

# Perioperative Problems in Infants Having Pulmonary Hypertension Following Ketamine General Anesthesia

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## ABSTRACT

**Aim:** In adolescents, pulmonary arterial hypertension (PAH) is linked through the substantial postoperative danger of serious problems such as pulmonary severe illness and heart attack. The efficacy of ketamine anesthesia inside this patient group is still unknown. Examine the health information about children having PAH in the past to identify the kind and occurrence of peri-procedural issues, as well as whether ketamine medication been connected to peri-procedural difficulties.

**Methods:** Adolescents having PAH who had general anesthesia for operations throughout the one-year interval (May 2020–April 2021) were eligible to participate. Specifics concerning the patient, PAH, surgery, anesthesia, and post-procedural course were recorded, as well as any untoward events that occurred while or inside 48 hours of the operation. Complication rates were reported separately for each surgery. The relationship among ketamine and peri-procedural problems has been investigated.

**Results:** Seventy-five children (median age 8.4 years, average weight 23 kg) had 193 surgeries performed on them. PAH intensity has been classified as mild (26%), medium (37%), or severe (37%). (41 percent). Medical intervention (n = 21), moderate surgery (n = 28), cardiac catheterization (n = 129), and nonsurgical treatments (n = 18) have been performed. During 152 surgeries, ketamine has been given. Thirty mild problems and nine significant problems reported identified. Cardiac arrest occurred in 0.79 percent of cardiac catheterization operations, 11 percent of significant medical procedures, and 2.7 percent of all processes. There has been no death as a result of the surgery. Ketamine administration was not linked to increases in problems.

**Conclusion:** Ketamine looks to be a safe anesthetic alternative for patients. people suffering from PAH We present data on cardiopulmonary resuscitation rates and significant death rates that are higher than that found.

**Keywords:** Pulmonary Arterial Hypertension, Infants, Hypertension, Cardiac Arrest.

## INTRODUCTION

Pulmonary arterial hypertension remains much characterized as a mean pulmonary arterial BP more than 26 mmHg at rest or 32 mmHg after workout, accompanied by different grades of pulmonary vascular remodeling, vasoconstriction, in addition then in situ thrombosis [1]. Adolescents experiencing PAH often had a greater need for medical resources also can necessitate rise to a variety of anesthetic for PAH diagnostic and treatment operations [2]. The etiology of PAH and the anesthetic concerns for kids and adults have been discussed. PAH is a factor in perioperative cause of death and disability. While ketamine was used effectively in the anesthetic treatment of PAH patients, its usage remains contentious since this was linked to greater PAP in older cases. Several researches on result of ketamine on pulmonary artery pressure in adolescents having PAH have shown contradictory outcomes. Authors previously studied ketamine hemodynamic reactions in adolescents having PAH and discovered that ketamine in attendance of sevoflurane did not raise resistance to blood flow [3]. Ketamine's impacts on PVR, either as solo agent or in combination with anesthetic drugs other than sevoflurane, also weren't studied. Resultantly it is not yet clear that if ketamine alone, without accompanying sevoflurane, is a suitable anesthetic choice for adolescents having PAH [4]. To resolve this uncertainty, researchers undertook the 6-year retrospective assessment of adolescents having PAH that had analytical also therapeutic operations in order to determine type also incidence of peri-procedural problems. Researchers expected that ketamine use through anesthesia remained not linked to peri-procedural problems [5].

## METHODOLOGY

This retrospectively cohort of adolescents having PAH which received general anesthesia for the surgery between May 2020 and April 2021 received Review Board clearance with both a waiver of explicit consent. Potential study subjects have been found by examining the Heart Center database for treatment of

pulmonary hypertension which had general anesthetic for cardiac catheterization. The medical archives among those individuals remained again checked to see if the study's eligibility requirements remained satisfied. The following requirements had been used to determine inclusion: (i) the PAP of 26 mmHg and the computed PVR (archived) of 4 Wood units; (ii) altogether respondents undergoing pulmonary vasodilator treatment for PAH (Analysis verified by cardiac catheterization); and (iii) at the age of 17 years.

The following remained the exclusion criteria for the present research was: (i) Pulmonary artery pressure rise due to main or proximal branch pulmonary artery blockages (ii) analysis of tetralogy of Fallot, respiratory atresia are also significant aortopulmonary promotional materials. Those operations done under over-all anesthesia throughout research phases remained identified by reviewing the medical records of patient populations. Participant demographics, preprocedural diagnosis, operation done, anesthetic management, catheterization results, production due course till hospital release, and any negative things that occurred after or inside 48 hours after the surgery have all been documented. The length of follow-up and death rates have also been documented. Morbidities definitions remained line with the past findings. A temporary shift in measured readings was noted, which had little influence on the person's health and needed minimum or no therapy. A mild difficulty remained indeed very brief occurrence that had no long-term negative impact on case and it was treated through particular therapy. The possible life incident need prompt care was a significant consequence. In the bivariate analysis, contributing factors increased difficulty were investigated that used a progressive selection technique, including entrance of variable star into model set at P £ 0.06 and removal set at P £ 0.11. Odds ratio (OR) through 96 percent CI remained obtained. The statistical analysis of the present study was performed by using SPSS version 24.0 software. Some children from the present study received more than one treatment, morbidity rates remained provided by procedure rather than per individual. Overall research

individuals' problems were evaluated. The nonsurgical treatments grouping was then assessed individually.

