JOURNAL OF SURGERY AND SCIENCE VOL.2 NO.1 DECEMBER 2014
ISSN 2333-4703 (Print) **ISSN** 2333-4711 (Online) http://www.researchpub.org/journal/jss/jss.html

Prone Position Improved Pneumonia in a Patient with Total Artificial Heart

Sami S. Tannouri, MD, Harrison T. Pitcher, MD, Jaime Byrne RN, Joseph Miessau, MS,
Nicholas C. Cavarocchi, MD, Hitoshi Hirose, MD PhD.*

***Abstract*—Introduction: In the setting of acute lung injury or acute respiratory distress syndrome (ARDS), prone positioning has shown survival and outcome benefits. Our aim is to demonstrate the technical feasibility and benefit of this therapy in a patient with a total artificial heart (TAH). Case Report: A 29-year-old man was admitted to hospital with symptoms of NYHA class 4 heart failure. His hemodynamics acutely deteriorated despite inotropic support and echocardiography showed bilateral ventricular dysfunction. Subsequently, he was placed on venoarterial extracorporeal membrane oxygenation bridged to a total artificial heart (TAH). The patient had remained intubated, ventilator dependent, and was found to have bilateral multifocal pneumonias. Despite broad-spectrum antibiotic therapy and intermittent bronchoscopy for bronchial toileting, his pneumonia did not improve; thus, he was placed in prone position using the Rotoprone Therapy System (KCI, San Antonio, TX). There were no technical complications in regards to the patient's driveline or sternal incision. Hemodynamically, the patient had variations in flow and chamber filling at the extremes of rotation (left side or right side down), likely from the TAH compressing mediastinal structures. His pneumonia was improved after this therapy. Conclusion: Prone positioning is feasible and manageable in the patient with a total artificial heart**.

***Keywords* —Prone position, Total artificial heart, Acute respiratory distress syndrome.**

I. Introduction

THE simple concept of prone positioning patients to enhance pulmonary toileting was originally been described by Piehl in 1976 (1). An indication for use of prone positioning may include ventilator associated pneumonia. Despite improving lung oxygenation with prone positioning (2), improving lung consolidation by radiological imaging studies (3, 4), and the theoretical advantage of improved positional drainage of secretions (1, 5, 6), a survival benefit for patients with acute respiratory distress syndrome (ARDS) is not yet clear (7, 8). Prone positioning, initially utilized for medical patients, has been extended to surgical patients as well. Recently prone positioning has been accomplished for patients with mechanical circulatory device including ventricular assist devices (9), and extracorporeal membrane oxygenation (ECMO)(10). However, until now, utilization of prone bed positioning in a patient with a total artificial heart (TAH) has not yet been described; hence this is what we report in this paper.

II. Case Presentation

A 29-year-old male with large body habitus (186 cm, 134 Kg, body mass index 38.7 kg/m2) but no past medical history presented with one week of hemoptysis and shortness of breath. This had been preceded by several months of cough. CT scan showed multiple bilateral segmental pulmonary emboli, although there was no deep vein thrombosis by ultrasound study. Echocardiography demonstrated severe biventricular dysfunction with an ejection fraction of 10-15%. Two days after admission to the hospital, he became hemodynamically unstable, and developed signs of cardiogenic shock despite a milrinone infusion. Venoarterial ECMO was initiated for a bridge to decision. After 9 days on ECMO support, his biventricular function was not improved; thus, the patient underwent implantation of a TAH (Syncardia, Tucson AZ).

Postoperatively, repeated bronchoscopy was required to maintain adequate pulmonary toileting, particularly due to continued bloody endotracheal tube secretions. He was continuously febrile and had an elevated white blood cell count. A sputum culture was positive for Klebsiella pneumonia, which was treated with appropriate antibiotics. CT of the chest showed bilateral bibasilar dense consolidations (Figure 1A). The patient had a lack of response to medical management via antibiotics, mechanical ventilator management, and aggressive bronchoscopy.

Submited on 12/25/2013.
From Department of Surgery, Thomas Jefferson University, Philadelphia, PA, USA. 607 College Building, 1025 Walnut Street, Philadelphia, PA 19107, USA
*Correspondence to Hitoshi Hirose, MD, PhD. (e-mail: Hitoshi.Hirose@jefferson.edu).

