun Wang, MD

Abstract

Introduction: Congenital heart disease and pulmonary arterial hypertension are perilous to a gravida for the high morbidity and mortality.

Case presentation: We report an extremely rare case of a 27-year-old gravida with congenital heart disease and severe pulmonary arterial hypertension of 115 mmHg. Arterial blood gas analysis revealed her oxygen saturation (SpO₂) of 67.8% and oxygen partial pressure of 40.0 mmHg, which were severely low. The patient was diagnosed as having gestation combined with congenital heart disease, severe pulmonary arterial hypertension, and hypoxemia.

Interventions: The patient was treated with surgical abortion. The patient was monitored with invasive blood pressure (BP), electrocardiogram (ECG), heart rate, SpO₂, and arterial gas analysis as from entry into the operation suite. We performed total intravenous anesthesia with nitroglycerin inhalation. She was returned to the ward at the end of surgery.

Conclusion: To our knowledge, this is the first reported case in a gravida with severe heart disease and very low SpO₂. Nitroglycerin inhalation may provide dilation of the pulmonary artery, reduction of pulmonary artery pressure, and improvement of oxygenation. Our case report may provide alternative regimen to anesthesia practitioners in similar circumstances.

Abbreviations: BP = blood pressure, ECG = electrocardiogram, HR = heart rate, INN = inhalation of nebulized nitroglycerin, PaO₂ = oxygen partial pressure, SpO₂ = oxygen saturation.

Keywords: congenital heart disease, inhalation of nebulized nitroglycerin, low oxygen saturation, pulmonary arterial hypertension, surgical abortion

1. Introduction

We report a case of a 27-year-old gravida with 60-day gestation of Chinese nationality, who was comorbid with congenital heart disease and pulmonary arterial hypertension and was scheduled for surgical abortion. Gestation in combination with severe pulmonary hypertension is a rare condition, with a high morbidity and mortality in gravidae.^[1] This patient suffered severe congenital heart disease, pulmonary arterial hypertension, and hypoxemia with oxygen saturation (SpO₂) of 74%. Despite the report on successful application of inhalation of nebulized nitroglycerin (INN) in child with congenital heart disease to

decrease pulmonary arterial hypertension,^[2] a patient with such low SpO₂ as 74% is rare. With respect to such rare clinical cases, there is a paucity of accurate and detailed reference available nevertheless. To date, no similar case reports have been available for reference of anesthesia with both severe pulmonary hypertension and SpO₂ of 74%.^[3]

2. Case report

Written informed consent for publication was obtained from the patient. This study was approved by the Ethics Committee of Wuxi People's Hospital with handling NO. 2017KYSL-01.

A woman, 27 years old, 41 kg and 160 cm in height, was scheduled for surgical abortion with suction evacuation due to ineligibility for pregnancy. She was diagnosed as having early pregnancy, congenital heart disease, dysplasia of the right atrium, tricuspid stenosis, and severe pulmonary arterial hypertension. The echocardiography revealed tricuspid stenosis and mild regurgitation coupled with dysplasia of the right atrium, enlargement in both atria and ventricles, and severe pulmonary arterial hypertension of 115 mmHg. Routine blood tests revealed high hemoglobin and red blood cell counts (Table 1), and biochemical results were approximately normal (Table 2). Unfortunately, the arterial blood gas analysis showed SpO₂ of 67.8% and oxygen partial pressure (PaO₂) of 40.0 mmHg, which were severely low (Table 3). She was evaluated as at high risk by

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Department of Anesthesiology, People's Hospital of Wuxi, Jiangsu, China.

* Correspondence: Lian Xin, Department of Anesthesiology, People's Hospital of Wuxi, Jiangsu, China (e-mail: tomytomytomy123@sohu.com).

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Table 1

Preoperative routine blood examination.

Items	Results	Reference values
RBC	7.17	3.5–5.5 × 10 ¹² /L
HCT	0.68	0.30–0.46
HGB	223	105–160 g/L
WBC	4.4	4–10 × 10 ⁹ /L
PLT	100	80–300 × 10 ⁹ /L
PCT	9.4	6–11.5 fl
LY	0.155	0.2–0.4
NEU	0.756	0.50–0.75

HCT=hematocrit, HGB=hemoglobin concentration, LY=lymphocytes, NEU=neutrophils, PCT=plateletcrit, PLT=platelet count, RBC=red blood cells, WBC=white blood cells.

