

## Postoperative Outcome in Patients with Pulmonary Hypertension Undergoing Elective Non-Cardiac Surgery

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### ABSTRACT

**Introduction:** The impact of pulmonary artery hypertension on post-operative outcome in elective, non-cardiac surgery is incompletely understood. This study was designed to evaluate the post-operative outcome of patients undergoing elective, non-cardiac surgery with and without pulmonary hypertension.

**Methods:** The study was conducted in an inner-city hospital in Bronx, New York. A retrospective chart review was conducted on all patients who underwent elective, non-cardiac surgery from January 2000 to December 2010 and had echocardiogram within 30 days of surgery. Patients with systolic pressure of  $\geq 35$  mm of Hg as estimated by echocardiogram were enrolled. Case matched peers with normal pulmonary pressures served as controls. Post-operative outcomes were compared between the two groups.

**Results:** A total of 66 patients were analysed, 33 cases and 33 controls. All patients were followed up to 30-day post-surgery. Heart failure, myocardial infarction, arrhythmia, stroke, delayed extubation and deaths were measured in both the groups. There were two deaths in the control group while there were three deaths in pulmonary hypertension group (statistically not significant,  $P > 0.05$ ). A total of three patients in pulmonary hypertension group had adverse outcome (one had a major arrhythmia, one had delayed extubation ( $>24$  hours) and one had stroke). Whereas two patients in control group had adverse outcome (one had delayed extubation ( $>24$  hours) and one had major arrhythmia).

**Conclusions:** Pulmonary hypertension does not affect the post-operative outcome in the first 30 days for elective non-cardiac surgery.

**Keywords:** echocardiogram; elective surgery; non-cardiac surgery; post-operative outcome; pulmonary hypertension.

### INTRODUCTION

Pulmonary blood pressure is the pressure exerted by the right side of the heart to pump blood through the pulmonary arteries. Cellular proliferation and vascular remodelling in a genetically predisposed individual, who are exposed to an exogenous stimulus develop pulmonary hypertension resulting in progressive right ventricular function.<sup>1</sup>

Surgery is a stressful condition in which the body physiology is exposed to insults which alters homeostasis. Systemic hypotension, bursts of

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sympathetic stimulation in response to pain, change in preload and afterload due to fluid shift, change in autonomic nervous system induced by hypoxia and hypercapnia, periods of apnea and hypoventilation, effects of drugs, intubation, mechanical ventilation used for anesthetic purpose put the body in stress leading to systemic hypotension, arrhythmias which precipitate right ventricular ischemia and worsens right ventricular function. Patients with pulmonary hypertension have a compromised right ventricular function which makes it difficult to compensate these changes.<sup>2-5</sup>

The aim of our study was to evaluate the postoperative outcome of patients who were diagnosed with pulmonary hypertension based on echocardiography, did not have PAH-specific symptoms or therapy and were undergoing elective, non-cardiac surgery.

## METHODS

A retrospective chart review was conducted on all patients who underwent elective, non-cardiac surgery and had echocardiogram within 30 days prior surgery in inner-city hospital in Bronx, New York from January 2000 to December 2010. All patients were followed up to 30 days following surgery using hospital records. No patients were lost during the follow up period. Mortality and morbidity was measured in both groups. Morbidity was defined as the occurrence of any of the following: i) new heart failure (crackles on exam, pulmonary edema on chest imaging); ii) myocardial infarction: ECG with ST-segment elevation or depression of >1mm; iii) new onset arrhythmias; iv) stroke and v) delayed extubation >24 hours. The study was conducted in an inner-city hospital in Bronx, New York, from January 2000 to December 2010. The study was approved by Institutional Review board (IRB). Informed consent was waived by IRB as this was a retrospective study. A total of 66 patients (33 cases and 33 controls) were analysed. Patients with systolic pressure of  $\geq 35$  mmHg as estimated by echocardiogram were included as cases. Case matched peers with normal pulmonary pressure served as controls. All data were expressed as mean and were compared between the case and control group using a t-test. P value of < 0.05 was considered significant. We used XLSTAT version 2014, Addinsoft, New York, United States, to analyse continuous and non-continuous variables.

## RESULTS

A total of 66 patients were enrolled in the study, 33 cases and 33 controls (Table 1).

**Table 1. Characteristics of the patients in PH and control group.**

Number	PH group	Control group
Male	17	16
Female	24	09
Age (years)	66 (mean)	63 (mean)
Hypertension	20	22
Diabetes mellitus	18	16
Coronary artery disease	8	10
LVEF (%) (mean)	50 %	60%
Pulmonary disease	8	8
Chronic Kidney disease	3	3
Chronic liver disease	1	0
Right ventricular systolic pressure (mean)*	80.2	30.8

PH: Pulmonary hypertension, LVEF: Left ventricular ejection fraction, \* $P < 0.001$  other were not significant.

