

Superior Vena Cava-Right Pulmonary Artery Anastomosis (Glenn Operation)

Yüksel Bozer, M.D., F.A.C.C.* / Tahsin Tuncalı, M.D.**

Anastomosis of the superior vena cava and right pulmonary artery has been used in certain congenital cardiac defects to bypass the right side of the heart. The operation was first suggested by Carlon in 1951, followed by Glenn and Robicsek in 1954 and 1956 respectively.¹ Successful clinical application of this procedure was reported by Glenn² in 1958 and by Bakulev³ in 1959.

In this operation the right pulmonary artery is ligated and cut, the distal end is anastomosed to the side of the superior vena cava (end-to-side) and the superior vena cava is then cut and sutured between the anastomosis and the right atrium (Figures 1 and 2). Bakulev³ prefers an end-to-end anastomosis; Rodbard and Wagner⁴ and Shumacker⁵ previously attempted anastomosis of the right pulmonary artery and the right auricle.

Materials and Methods

From 1964 to 1967 we used this technique in seven patients whose ages ranged from 15 months to 16 years. Five of them had tricuspid atresia and two Ebstein's anomaly. All patients had cyanosis and increased hemoglobin and hematocrit levels. Their physical capacities were severely limited. One patient with Ebstein's anomaly (Case 3), who also had tricuspid insufficiency and right-to-left shunt at the atrial level, showed severe arrhythmia on electrocardiogram (Figure 3 a).

The operation was performed under general anesthesia using a lateral incision in the right fourth intercostal space. The anastomosis between the superior vena cava and right pulmonary artery was done as described by Glenn.² The pressure in the superior vena cava

From Hacettepe University Faculty of Medicine, Department of Surgery, Division of Cardiovascular Surgery, Ankara.

* Associate Professor of Surgery and Cardiovascular Surgeon.

** Associate Professor of Pediatrics and Pediatric Cardiologist.

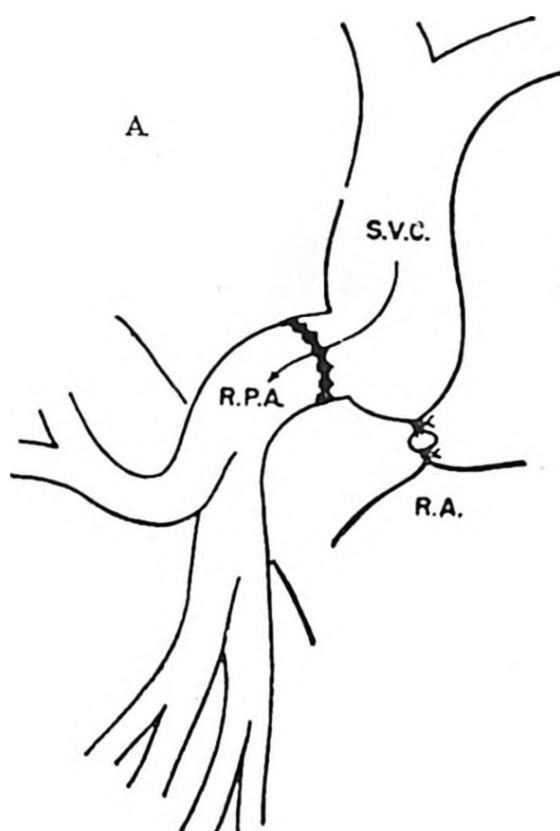


Figure 1. Glenn operation (schematic).