Table 2

Preoperative blood biochemical examination.

Items	Results	Reference values
K ⁺	4.14	3.5–5.5 mmol/L
Na ⁺	134.8	135–145 mmol/L
Cl ⁻	99.5	96–108 mmol/L
Ca ²⁺	2.45	2.0–2.8 mmol/L
TP	82.4	55–80 g/L
ALB	41.7	35–53 g/L
GLO	40.7	17.0–33.5 g/L
TBILI	27.7	3–25 μmol/l
GOT	13	0–64 U/L
GPT	15	0–42 U/L
AKP	99	32–121 U/L
LDH	255	109–245 U/L
Urea	7.0	2.5–7.1 mmol/L
GLU	4.19	3.9–6.1 mmol/L
Crea	55.8	53–135 μmol/L

AKP=alkaline phosphatase, ALB=albumin, Ca²⁺=calcium, Cl⁻=chloridion, Crea=creatinine, GLO=globulin, GLU=glucose, GOT=glutamic oxaloacetic transaminase, GPT=glutamic-pyruvic transaminase, K⁺=potassium, LDH=lactic dehydrogenase, Na⁺=sodium, TBILI=total bilirubin, TP=total protein, Urea=urea nitrogen.

cardiologist and anesthesiologist, and emergency was prepared before anesthesia. Total intravenous anesthesia was performed to obviate the potential risk to the myocardium by the pain from surgical abortion.

As from her entry into the operation theater, the patient could not take supine but semirecumbent position. She presented with

Table 3

Preoperative blood gas analysis.

Items	Results	Reference values
pH	7.29	7.35–7.45
PaO ₂	40.0	80–100 mm Hg
PaCO ₂	44.3	35–45 mm Hg
SpO ₂	67.8	95%–98%
HCO ₃ ⁻	20.3	22–27 mmol/L
HCO ₃ ⁻ std	18.3	22–27 mmol/L
BE	-6.7	-3–3 mmol/L
SBE	-5.3	-3–3 mmol/L
TCO ₂	48.5	50%–68%
T°C	36.2	36.5°C –37.5°C
FIO ₂	21.0	%

BE=base excess, FIO₂=inhale oxygen flow, HCO₃⁻=bicarbonate ion, HCO₃⁻ std:standard bicarbonate ion, PaCO₂=partial pressure of carbon dioxide, PaO₂=oxygen partial pressure, pH=potential of hydrogen, SBE=standard base excess, SpO₂=oxygen saturation, T°C=temperature (degrees Celsius), TCO₂=total carbon dioxide.

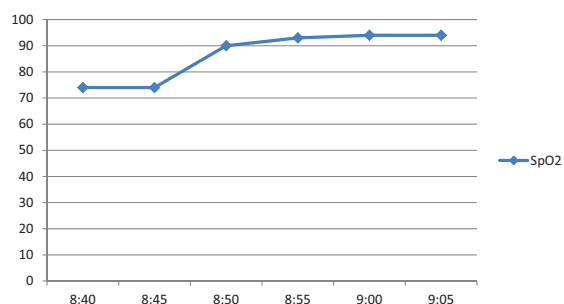


Figure 1. SpO₂ in anesthesia. Time points of anesthesia on the horizontal axis and percentages of SpO₂ on the vertical axis. SpO₂=oxygen saturation.

dyspnea, with cyanosis in the lips and more severe cyanosis with anthracoid appearance in the hands. Emergency was available with equipment and medication as well as intravenous access for liquid infusion and medicine administration. BP, ECG, heart rate (HR), and pulse oximetry were monitored: BP of 120/80 mmHg, HR of 80 bpm and SpO₂ of 74%. Oxygenation was provided through nasal oxygen catheter at the flow rate of 3 L/min. Radial artery was catheterized for continuous monitor of BP and blood gas analysis, indicating a PaO₂ of 45 mmHg.