**RESULTS**

196 operations were performed on 75 youngsters (39 boys and 36 girls) over the research period. The participant's median (range) age was 8.4 years (15 days–19.5 years) and weight were 24 kg (3.5–107 kg). Congenital heart problems were found in 45 (62.9%) of the individuals, and 13 infants became identified having genetic diseases (trisomy 23: n = 8, trisomy 19: n = 1, Stickler disorder: n = 1, William's disorder: n = 1, various dysmorphic characteristics of nonspecific sequence: n = 1). Table 1 describes the clinical forms of pulmonary hypertension. Since some individuals had numerous variables related to PAH, the categorization is arbitrary. Table 2 and Figure 1 show chosen facts concerning the operations, the individuals' paranesthesia condition, and the anesthetic modalities used. Previous to their treatment, 19 (10.7%) individuals had very endotracheal tube or tracheostomy tube in place, 16 (8.4%) had an arterial surveillance catheter, 23 (12.8%) had a nasogastric tube, and 7 (4.2%) were all on intravenous occlusive support. Pediatric cardiac anesthetists [186 (95 percent)], pediatric general anesthesiologists [8 (4 percent)], and pediatric heart intensivists [4 (2 percent)] provided anesthesia treatment for the operations. For 164 (82 percent) of the operations, anesthetic training (residents or associate) was available. Ketamine (53.2 percent), sevoflurane (49.8 percent), propofol (12.8 percent), and procedural sedation (4.8 percent) were the drugs used to induce anesthesia (Data given as percentage of total procedures). Ketamine (67.8 percent), propofol (64 percent), pentobarbital (31.2 percent), isoflurane (19.3 percent), and isoflurane were the most often used anesthetic drugs for upkeep (16.2 percent). The majority of individuals receiving ketamine every year was about 50 lb during the first two years and climbed to around 120 lb it during final three years of the research period. Neuromuscular blocker medications were used in 59 (28.8 percent) of the surgeries, while analgesics were used in 72 (39 percent). Many patients' airways [123 (64.6 percent)] were treated by using nasal cannula oxygen or a facemask. In 63 (32.8 percent) of the instances, an endotracheal tube was utilized, a laryngeal mask is being used in 4 (2.1 percent), and a tracheostomy tube was still in place in 3 (1.6 percent). Throughout 29 (15.7 percent) of the surgeries, intravenous inotropes have been given as a bolus or as an infuse. In four (2%) cases, anesthesia records were missing.

Table 1:

Category	N= 82	Percentage
PAH	14	18.7
Collagen vascular	3	3.4
rheumatoid arthritis	34	48.2
Congenital Hypertension	3	3.5
Kidney Illness	9	12.9
pulmonary hypertension	4	5.5
Chronic obstructive illness	2	2.8
Sleep-disorder	7	9.9
hernia	4	5.5
Thromboembolic	2	2.8

Table 2:

	N= 569
Other procedures	18 (9.7%)
Cardiac catheterization	129 (67.8%)
Major	22 (12.4%)
Minor	29 (15.2%)
Severe	78 (41.2%)
Mild	47 (24.5%)
Moderate	72 (37.6%)
In-patient	59 (31.4%)
Heart failure therapy	59 (31.4%)
ASA	115 (59.8%)

**DISCUSSION**

The following are the novel results of the current retrospective analysis of adolescents having PAH which had anesthesia for

patient care: (i) Ketamine administration remains not correlated having greater problems, whether prescribed as only anesthetic monotherapy or in combination to propofol or volatile anesthesia; (ii) rates of cardiopulmonary resuscitation also death remained inferior than formerly described for young kids to PAH; (iii) peri-process health conditions would include major surgery [6], airway measuring instruments, and opioid administration; and (iv) exposed to air was not correlated with greater health problems throughout nonsurgical processes. In adult people treated cardiac and noncardiac operations, PAH remained the predictor of perioperative mortality [7, 8, 9]. PAH was associated with a greater likelihood of intraoperative mortality in the retrospective appraisal of pediatric in addition adult individuals having congenital heart disease having non-cardiac surgery. Conversely, in babies and toddlers having open-heart surgery, pretreatment PAH was very substantial risk factor for postoperative in-hospital mortality. They evaluated 75 adolescents with PAH who had anesthesia also cardiac catheterization in addition discovered a 6.9 percent risk of sudden cardiac massage and a 2.5 percent death rate [11, 12]. One researcher examined 256 cardiac catheterization and non-cardiac cosmetic surgeries in adolescents with PAH and discovered a 3.2 percent incidence of cardiac arrest and a 1.5 percent fatality rate for catheter - based. Children in danger of PAH had a preoperative 1-month death rate of 9.6 percent following heart surgery, while 8.2 percent of our research participants needed cardiopulmonary resuscitation following open-heart surgery and none died. Multiple impacts at altogether stages of the surgery, after and during it. For individuals in this high-risk category, heightened care is required during the peri-procedural period [13, 14, 15]. It has been observed that initial supersystem PAH is a substantial predictor of serious problems. Our data showed that pulmonary vasodilator medication reduced risk, which might explain why researchers observed no link among problems also cruelty of PAH. Airway instrumentation was just been linked to reality or fatal increases in pulmonary artery volumes, and researchers discovered that intubating predicted problems [16].

