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ORIGINAL ARTICLE

Incidence and outcome of pulmonary complications after open cardiac surgery, Thowra Hospital, Cardiac center, Sana'a, Yemen

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Abstract This prospective study was designed to determine the incidence of pulmonary complications after open cardiac surgery as well as to identify predisposing factors of these complications. The cumulative incidence of pulmonary complications was 15.08% with a mortality rate of 18.5% from patients who developed complications and overall mortality among all patients was 2.79%. Pulmonary complications occurred in 7.82% of patients with coronary artery revascularization, 2.23% in patients with valvular replacement and 5.05% in patients with congenital heart disease.

ARDS occurred in 3.35% of patients with a mortality rate of about 66.6%, dehiscence sternum and mediastinitis occurred in 1.6% with mortality 33.3%, pneumonia in 2.79%, atelectasis in 3.35%, pleural effusion in 2.22% and pneumothorax in 0.55%. The most predisposing factors were massive blood transfusion, re-exploration for control of post-operative bleeding, cardiopulmonary resuscitation and prolonged length stay in the intensive care unit.

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Introduction

The various components of the respiratory system; airways, lungs, chest wall, intercostals muscles; diaphragm and neural pathways, to and from these various components are subjected to damage caused by a variety of processes associated with cardiac surgery and cardio pulmonary bypass (CPB). Cardiac surgery through either a sternotomy or thoracotomy has deleterious effects on the function of the muscle pump and the chest wall. Additionally, phrenic nerve damage resulting from cold topical solution applied inside the pericardium may cause mechanical problems. Left side cardiac distension

or elevated pressure may cause alveolar edema, and transfusion reaction or allergic reaction to drugs (e.g. protamin) may increase capillary permeability leading to alveolar flooding [1].

Mechanical alterations in lung function

(A) Atelectasis

It is the most common pulmonary complication after cardiac surgery occurring in about 70% of cases. During (CPB), the lungs are not perfused and they are allowed to collapse to functional residual capacity. When the lungs are subsequently re-expanded then variable degree of pulmonary atelectasis remains [2].

Etiology of pulmonary atelectasis

Preoperative factors [3]:

- (1) Smoking, chronic bronchitis.
- (2) Obesity [decreased functional residual capacity (FRC)].
- (3) Cardiogenic pulmonary edema.

(B) Acute lung injury [ARDS] and cardio-pulmonary by pass

Activation of complement and neutrophils causes sequestration of neutrophils in the pulmonary microvasculature and an increase in the pulmonary capillary permeability [4].

On the other hand reperfusion injury after ischemia generates oxygen free radicals and may also contribute to lipid peroxidation at this time [5]. There is an increased systemic level of thromboxane during (CPB). Thromboxane released from platelets activated by extra corporeal circuit, and its profound effects on vasoconstriction and platelet aggregation could further injure the microcirculation [6].

(C) Postoperative pneumonia

Pneumonia remains the greatest threat to survival that exists in a surgical patient. Patients are often debilitated by the effects of the disease process, intravenous lines, bladder catheters, endotracheal tube and surgical wound. The incidence of pneumonia is about 5–19%. More than 90% of nosocomial pneumonia is bacterial and in 50–70% of cases the responsible organisms are gram negative bacilli. The most important causative gram negative organisms include *Klebsiella* species, *Escherichia coli* and *Pseudomonas aeruginosa* [7].

Aim of the work

- (1) Determining the incidence of pulmonary complications after open heart surgery as well as identifying predisposing factors of these complications.
- (2) Minimizing the risk of developing pulmonary complications as well as mortality after open cardiac surgery.

Materials and methods

This prospective study was performed at the cardiac center, Thowra Hospital, Sana'a from Jan 2004 to Dec 2009.

During this period 179 patients (130 males and 49 females) were included in this study. The patients were divided into three groups:

- *Group I*: Included 88 patients (72 males and 16 females) with mean age of 49.58 and 53.6 years, respectively. These patients underwent coronary arteries bypass surgery.
- *Group II*: Included 53 patients (36 males and 17 females) with mean age of 29.6 and 40.7 years, respectively. These patients underwent valve replacement.
- *Group III*: Included 38 patients (22 males and 16 females) with mean age of 5.6 and 4.2 years, respectively. These patients underwent open cardiac surgery for correction of congenital heart disease.

All patients were subjected to the following:

- (1) Complete history taking and clinical examination.
- (2) Chest X-ray and EGG.
- (3) Complete blood picture and serum potassium and sodium.
- (4) Blood urea and serum creatinine.
- (5) Fasting blood sugar.
- (6) Serum bilirubin, albumin, SGOT and SGPT.
- (7) Prothrombin time, concentration and INR.
- (8) Coronary angiography for all patients with ischemic heart disease and patients with valvular heart lesion whose ages are over 40 years and congenital heart lesion, (when indicated).

All patients were followed up for the following:

- (1) Total operative time.
- (2) Coronary by-pass time.
- (3) Cross clamp time.
- (4) Ten days follow up in the hospital and 1 month after discharge.
- (5) Intraoperative complications and blood transfusion.
- (6) Postoperative complications.
- (7) Time of post-operative complications.
- (8) Post-operative ECG, chest X-ray, complete blood picture, blood urea, serum creatinine, serum potassium and sodium. Prothrombin time, concentration and INR.
- (9) Amount of post-operative blood transfusion.
- (10) Blood gas analysis.
- (11) Management of complications and outcome patients.
- (12) Trans-tracheal aspiration, gram stain and culture cases of pulmonary infection.

Criteria for diagnosis of post-operative pneumonia:

- (1) Fever and purulent sputum.
- (2) New chest radiographic shadow.
- (3) New onset radiographic shadowing, progressive inflation, consolidation, cavitations or effusion.
- (4) Organism isolated from sputum obtained by trans-tracheal aspiration.

Criteria for diagnosis of acute respiratory distress syndrome:

- (1) Bilateral diffuse pulmonary infiltration.
- (2) Refractory hypoxemia p_{aO_2}/F_{iO_2} is 200.
- (3) Reduced total lung compliance less than 50 ml/cm H_2O .
- (4) No evidence of heart failure by clinical examination and echocardiography.

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