The case and control were demographically matched. Co-morbidities like systemic hypertension, diabetes mellitus, coronary artery disease, pulmonary disease, chronic kidney disease and chronic liver disease were matched and was statistically not significant. Mean left ventricular ejection fraction in cases was 50%, and that in control group was 60%. The mean right ventricular systolic pressure among the patients with pulmonary hypertension was 80.2 mmHg and that in control group was 30.8 mmHg, which was statistically significant. None of the patient had right ventricular dysfunction or systolic failure. None of our patients had PAH related symptoms and they were not on any PH specific treatment. The type of surgery the cases and control underwent were matched and statistical significance was not found (Table 2).

Among patients with pulmonary hypertension, one had delayed tracheal extubation (>24 hours), one patient developed stroke and major arrhythmia was identified in one patient. Whereas in patients of control group, one developed delayed extubation (>24 hours) and one had major arrhythmia. Heart failure and myocardial ischemia/infarction was not observed in any of the two study groups. There were three deaths in patients with pulmonary hypertension and two in control group, which was statistically not significant.

**Table 2. Types of surgeries and anesthesia used in the case and control group.**

Type of surgery	n	Type of anesthesia
Non-cardiac chest surgery	5	GA
Hernia repair	8	GA
Hysterectomy	2	GA
Video assisted thoracic surgery	3	GA
Partial gastrectomy	5	GA
Open cholecystectomy	2	GA
Transurethral resection of prostate	5	GA
Cole's fracture	1	Regional
Arterial- venous graft	2	Regional
Total	33	

GA: General Anesthesia

A total of three patients with pulmonary hypertension and two in control group developed adverse outcome, which was statistically not significant (Table3).

**Table 3. Post-operative outcomes.**

Morbidity*	PH group	Control group
Heart failure	0	0
Delayed tracheal extubation (> 24 hours)	1	1
Stroke	1	0
Myocardial ischemia/ infarction	0	0
Arrhythmia	1	1
Total	3	2
Mortality*	3	2

PH: Pulmonary hypertension, NS: Not significant

## DISCUSSION

This is a retrospective cohort study comparing the postoperative outcome in the first 30 days among patients undergoing elective non-cardiac surgery with and without pulmonary hypertension based on estimate provided by echocardiogram. Our study found that pulmonary artery hypertension as estimated

by echocardiogram does not significantly affect the postoperative outcome in elective non-cardiac surgery.

Compared to case-matched controls, patients with pulmonary hypertension did not have any worse outcome. During the 30 days follow up post-surgery, there were two deaths in the control group, whereas three deaths (9%) in pulmonary hypertension group, which was statistically not significant. Likewise, there was no difference in postoperative morbidity in both the groups.

Like our study, Ramakrishna and colleagues utilized a Doppler echocardiographic estimated right ventricular systolic pressure  $\geq 35$ mmHg in their retrospective investigation of 143 patients to evaluate the impact of PH on outcomes of non-cardiac surgery.<sup>6</sup> The observed mortality was 7%. Similar to our study, respiratory failure, cardiac arrhythmia and heart failure were the most common morbidity. New York Heart Association (NYHA) functional class of II or more and presence of systemic hypertension were associated with increase morbidity in a univariate analysis. History of pulmonary embolism and NYHA functional class  $\geq$ II was considered predictors of short-term morbidity in the multivariate analysis.

Most recently Meyer et al reported results of their prospective 3- year questionnaire based survey among 11PAH centres and collected data from consecutive patients with PAH undergoing non-cardiac surgery.<sup>7</sup> A total of 114 patients with PAH were identified. Total of 43% of patients at the time of surgery were in New York heart Association (NYHA) functional class III and IV. General anesthesia was administered in 82% of the patients while 18% patients who received interventions received spinal anesthesia. Major complications occurred in seven patients, of whom four died resulting in an overall perioperative mortality rate of 3.5%. Risk factors for major complications were an elevated right atrial pressure, a six-minute walk distance of less than 399 m at the respective last preoperative assessment, the use of vasopressors and the need of emergency surgery

However, unlike other studies, Kaw et al examined 173 patients who underwent right heart catheterization and non-cardiac surgery.<sup>8</sup> The definition of PH was mPAP of  $>25$ mmHg. Of the 96 patients with PH, 26% suffered morbidity/mortality. Similar to our study, congestive heart failure, hemodynamic instability and respiratory failure were the most common events.

These studies have shown successful outcome in patients with pulmonary hypertension, undergoing non-cardiac surgery. However, for patients with advanced symptomatic PAH, interdisciplinary approach between

anaesthetist, pulmonologist, surgeon and cardiologist is recommended for a successful outcome of surgery.<sup>4,9</sup> Successful outcomes of surgery include patients with PAH undergoing cholecystectomy, hysterectomy, and femoral artery and abdominal aortic aneurysm repairs.<sup>10,11,12,13</sup> The outcome is poor when the surgery is performed under emergency circumstance and perioperative optimization of patient has not been done adequately.<sup>7</sup>

Our study had several limitations. The diagnosis of pulmonary hypertension was based solely on echocardiographic estimates. None of our patients had

right heart catheterization before surgery and were not on any PAH specific treatment.

## CONCLUSIONS

We conclude that patients with pulmonary artery hypertension as estimated by echocardiography and without any PH symptoms can undergo non-cardiac surgery without any increase risk of perioperative morbidity or mortality.

**Conflict of Interest: None.**

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