

## REVIEW OF THE SPIRAL PUMP PERFORMANCE TEST, DURING CARDIOPULMONARY BYPASS, IN 43 PATIENTS

### **Edivania Wada**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, São Paulo, Brazil  
e-mail : [edivaniawada@srnet.com.br](mailto:edivaniawada@srnet.com.br)

### **Aron Andrade**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, São Paulo, Brazil  
e-mail : [aandrade@fajbio.com.br](mailto:aandrade@fajbio.com.br)

### **Denys Emilio C. Nicolosi**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, Av. Dante Pazzanese, 500 Ibirapuera, São Paulo.  
e-mail : [Denys@neurotrend.com.br](mailto:Denys@neurotrend.com.br)

### **Eduardo G.P. Bock**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, São Paulo, Brazil  
e-mail : [eduardo.bock@yahoo.com.br](mailto:eduardo.bock@yahoo.com.br)

### **Jeison Fonseca**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, São Paulo, Brazil  
e-mail : [jfonseca@fajbio.com.br](mailto:jfonseca@fajbio.com.br)

### **Juliana Leme**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, Av. Dante Pazzanese, 500 Ibirapuera, São Paulo.  
e-mail : [julianafatec@yahoo.com.br](mailto:julianafatec@yahoo.com.br)

### **Jarbas J. Dinkhuysen**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, Av. Dante Pazzanese, 500 Ibirapuera, São Paulo.  
e-mail: [j.dinkhuysen@uol.com.br](mailto:j.dinkhuysen@uol.com.br)

### **José Francisco Biscegli**

Department of Bioengineering, Institute Dante Pazzanese of Cardiology, Av. Dante Pazzanese, 500 Ibirapuera, São Paulo.  
e-mail : [Jose\\_Biscegli@fajbio.com](mailto:Jose_Biscegli@fajbio.com)

**Abstract.** *A centrifugal blood pump called Spiral Pump (SP) has been tested in our laboratories. SP is based on two different pumping principles: centrifugal and axial (1). This study is a review of the SP clinic evaluation, during cardiac surgery with cardiopulmonary bypass, assembled in the Institute Dante Pazzanese of Cardiology. Data survey, from 43 cardiac patients was collected from files and doctor's reports. The criteria to patient's selection were: weight, age and pathology. During the surgeries, parameters of rotation (rpm) and flow (l/min) were observed by monitoring the SP operation. The clinical results were satisfactory, showing that SP is a reliable pump with hydraulic capability to keep the flow and the systemic pressure, during the perfusion period.*

**Keywords:** *Centrifugal pump, Blood pump, Cardiopulmonary bypass*

## 1. Introduction

A Blood pump has been a very important resource to cardiac surgery (3). Currently, Extracorporeal Circulation is performed with both centrifugal and roller pumps during the procedure. Roller pumps are often the favorite surgeon's choice due to its simplicity, safety and convenience. Centrifugal blood pump safety is the major characteristic to this choice due to air pumping impossibility. Other advantages in centrifugal pumps used during cardiac surgery are operational simplicity, low cost, lower hemolysis index than roller pumps, and less related cases of post cardiectomy cardiogenic shock.

In 1995, a new concept of blood pump appeared – The Spiral Pump (SP). The centrifugal blood pump totally is composed by several plastic injected parts and mechanical parts isolated from the blood contact. This project, developed at Department of Bioengineering in association with Surgical Research Department of the Institute Dante Pazzanese of Cardiology including several investigators for the attainment of a mechanical device efficient, safe and made with national technology, as it shows the transversal section of the Spiral Pump and its internal and external components.