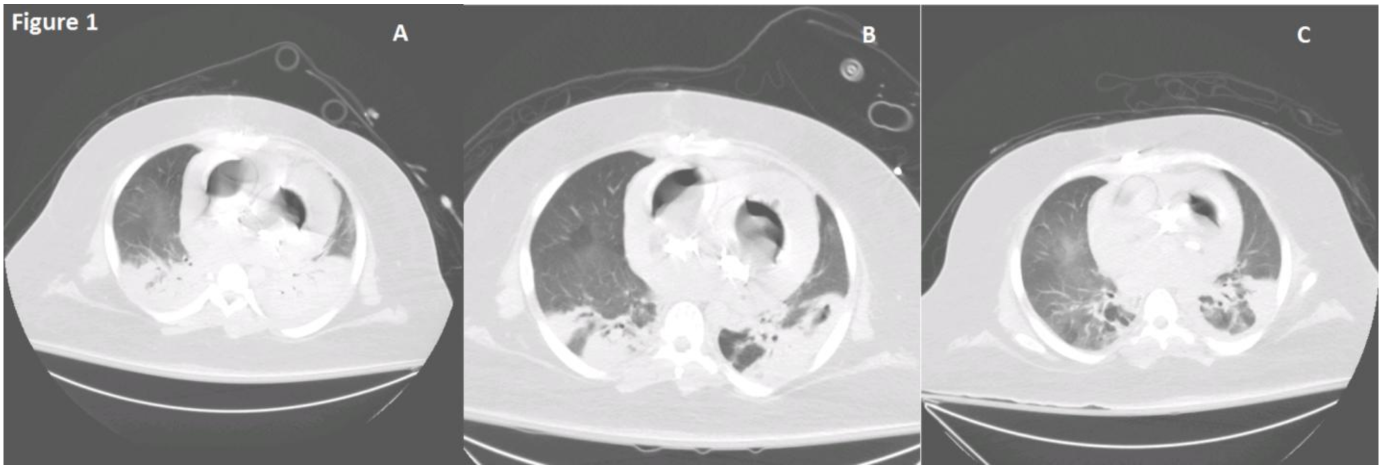

Fig. 1. CT scan prior to prone positioning shows bilateral pneumonias (A). CT scan after completion of 5 day course of prone positioning shows interval improvement of pneumonia (B). CT scan 19 days after completion of prone positioning shows resolution of pneumonia.

The Rotoprone Therapy System (KCI, San Antonio, TX) was initiated to improve his pulmonary toileting and secretions and to enhance oxygenation to his lungs after multiple insults, including pulmonary embolism and prolonged mechanical ventilation.

The Rotoprone system oscillates the patient in the prone position for 3 hour intervals, interspersed with 1 hour supine breaks. Care was taken to ensure safe passage of the drivelines through the tubing window at the foot of the bed (Figure 2).

A deep level of sedation was required to maintain stability and safety for all the patients' wires, lines, and tubing while in the prone position in the bed. Particular attention was paid to all pressure points, ensuring that the patient was adequately padded to prevent pressure-related deep skin injury. While prone, he did develop facial edema, which quickly resolved after returning to the supine position. An absorbent pad was placed on the floor under the patient's face due to the extensive oral-nasal secretions draining by gravity. No modifications of the patient's ventilator settings were necessary throughout this period. The total artificial heart measures and records hemodynamic parameters and it showed stable perfusion despite extreme positional shifts (Figure 3). The Rotoprone system was used for 5 days until signs of infection improved.

Follow-up chest CT after completion of the 5-day course of the Rotoprone system showed interval improvement of bilateral consolidation (Figure 1B). Pulmonary functions improved and a repeat CT scan obtained 19 days after the liberation from Rotoprone showed improvement of consolidation (Figure 1C). Although the patient required a tracheostomy on POD # 16, he was quickly discontinued from the ventilator after tracheostomy. He started ambulating in the intensive care unit on POD # 30 and transferred to the step down unit on POD # 80.

Fig. 2. Set up of prone bed with total artificial heart system. There were no issues or complications from the drive lines exiting through the prone bed line window.

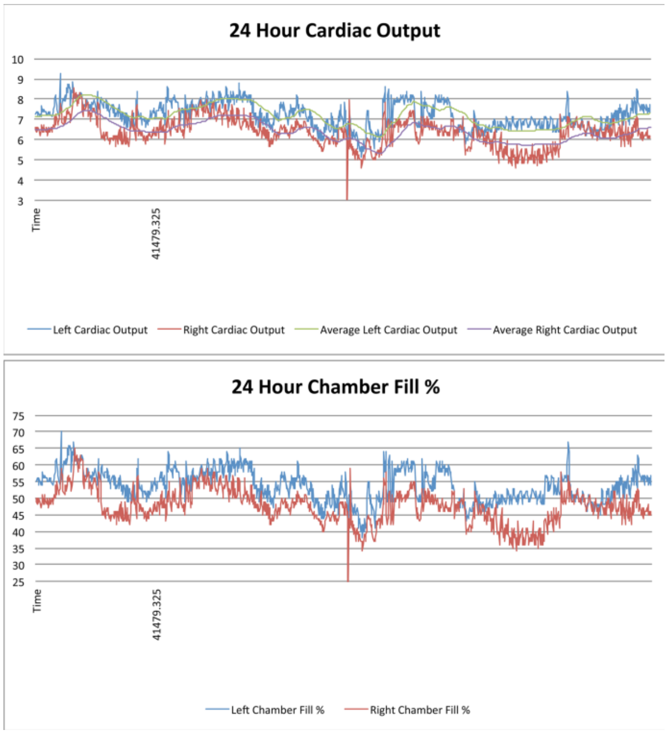

Fig. 3. Trend of cardiac output while prone positioning by the total artificial heart (A). Trend of left and right chamber filling % by the total artificial heart (B).

