Original Article

Postoperative pulmonary complications among patients undergone percutaneous nephrolithotomy

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ABSTRACT

Background: *Post-operative pulmonary complications (PPC) are not unusual following anesthesia and surgery in PCNL as the incidence is being higher. Complication rates vary according to different procedures and different types of anesthesia and may be affected by the patient condition.*

Objective: *To assess postoperative pulmonary complications among the patients who had undergone PCNL.*

Methodology: *This was a prospective observational study of 111 consecutive adult patients over a period of one year who underwent PCNL surgery. The data of the patient, surgery and anesthesia was collected and analyzed to find association with PPC*

Results: *Seven patients (6.3%) had developed pulmonary complications postoperatively, six of them had pneumothorax and one had atelectasis who, died at the 15th postoperative day due to respiratory failure. All the 6 patients with pneumothorax were managed by inserting a chest drain. The other non pulmonary complications among the patients were shivering (40%), blood loss (15%), hyperthermia (9%). It is seen that patients who had a history of smoking and the patients who were operated on the left kidney had shown more incidence of developing pneumothorax and the difference was found to be statistically significant (p<.05).*

Conclusions*: From the present study it can be concluded that the most common type of post-operative complication following PCNL is pulmonary, with pneumothorax. A close working relationship between the surgeon and anesthetist is essential to coordinate the access puncture with deflation of lung and ventilator standstill to minimize the chances of pleural injury.*

Key words: *Pulmonary complications, nephrolithotomy, pneumothorax*

Introduction

Percutaneous nephrostomy (PCN) is a passageway that is introduced percutaneously into the renal pelvicalyces that can later be maintained by a tube, stent or catheter. Following its introduction by Wickbom in 1954 who described percutaneous puncture of the renal pelvis as a diagnostic procedure, Goodwin and Casey first described its therapeutic use for relief of urinary tract obstruction the following year in 1955. [1, 2] Thanks to its good safety profile, percutaneous nephrostomy is the preferred technique for treatment of various urological conditions, and its pioneering role for relief of urinary tract obstruction remains in good use until today. [3]

Anesthesia for PCNL can be general or regional. Complications of general anesthesia such as pulmonary (athlectasia), vascular, and neurologic disorders (brachial nerve injury or spinal cord injury), especially during change of the position are more likely than. Recently, a survey of urologists in Europe revealed that percutaneous

procedures are performed by 69.6% of the respondents with a mean of 16.8 PNL procedures a month, clearly underlining the importance of the procedure. PNL is generally a safe treatment option and associated with a low but specific complication rate. [4] Many complications develop from the initial puncture with injury of surrounding organs. (e.g, colon, spleen, liver, pleura, lung) Other specific complications include postoperative bleeding and fever. [5]

Urinary tract stone disease is a major health-care problem, and after urinary tract infections and prostate pathology, is the third in rank among the diseases of the urinary system.

Percutaneous nephrolithotomy is a minimally-invasive therapy for treatment of upper ureteral and renal stones.[6,7] It is the treatment of choice for kidney stones larger than 20-30mm in size, staghorn stones and stones that are multiple or resistant to ESWL.[8] In most cases, PCNL is performed under general anesthesia, whereas complications and the costs of general anesthesia are higher than spinal anesthesia.[9] Complications are more common when the patient position is changed from supine to prone. The most common complications are the lung, brachial plexus, tongue and occasionally the spinalcord injury. When the position is changed as well as neurological complications and side effects related to displacement of tracheal tube. Some scientific evidence shows that in certain cases such as patients who are in high risk for surgery, we can use either spinal, epidural, or intrapleural anesthesia.[10]

Post-operative pulmonary complications (PPC) are not unusual following anesthesia and surgery in PCNL, and their incidence may be higher than 10%.[11,12] These complications include atelectasis, pneumothorax, hemo- or hydro-thorax, pleural effusion, pulmonary edema, pneumonia, and acute respiratory distress syndrome.[13] Important risk factors are advanced age, surgery near the diaphragm and poor health.[14] During the procedure the renal upper-pole approach may accidentally puncture the pleural cavity and the lung. During the procedure the urologist uses large volumes of irrigation fluids which may cause pulmonary congestion and edema if a minute fraction is absorbed into the blood stream. [15] We report the results of a study of the occurrence of PPC following PCNL.

