Perioperative Complications in Patients with End-Stage Renal Disease Undergoing Pulmonary Resection

Koichi Suehiro* and Ryu Okutani
Department of Anesthesiology, Osaka City General Hospital, Miyakoimakku, Osaka City, 534-0021, Osaka, Japan

Abstract

Introduction: Among the perioperative complications encountered in patients with renal failure, there is a high risk of events such as heart failure and increased susceptibility to infection. Herein, we report the results of our investigation of perioperative management in patients with chronic renal failure who underwent a pulmonary resection.

Methods: The subjects were 21 hemodialysis patients with renal failure who underwent pulmonary resection for lung cancer. We retrospectively investigated their clinical characteristics and perioperative management. The patients were classified into two groups; those with and without symptoms of postoperative acute heart failure. Intergroup comparisons of preoperative examinations and management were performed.

Results: The most common preoperative comorbidity was cardiac complications, which occurred at a high incidence of 38%. There were no serious perioperative complications. In contrast, postoperative complications associated with renal failure were numerous, including acute heart failure in 3 (14%) and hyperkalemia in 2 (9.5%). We concluded that preoperative respiratory function, intraoperative fluid infusion volume, and perioperative cardiac comorbidities are potential risk factors for postoperative heart failure in such patients.

Conclusion: Although there were no cases with perioperative mortality, postoperative complications were encountered, including heart failure and hyperkalemia, suggesting that more stringent cardiovascular and respiratory management techniques are necessary.

Keywords: Pulmonary resection; Renal failure; Dialysis; Complications; Acute heart failure

Introduction

The number of patients who receive maintenance hemodialysis due to chronic renal failure is steadily increasing. However, there is an elevated risk of perioperative complications in patients with renal failure, such as heart failure and increased susceptibility to infection. Especially in those who undergo pulmonary resection surgery, acute postoperative heart failure is a key concern, due to the abrupt decrease in total pulmonary vascular cross-sectional area, increased pulmonary vascular resistance, and enhanced pulmonary vascular permeability [1]. We investigated perioperative management methods used and the incidence of complications in hemodialysis patients with chronic renal failure who underwent a pulmonary resection procedure at our hospital. Based on our findings, we also point out potential problems encountered when performing perioperative management in regard to safe pulmonary resection procedures in the increasing number of hemodialysis patients and discuss various solutions.

Subjects and Methods

The subjects were 21 patients with renal failure and receiving maintenance hemodialysis who underwent pulmonary resection surgery for lung cancer at our hospital between 1995 and 2007. Following approval from the institutional review board, we performed a retrospective investigation of the clinical characteristics and perioperative anesthetic procedure methods used, as well as complications in those patients.

Postoperative complications were defined as follows: 1) heart failure diagnosed via echocardiography by a cardiovascular specialist (inferior vena cava dilation >23mm, respiratory change <40%) and characterized by findings of pulmonary congestion on chest radiography, which required catecholamine treatment for decreased blood pressure (systolic blood pressure <80mmHg) within 3 days after surgery; 2) pneumonia shown by a white cell count of 12 000 mm\(^{-3}\) or greater, a fever of 38 degrees or greater and findings of decreased permeability in both lung fields by chest radiography, with diagnosis made by a radiologist who specializes in respiratory disease within 1 week after surgery; and 3) the presence of hyperkalemia, as indicated by a potassium level of 6.5 mEq L\(^{-1}\) or greater in blood tests on the day of surgery.

Patients were classified into two groups, those with (Group H) and without (Group N) symptoms of postoperative acute heart failure. Intergroup comparisons were retrospectively performed in regard to the preoperative examinations and case management.

Statistical analysis was conducted using Student’s t-test or a chi-square test, with differences of p<0.05 regarded as statistically significant.

Results

Preoperative clinical data are summarized in (Table 1). There were 17 men and 4 women, with a mean (+SD) age of 66±8.6 years (range, 55 to 83 years). The indications for hemodialysis were diabetes mellitus in 10 patients, chronic nephropathy in 6, post-nephrectomy in 1, chronic heart failure in 1, hypertensive nephropathy in 1, renal hemorrhage in 1, and unknown in 1. The mean period of hemodialysis before surgery was 54±60.2 months.