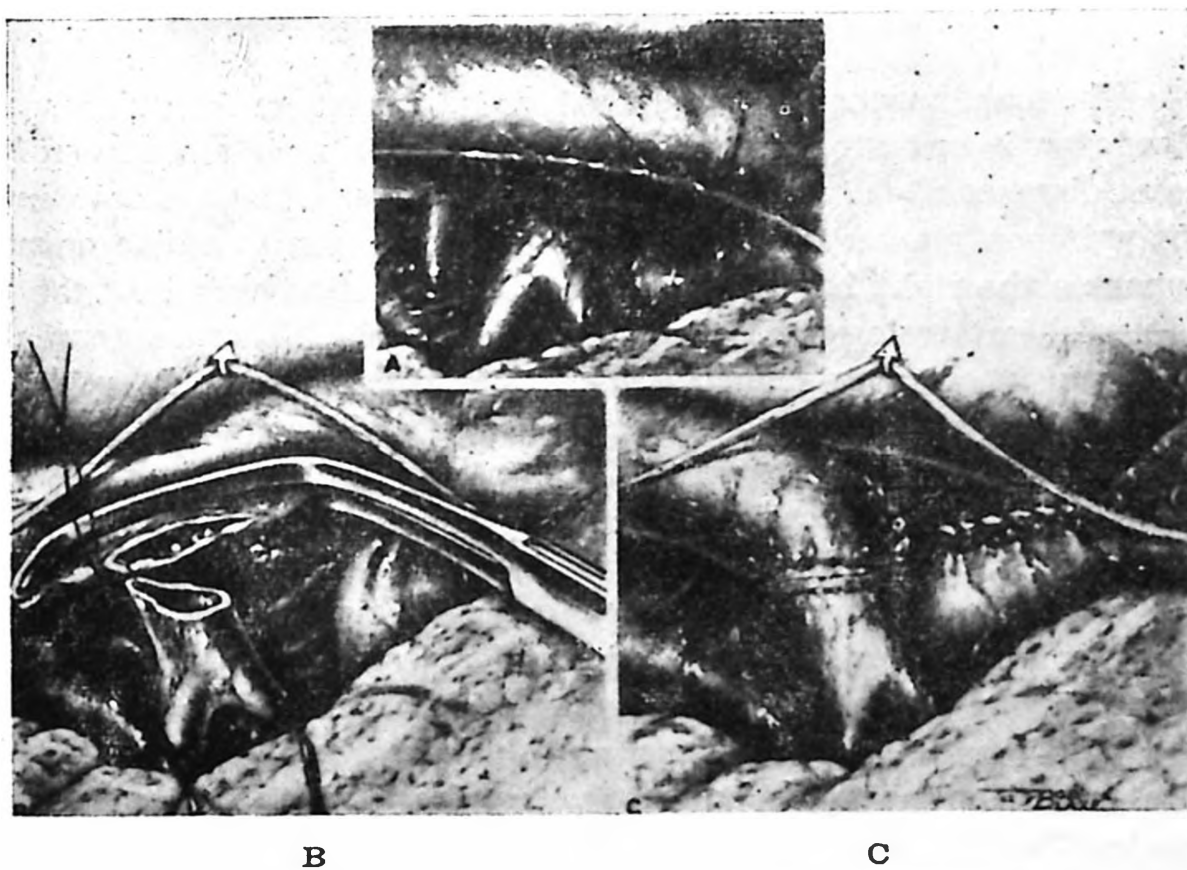


Figure 2. Consequential stages of Glenn operation.