Methodology

A prospective study of 111 adult patients who underwent elective PCNL under general anesthesia in our hospital during the period of Jan 2014 – Dec 2014 were included in the study. The study was approved by our local Ethics Committee. The pre-, intra- and post-operative management was similar for all the patients in the study. On admission to the hospital, the patient was examined by an urologist and an anesthesiologist, One hour before the surgery the patient was pre-medicated with oral metoclopramide 10 mg and diazepam 10 mg. On arrival at the operating room, the patient was monitored with non-invasive blood pressure, electrocardiogram and pulse-oximeter, and intravenous access and arterial line were established. General anesthesia was induced with intravenous propofol (2-3 mg/kg) and fentanyl (0.001-0.002 mg/kg), followed by vecuronium (0.08 mg/kg). After endotracheal intubation

and tube fixation were accomplished in the supine position, the patient was advanced to the distal end of the operating table and moved to the lithotomy position for cystoscopy and insertion of the ureter-catheter under radiographic guidance. Then the patient was turned to the prone position for the percutaneous nephrolithotomy. Under fluoroscopy, an 18 Fr needle was used to access the collecting system and a guide wire was inserted to the collection system. Thereafter, the tract was dilated to 25 Fr, an access sheath was inserted, and a rigid nephroscope was used for stone destruction and removal. Following complete destruction of the stone, a 22 Fr nephrostomy tube was inserted. After completion of the procedure, the patient was turned to the supine position and extubated. Following extubation the patient was transferred to the post-anesthesia care unit (PACU), where he/she stayed for 2 hours or more, and was treated with analgesics. The patient's oxygen saturation was recorded and a chest X-ray was performed. In case of pneumothorax, a chest drain was inserted. Data was collected for each patient concerning patient demographics, pre- and intra-operative parameters, and post-operative consequences. Statistical analysis was done by using SPSS version 16 by parametric and nonparametric methods.

Results

The study population included in the study was 111 patients with 70 males and 41 females. The mean age among the males was 58 and that of females was 53. ASA class distribution was: ASA I = 22 patients; ASA II = 76; ASA III = 10; ASA IV = 3 patients. The mean duration for the surgery was about 2 and half hours. Fifty two patients had history of smoking and 21 patients had chronic obstructive lung diseases preoperatively. The serum creatinine level was above normal for 12 patients and the mean volume of irrigation fluid used was almost 17 litres.

Table 2 shows the comparison of various parameters measured between the patients with and without pulmonary complications. Seven patients (6.3%) had developed pulmonary complications postoperatively, six of them had pneumothorax and one had atelectasis who, died at the 15th postoperative day due to respiratory failure. All the 6 patients with pneumothorax were managed by inserting a chest drain. The mean duration of stay at PACU for all the patients was 2.5 hrs and the mean duration of hospitalization was 5.3 days.

The other non pulmonary complications among the patients were shivering (40%), blood loss (15%), hyperthermia (9%). From table 2 it can be inferred that patients who had a history of smoking and the patients who were operated on the left kidney had shown more incidence of developing pneumothorax and the difference was found to be statistically significant. More number of patients who had developed pulmonary complications had received the blood transfusion and the difference was found to be statistically significant (<0.05), whereas the other factors did not show any significant association between patients with and without pulmonary complications.

Table 1: Demographic details and the parameters measured for the patients undergone PCNL

Variables	Male	Female
Number	70	41
Age (mean/SD)	59±2	53±14
Weight (mean/SD)	68±16	64±13
Surgery on **Right side** **Left side** **Bilateral**	 44 25 1	 20 21 0
Surgical approach **Upper pole** **Others**	 58 12	 30 11
Patients received blood transfusion during surgery	9	5
Duration of surgery , hrs (mean/SD)	2.6±0.3	2.5±0.4
Irrigation fluid volume	16.8L	17L
Patients with history of smoking	58	0
Patients with COPD preoperatively	15	6
Patients with Sr. Creatinine >2mgs%	9	3

Table 2: Comparison of parameters between patients with and without postoperative pulmonary complications