*Corresponding author: Koichi Suehiro, MD, Department of Anesthesiology, Osaka City General and Children’s Hospital, 2-13-22, Miyakoimakku-hondori, Miyakoimakku, Osaka City, 534-0021, Osaka, Japan, Tel: +81-6-929-1221; Fax: +81-6-929-1855; E-mail: suehirokoichi@yahoo.co.jp

Received February 04, 2011; Accepted March 08, 2011; Published March 09, 2011

Citation: Suehiro K, Okutani R (2011) Perioperative Complications in Patients with End-Stage Renal Disease undergoing Pulmonary Resection. J Anesthe Clinic Res 2:127. doi:10.4172/2155-6148.1000127

Copyright: © 2011 Suehiro K, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Page 2 of 4

8.1±9.2 years (range, 1 to 36 years). Preoperative hemodialysis was present in 8 of the 21 patients (38%). Preoperative comorbidity factors were angina pectoris in 6 patients, myocardial infarction in 1, and partial lung resection in 1. For the anesthetic method, general anesthesia alone using oxygen with sevoflurane, vecuronium, and fentanyl was used in all cases, with no epidural anesthesia given in any. The choice of anesthetic agents and anesthetic management method was left up to the judgement of the anesthesiologist in charge.

Table 2 shows perioperative patient data. The surgical procedure utilized was pulmonary lobectomy in 19, pulmonary segmentectomy in 1, and partial lung resection in 1. For the anesthetic method, general anesthesia alone using oxygen with sevoflurane, vecuronium, and fentanyl was used in all cases, with no epidural anesthesia given in any. The choice of anesthetic agents and anesthetic management method was left up to the judgement of the anesthesiologist in charge. Arterial line was placed in all cases, and arterial blood gas data analysis was measured as needed. There was no cases with desaturation (SpO2<96%) during surgery. The central venous pressure line was placed in all cases, and arterial blood gas data analysis was measured as needed. There was no cases with desaturation (SpO2<96%, PaO2<100mmHg) during surgery. The central venous pressure line was monitored as needed. There was no cases with desaturation (SpO2<96%, PaO2<100mmHg) during surgery. The central venous pressure line was monitored as needed. There was no cases with desaturation (SpO2<96%, PaO2<100mmHg) during surgery. The central venous pressure line was monitored as needed. There was no cases with desaturation (SpO2<96%, PaO2<100mmHg) during surgery. The central venous pressure line was monitored as needed.
secured and its pressure monitored only in surgical cases with high preoperative risk or a high level of difficulty. Monitoring of central venous pressure was performed in only 7 patients. Following surgery, all subjects were managed in the surgical ward as critically ill patients. Intraoperative data

Table 3: Perioperative data of the patients without/with postoperative cardiac heart failure

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group N (n=18)</th>
<th>Group H (n=3)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of patients with preoperative cardiac comorbidities</td>
<td>5 (%)</td>
<td>3 (100%)</td>
<td>0.017</td>
</tr>
<tr>
<td>NYHA classification I, II (cases)</td>
<td>18</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>III, IV (cases)</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Hugh-Jones classification I, II (cases)</td>
<td>18</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>I,II/III (cases)</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Respiratory function FEV1.0, %</td>
<td>76.5±13.3</td>
<td>82.0±11.4</td>
<td>0.509</td>
</tr>
<tr>
<td>%VC, %</td>
<td>88.7±13.0</td>
<td>73.3±5.15</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>Laboratory Findings Hematocrit (%)</td>
<td>31.9±5.24</td>
<td>30.4±1.42</td>
<td>0.340</td>
</tr>
<tr>
<td>Total Protein (g/dl)</td>
<td>6.81±0.55</td>
<td>6.57±0.06</td>
<td>0.091</td>
</tr>
<tr>
<td>Intraoperative data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation time, min</td>
<td>186±41.7</td>
<td>238±119</td>
<td>0.532</td>
</tr>
<tr>
<td>Anesthesia time, min</td>
<td>238±43.4</td>
<td>283±113</td>
<td>0.558</td>
</tr>
<tr>
<td>Infusion, ml/kg/hr</td>
<td>2.8±1.81</td>
<td>5.57±0.398</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>Blood loss, ml/kg/hr</td>
<td>1.11±0.696</td>
<td>1.49±0.354</td>
<td>0.378</td>
</tr>
<tr>
<td>Cases of blood transfusion, cases</td>
<td>2 (11.1%)</td>
<td>1 (33.3%)</td>
<td>0.899</td>
</tr>
</tbody>
</table>