Nebulized nitroglycerin was inhaled with 1 mg nitroglycerin diluted into 10 mL through a mask connected to an oxygen-driven and disposable inhaler with the oxygen flow of 6 L/min,^[4] lasting approximately 6 minutes. The SpO₂ increased gradually from 74% to 94% 10 minutes thereafter (Fig. 1). Oxygen inhalation was maintained at the flow of 3 L/min. Fentanyl citrate (50 μg) was slowly infused, followed by propofol injection of 50 mg 2 minutes later according to the invasive BP. The operation, which lasted for only 3 minutes, was successfully performed. The SpO₂ was maintained >90% with a peak of 94% throughout the operation. Metaraminol (200 μg) was injected once due to onset of BP decline to 95/65 mmHg. Throughout the anesthesia, the HR was smooth and steady in the patient (Fig. 2), who awoke 4 minutes postoperatively without discomfort or pain, and was capable of clear and cheerful communication. She had 80% of SpO₂ and was discharged with advice for further cardiac therapy 4 days thereafter.

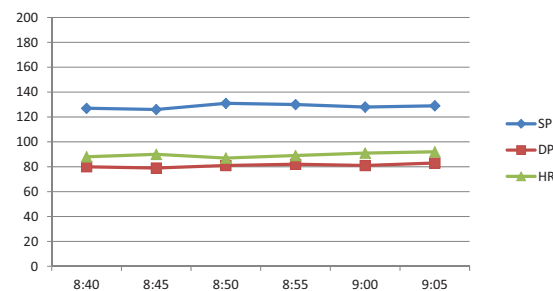


Figure 2. BP and HR in anesthesia. Time points of anesthesia on the horizontal axis and parameters of SP, DP, and HR on the vertical axis. BP=blood pressure; DP=diastolic pressure, HR=heart rate, SP=systolic pressure.

3. Discussion

Gestation accompanied with congenital heart disease is highly risky. Despite the advancement in medical, obstetric, anesthetic, and intensive care, mortality remains disappointingly high. In this case, the gravida was advised by her obstetricians to terminate pregnancy due to her severe cardiopulmonary insufficiency with 74% of SpO₂. Her congestive heart failure rendered her incapable of supine position, and we adopted semirecumbent position to reduce the blood regurgitation from the low part of her body to her right heart. This kind of treatment may simultaneously alleviate both the preload of her right heart and her pulmonary artery pressure with high efficacy. She presented with severe hypoxemia with PaO₂ of 40 mmHg and pulmonary artery hypertension with 115 mmHg accompanied with heart failure. Central respiratory drive could not be inhibited in the case of the PaO₂ >30 mmHg. Moreover, respiratory stimulant would also be invalid to heart failure. It would burden the respiratory muscles and increase oxygen consumption. Inhalation of oxygen at high flow is preferred in that it does not inhibit the respiratory drive with partial pressure of carbon dioxide (PaCO₂) of 44.3 mmHg. Conventional inhalation of nitric oxide may decrease mean pulmonary artery pressure and pulmonary vessel resistance and increase PaO₂/inhale oxygen flow in hypoxemic patients.^[5] Nonetheless, INN may well attenuate pulmonary hypertension and ameliorate oxygenation with good efficacy and reduce postoperative complications.^[6] In addition to its benefit in marked attenuation of pulmonary artery pressure without an impact on systolic pressure, INN can also contribute to the mitigated muscularization of small pulmonary arteries.^[7] With INN, no fluctuations of BP were observed from the monitor of invasive BP throughout the inhalation. Moreover, fentanyl is routinely indicated for analgesia in abortion clinically.^[8] Fentanyl (50 µg) may provide good analgesia with rapidity and efficacy as well as short duration in the theater. Sufentanil may also be clinically applicable to analgesia. Propofol is more preferable in surgical abortion for its short duration. We administered 50 mg propofol to avoid overdose-induced respiratory and cardiac depression.

In summary, we employed INN in a surgical abortion in a gravida with congenital heart disease and severe pulmonary arterial hypertension, with pulmonary artery pressure and afterload significantly reduced and right ventricular and SpO₂ improved.

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Author contributions

Supervision: Zhiping Wang, Jun Wang.

Writing – original draft: Lian Xin.

Writing – review and editing: Zhengfeng Gu.

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