Parameters	Patients with pulmonary complications (n=7)	Patients without pulmonary complications (n=104)	P value
Male /female	5/2	66/39	0.79
Age (mean/SD)	52±6	56±4	0.63
ASA grading I/II/III/IV	0/5/2/0	22/71/9/2	0.55
Patients with history of smoking	5 (71.4%)	54 (51.9%)	**0.04**
Patients with COPD preoperatively	1 (14.2%)	20 (19.2%)	0.68
Patients with Sr. Creatinine >2mgs%	2 (28.5%)	10 (9.6%)	0.09
Surgery on **Right side** **Left side** **Bilateral**	 1(14.2%) 5 (71.4%) 1(14.2%)	 63 (60.5%) 41(39.4%) 0	 **0.025** **0.036** **0.04**
Surgical approach **Upper pole** **Others**	 5 (71.4%) 2 (28.5%)	 83 (79.8%) 21 (20.1%)	 0.59 0.73
Patients received blood transfusion during surgery	3 (42.8%)	11 (10.5%)	**0.027**
Duration of surgery , hrs (mean/SD)	2.4±0.2	2.2±0.4	0.68
Irrigation fluid volume	17±1.2	16.8±1.3	0.83

Of all the 104 patients who had not developed any pulmonary complications only one patient had died due to sepsis on the 7th postoperative > and among the 7 patients who developed pulmonary complications 1 had died due to respiratory failure. So the overall mortality rate among the patients without pulmonary complications was 0.009% and with pulmonary complications it was 14.2%.

Discussion

In this study we found that the main post-operative complication following PCNL was pulmonary, affecting 6% of the patients, while 40% of the patients had post-operative complication that were not pulmonary like shivering, blood loss and hyperthermia which were less symptomatic. The most common PPC was pneumothorax, which was managed with a chest drain in all the patients. . The results were almost in par with the study done by Gili etal, [16] where he found that the main post-operative complication following PCNL was pulmonary, affecting 8% of the patients, while 5% of the patients had post-operative complications that were not pulmonary and the most common PPC was pneumothorax.

Anatomically the lower border of the pleural reflection crosses the 10th rib in the midaxillary line and crosses the 12th rib posteriorly at the lateral border of sacrospinal muscle. The posterior portion of the diaphragm arises from the tip of the 10th to 12th ribs and from the lateral and medial arcuate ligament, mean while the 11th and 12th ribs cross the upper pole of the kidney. Thus all supracostal nephrostomy tracts traverse the diaphragm and in many cases also the pleural space, but the lung s will be avoided. [17] Supracostal approach above the 11 th rib is associated with 23.1% intrathorasic complications compared with 1.5% to 12% for above 12th rib approach and 0.5% for subcostal approach to access the collecting system. [18]

Kukreja et al found that diabetes mellitus, multiple tract procedures and a prolonged operative time associated with significantly greater blood loss. [19] Chang et al report a case of a patient with hydrothorax two weeks later after percutaneous nephrolithotomy, so one should be aware that hydrothorax may follow after removing D-J stent one or several weeks later. [20] Extravasation is a common incident during PCNL, which can potentially lead to untoward consequences depending on the rate, volume and nature of fluid absorbed. [21] During PCNL, maintaining low pressure within the irrigation system minimizes the chances of fluid and air entering the pleural space through the pleural opening from supracostal approach. The anaesthetist role is important when making the tract, as it helps to co-ordinate respiration with tract dilatation so that the patient is maintained in expiration during puncture and tract dilatation

It was found that patients who had PCNL on the right side were at significantly lower risk for PPC. This may be the result of the difference in right and left kidney anatomy, specifically the kidney's level/height. Since the right kidney is 'lower' than the left, getting to its upper pole is easier than with the left kidney.

Most of the patients in our study (79.2%) had the upper-pole approach, although no significant difference in PPC

occurrence was found between patients who had their upper pole approached and the others. Nevertheless, since the main complication was pneumothorax, it is reasonable to suspect that approaching the upper pole played a role in its occurrence. In their retrospective study Netto et al [22] found that the upper-pole approach carried a slight increase in the incidence of acceptable complications. Shilo et al [23] published a similar study which found that upper and multiple access approaches were associated with a higher overall incidence of pleural effusion compared with the lower-pole access.

In our study we found that previous chronic lung disease or history of smoking had no significant effect on the PPC rate and the results were almost in par with the study done by Gili Palnizky etal [16] and also, patient's ASA class, as an indicator of patient's general health, was not significantly different in patients with or without PPC.

A high index of suspicion should be maintained when PCNL is performed for complete staghorn calculi, especially with prolonged operating time, multiple tracts and supracostal access. A close working relationship between the surgeon and anesthetist is essential to coordinate the access puncture with deflation of lung and ventilator standstill to minimise the chances of pleural injury. Individually managed intra- and post-operative care should be customized to the patient and his/her condition and diseases, thus keeping the complication rate reasonable in all patients.

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