III. DISCUSSION

A. Although the theoretic advantages of prone positioning such as improvement of the alveolar ventilations in the dorsal lungs, which is most frequently affected by gravity dependent atelectasis observed in severe ARDS patients (5), previous randomized trials of prone versus conventional positioning failed to demonstrate survival benefits or reduction of the ventilator associated pneumonia in prone group (6, 7) However, in high risk patients in there previous study, prone positioning had shown improved survival compared to control (7). In these patients with severe lung injury may reserve the clinical benefit from prone positioning by alveolar recruitment and positional drainage of pulmonary secretions. The presented patient's copious pulmonary secretions were not being effectively managed by conventional suctioning or daily bronchoscopy. We believe the prone position helped clear his deep airways from secretions and may have improved his pneumonia.

B. The challenge of prone positioning a TAH recipient was access to the drivelines, endotracheal tube, multiple intravenous drug lines and the question of hemodynamics of the TAH. Drivelines, intravenous tubing, and endotracheal tube were effectively managed by the Rotoprone's built-in tunnel tubing system. The endotracheal tubing and intravenous tubing was passed from the head-of-bed window while the drive-line was passed from the foot-of-bed window. Pressure ulcer formation during the prone position was another concern since shifting areas are being compressed. Careful observation of contact points and diligent padding on the patient's anterior was essential to prevent ulcer formation. Deep sedation was required to minimize patient anxiety while in prone position and to ensure drive-line safety. The hemodynamic behavior of the TAH was continuously monitored closely by skilled personnel throughout the entire process.

C. On review of the hemodynamic data from the TAH, there was minimal cardiac output change while prone. A slight decrease in cardiac output while in prone position can be explained by compression of the atrium between the device and the sternum. This was easily compensated by minor adjustments of heart rate and chamber vacuum settings. Typically, the heart rate setting was lowered (5 beat/min less) to allow better filling of the TAH ventricle while prone. If this adjustment was not sufficient, the vacuum was decreased by 2 mm Hg. As the patient moved back to supine, these adjustments were reversed as needed.

IV. CONCLUSIONS

PRONE POSITION WAS SAFE AND FEASIBLE IN A PATIENT WITH A TAH NOTING APPROPRIATE ATTENTION AND CARE TO THE DRIVE-LINE, ENDOTRACHEAL TUBE, AND PRESSURE ULCER PROPHYLAXIS

REFERENCES

[1] Piehl MA, Brown RS. Use of extreme position changes in acute respiratory failure. Crit Care Med. **1976** 4:13-4.

[2] Mounier R, Adrie C, Francais A, Garrouste-Orgeas M, Cheval C, Allaouchiche B, et al. Study of prone positioning to reduce ventilator-associated pneumonia in hypoxaemic patients. Eur Respir J. **2010**;35:795-804.

[3] Langer M, Mascheroni D, Marcolin R, Gattinoni L. The prone position in ARDS patients. A clinical study. Chest. **1988**;94:103-7.

[4] Gattinoni L, Tognoni G, Pesenti A, Taccone P, Mascheroni D, Labarta V, et al. Effect of prone positioning on the survival of patients with acute respiratory failure. N Engl J Med. **2001**;345:568-73.

[5] Pelosi P, Brazzi L, Gattinoni L. Prone position in acute respiratory distress syndrome. Eur Respir J. **2002**;20:1017-28.

[6] Alexiou VG, Ierodiakonou V, Dimopoulos G, Falagas ME. Impact of patient position on the incidence of ventilator-associated pneumonia: A meta-analysis of randomized controlled trials. J Crit Care. **2009**;24:515-22.

[7] Gattinoni L, Carlesso E, Taccone P, Polli F, Guerin C, Mancebo J. Prone positioning improves survival in severe ARDS: A pathophysiologic review and individual patient meta-analysis. Minerva Anestesiol. **2010**;76:448-54.

[8] Guerin C, Reignier J, Richard JC, Beuret P, Gacouin A, Boulain T, et al. Prone positioning in severe acute respiratory distress syndrome. N Engl J Med. **2013**;368:2159-68.

[9] Connors CW, Poltak JM, Christie AA. Noncardiac surgery in the prone position in patients with ventricular assist devices. J Cardiothorac Vasc Anesth. **2012** 2;26:e6-7.

[10] Kimmoun A, Guerci P, Bridey C, Ducrocq N, Vanhuyse F, Levy B. Prone positioning use to hasten veno-venous ECMO weaning in ARDS. Intensive Care Med. **2013**;39:1877-9.