Two areas of concern have been cited for hemodialysis patients who undergo pulmonary resection [1]. The first involves preoperative undernutrition, anemia, electrolyte abnormalities, bleeding tendency, and decreased immune function [6-13]. In the present study, preoperative cardiorespiratory function factors included angina pectoris and myocardial infarction, and were seen at a high frequency in 8 of the 21 patients (38%). Such conditions should be corrected as much as possible preoperatively, with reference to the recommended values for hematocrit, serum creatinine, blood urea nitrogen, and serum potassium, which are 30%, 6 mg/ml, 60 mg/ml, and 4.0 mEq/L, respectively [10]. We performed dialysis for all patients on the day before surgery in order to correct for electrolyte abnormalities and other abnormal findings. However, none of our patients received a preoperative blood transfusion to correct the hematocrit value. Additionally, some of our patients had postoperative electrolyte abnormalities that caused concern. We performed blood analysis immediately after surgery, which showed hyperkalemia with a serum potassium level of 6.5 mEq/L or higher in 2 patients (9.5%). Hemodialysis was performed in all patients on the day after surgery, with no serious complications encountered, such as ventricular arrhythmia. Postoperatively, the original hemodialysis schedule should be resumed as soon as possible, though postoperative bleeding due to treatment with anticoagulants may present a problem. In our patients, nafamostat mesilate, an ultra-short-acting anticoagulant that is effective in patients at high risk for postoperative bleeding [14], was administered for anticoagulation prior to postoperative dialysis and there was no clinically significant postoperative bleeding in any.

The second area of concern is in regard to cardiorespiratory complications, as pulmonary hypertension due to a decrease in the total pulmonary vascular cross-sectional area is prone to occur after a pulmonary resection procedure. In patients with renal failure, management of water balance is extremely difficult and there is a high likelihood of postoperative pulmonary edema. Postoperative heart failure was seen in 3 of our patients (14%). For prevention, perioperative fluid overload must be avoided and vasoactive agents should be used to reduce the need for perioperative fluid replacement. In the present study, there were significant differences between the two groups with and without postoperative acute heart failure in regard to perioperative respiratory function, intraoperative fluid infusion volume, and number of patients with preoperative cardiac comorbidities.

There was no perioperative mortality in our series, while Tsuchida...
et al. [1] reported 1 perioperative death among 7 patients receiving hemodialysis treatment who underwent pulmonary resection [1]. In a study of various types of surgery for patients with chronic renal failure, the perioperative mortality rate ranged from 0–6%, with the main causes of death including heart failure, hemorrhage, sepsis, liver failure, pneumonia, and hyperkalemia [6]. Additionally, since cardiorespiratory complications due to decreased lung volume and difficulty maintaining water homeostasis may occur during a pulmonary resection procedure, it is expected that perioperative mortalities will increase as the number of such procedures increase. In particular, a decrease in pulmonary function is believed to be an important predictive factor of postoperative heart failure. In order to prevent postoperative heart failure in patients with decreased respiratory function, care must be taken to institute hemodialysis and maintenance hemodialysis at an early stage.

Significant limitations to this study include that this is a retrospective chart review over many years where there have been considerable advances in care of patients on hemodialysis, cardiac risk stratification and better assessment of fluid status. In addition, the choice of anesthetic agents and anesthetic management (use of central venous line) were not standardized, but rather varied according to updated information during the extended study period from 1995 to 2007. Another limitation is that the number of patients is very small and is not enough to produce statistical significance. In spite of these limitations, our findings showed that preoperative respiratory function, intraoperative fluid infusion volume, and preoperative cardiac

**Conclusions**

We performed a retrospective investigation of patients with chronic renal failure who underwent pulmonary resection surgery procedures performed at our hospital. Although there were no perioperative deaths, postoperative complications occurred, including heart failure in 3 patients (14%) and hyperkalemia in 2 (9.5%). We concluded that preoperative respiratory function, intraoperative fluid infusion volume, and preoperative cardiac comorbidities are potential risk factors for postoperative acute heart failure. Thus, stringent cardiorespiratory management is essential for hemodialysis patients undergoing pulmonary resection surgery, especially in those with decreased preoperative pulmonary function and without cardiac reserve.

**Declaration**

We have no conflict of interest. The contents have not been published elsewhere and the paper is not being submitted elsewhere. The manuscript has been read and approved by all co-authors.

**References**