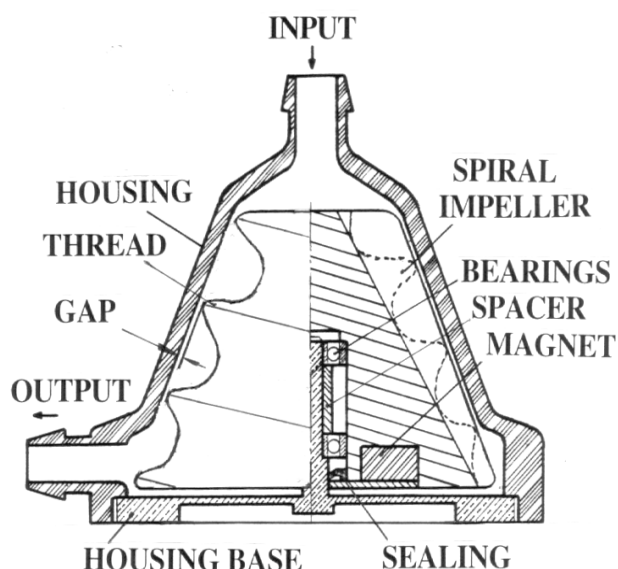


Figure 1 – Transversal section from Spiral Pump shown its mechanical parts and details

A blood pump that has two different principles of pumping: centrifugal and axial. The centrifugal and axial principles occur in function of a spiral impeller assembled inside of pump that is conically shaped and has threads on the surface. Those two principles acting simultaneously allow obtaining physiological levels of pressure and flow during cardiopulmonary bypass, working in low rotation that pump equipments that use only the centrifugal strength (1). Figures 1 and 2 shows the Spiral Pump pumping module.



Figure 1: The Spiral Pump assembly is shown.



Figure 2 : Spiral Pump assembly schematic

## 2. Materials and Methods

A mechanical blood-propelling device has important features to hydrodynamic performance and efficiency that can predict blood components trauma. A clinical comparative study of hemolysis in patients was performed. Patients who suffers a cardiac surgeries with extracorporeal circulation procedure were chosen in divided in two groups, one of them Biomedicus Pump (BioPump) and other Spiral Pump. In both groups the Normalized Index of Hemolysis (NIH) findings were quite similar the daily non-centrifugal procedures values. Among centrifugal pumps, Biopump has the lowest NIH and this tendency showed a small difference between Spiral Pump and Bio-Pump.

This study was performed with a group of 43 patients with age between 47 and 83 years old, weight between 51 and 80 Kg, 34 patients are male (table 1) .The used exclusion criteria were: myocardial acute infarction, emergency surgery, renal disease with creatinine above of 2,0 mg%, diabetes mellitus insulin-dependant and anemia.

Table 1. Demographic Appearance of groups.

Number of studied cases	43 (100%)
Years	47 to 83 years
Peso	51 a 80 Kg
Number of Male patients	34 (79%)
Number of Female patients	09 (21%)

It was made a total of 43 surgeries where: 31 (72% of cases) was made with MR (Myocardial Revascularization); 10 (23% of cases) with orovalvar surgeries and 2 (5% of cases) with MR associated to valves surgery. In that cases, was used a membrane oxigenator. The esophagus temperature was kept about 32 Celsius degrees (table 2).

Table 2. Clinic suggestions and surgery data.

Number of surgeries with Cardiopulmonary Bypass - 43 (100%)

Miocardius Revascularization	31 (72 %) of cases
Orovalvar Surgery	10 (23 %) of cases
MR with valve surgery	2 (05 %) of cases

### 3. Results

Through the evaluation of perfusion time necessary during cardiac surgery, the obtained results show the Spiral Pump performance.

The surgery duration time was between 1h and 3h30. During this period, the Spiral Pump do not shown any malfunction.

### 4. Conclusion

Spiral Pump is a blood-propelling device and its hydrodynamic design associates both axial and centrifugal forces as well known as mixed pump. In Vitro evaluation of Spiral Pump suggests that proposed modifications turned it more efficient and less traumatic to blood components. In Vivo animal experiments reproduced the same findings trend proving safety and effectiveness.

Eventually, hydraulic efficiency was proved and the low traumatic impact to blood elements observed in a patients group submitted to cardiac surgery with extracorporeal circulation with Spiral Pump.

The realized study was satisfactory, and the Spiral Pump shown a security and stable behavior with enough hydraulic capacity in order to keep the demanded blood flow and debit for long periods.

### 5. Acknowledgements

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