**CONCLUSION**

Individuals who were given ketamine throughout nonsurgical treatments had a lower chance of having their airways outfitted. Previously, we demonstrated that ketamine preserved PaO2 while having no effect on cardiac index, average systemic arterial pressure, arterial in individuals breathing voluntarily through their native airway. Thoracic energy seems to be substantially conserved. Whereas this anesthetic method proved safe and maybe beneficial in terms of airway modification and PAH, researchers advise getting extra precautions to avoid hypoxia and hypercapnia, even though these situations enhance PVR. Ketamine's opioid-sparing action was expected due to the drug's analgesia characteristics.

**REFERENCES**

1. Diaz-Rodriguez N, Nyhan SM, Kolb TM, et al. How we would treat our own pulmonary hypertension if we needed to undergo cardiac surgery [e-pub ahead of print]. *J Cardiothorac Vasc Anesth.* <https://doi.org/10.1053/j.jvca.2021.09.030>. Accessed Month DD, YYYY.
2. Inhaled nitric oxide in cardiac surgery: Evidence or tradition?. *Nitric Oxide.* 2015; 49: 67-79
3. Barnes H, Yeoh HL, Fothergill T et al. Prostacyclin for pulmonary arterial hypertension. *Cochrane Database Syst Rev.* 2019; 5CD012785
4. Olschewski H, Rohde B, Behr J et al. Pharmacodynamics and pharmacokinetics of inhaled iloprost, aerosolized by three different devices, in severe pulmonary hypertension. *Chest.* 2021; 124: 1294-1304
5. Gessler T, Ghofrani HA, Held M et al. The safety and pharmacokinetics of rapid iloprost aerosol delivery via the BREELIB nebulizer in pulmonary arterial hypertension. *Pulm Circ.* 2019; 7: 505-513
6. Winterhalter M, Rex S, Stoppe C et al. Effect of iloprost inhalation on postoperative outcome in high-risk cardiac surgical patients: A

- prospective randomized-controlled multicentre trial (ILOCARD). *Can J Anaesth.* 2019; 66: 907-920.
7. Simonneau, G., Galie, N., Rubin, L. J., Langleben, D., Seeger, W., Domenighetti, G., ... & Fishman, A. (2004). Clinical classification of pulmonary hypertension. *Journal of the American College of Cardiology*, 43(12S), S5-S12.
  8. Gaine, S. (2000). Pulmonary hypertension. *Jama*, 284(24), 3160-3168.
  9. Rich, S. (2001). Pulmonary hypertension. In *Cardiology for the primary care Physician* (pp. 313-318). Current Medicine Group.
  10. Rich, S. (2001). Pulmonary hypertension. In *Cardiology for the primary care Physician* (pp. 313-318). Current Medicine Group.
  11. Hoeper, M. M., Ghofrani, H. A., Grünig, E., Klose, H., Olschewski, H., & Rosenkranz, S. (2017). Pulmonary hypertension. *Deutsches Ärzteblatt International*, 114(5), 73.
  12. Waxman A Restrepo-Jaramillo R Thenappan T et al. Inhaled treprostinil in pulmonary hypertension due to interstitial lung disease. *N Engl J Med.* 2021; 384: 325-334
  13. Kumar P Thudium E Laliberte K et al. A comprehensive review of treprostinil pharmacokinetics via four routes of administration. *Clin Pharmacokinet.* 2019; 55: 1495-1505
  14. Kundra TS Prabhakar V Kaur P et al. The effect of inhaled milrinone versus inhaled levosimendan in pulmonary hypertension patients undergoing mitral valve surgery - a pilot randomized double-blind study. *J Cardiothorac Vasc Anesth.* 2018; 32: 2123-2129.
  15. Rubin, L. J. (1997). Primary pulmonary hypertension. *New England Journal of Medicine*, 336(2), 111-117.
  16. Abdelbaser I Mageed NA Elfayoumy SI et al. The direct comparison of inhaled versus intravenous levosimendan in children with pulmonary hypertension undergoing on-cardiopulmonary bypass cardiac surgery: A randomized, controlled, non-inferiority study. *J Clin Anesth.* 2021; 71110231