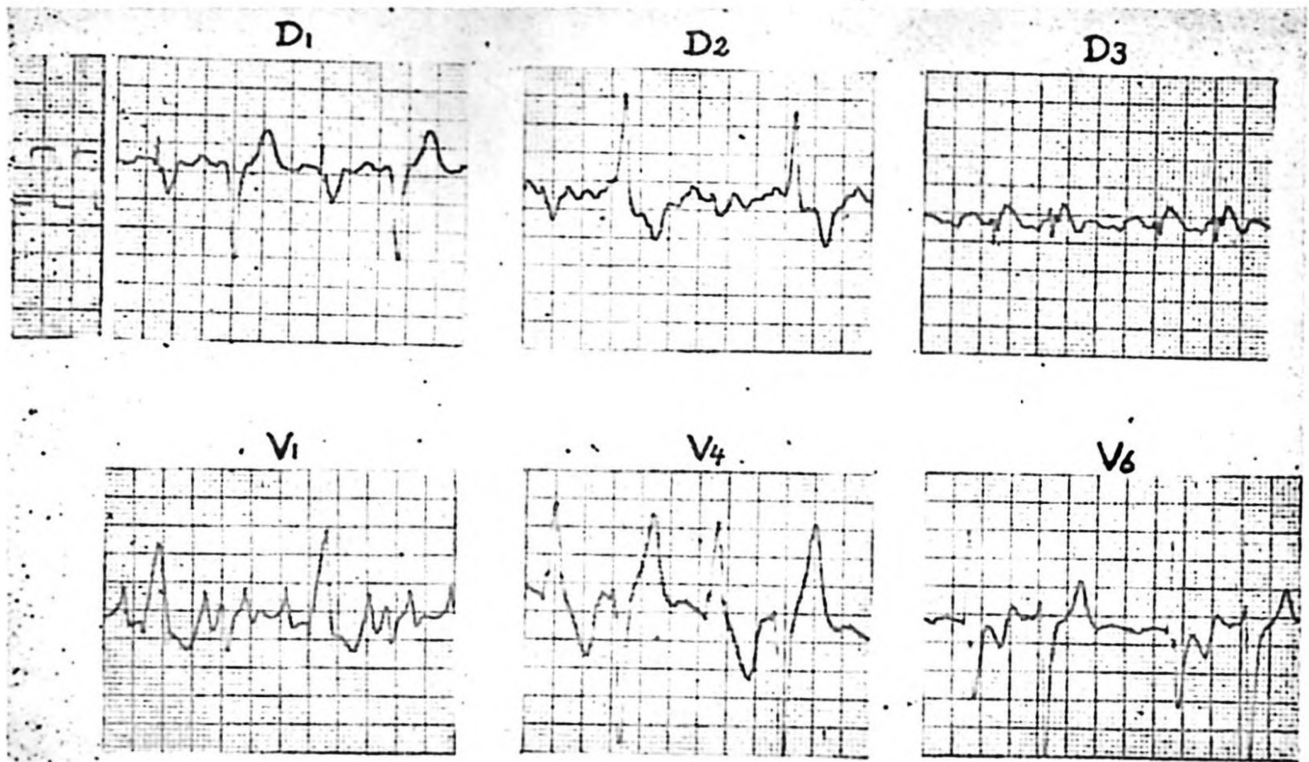


Figure 3 a. Preoperative E.C.G. of patient No. 3 (H.S.).

was measured before and after the occlusion. In the postoperative period the head of the patient was elevated at 45° to prevent facial edema. Electroencephalographic control was not done during the operation.

Results and Discussion

The main purpose of this procedure is to increase the pulmonary blood flow in order to relieve the cyanosis found in certain congenital heart diseases. By diverting the blood of the superior vena cava into the pulmonary artery, 30 to 40 per cent of the total cardiac output bypasses the right heart.⁶ Therefore, the operation was thought to be useful in tetralogy of Fallot, tricuspid atresia, Ebstein's anomaly and even in complete transposition of the great vessels. In spite of having some advantages over the Potts-Smith-Gibson operation and the Blalock-Taussig anastomosis,⁷ it is now indicated only in tricuspid atresia and Ebstein's anomaly, because the superiority of the other operations in transposition and in tetralogy of Fallot have been accepted even by Glenn.^{1 8 9} Of our seven patients who underwent the Glenn operation, five had tricuspid atresia, two Ebstein's anomaly, and in all cyanosis improved considerably, their preoperative and postoperative hemoglobins and hematocrits supporting this (Table 1). The average postoperative hospitalization was about three weeks. The cases have been followed six months to four years with no deaths occurring.

TABLE 1
GLENN OPERATIONS PERFORMED AT HACETTEPE MEDICAL CENTER
FROM 1964 to 1967

Case Number	Name and Chart Number	Age and Sex	Diagnosis	Preop. Hgb (Hct)	Postop Hgb (Hct)	Date of Operation	Result
1	N.K. (64/33476)	19 mos F	Tricuspid Atresia	16.95	12.00	1/3/1966	Good
2	M.Y. (63/26043)	15 mos M	Tricuspid Atresia	15.85 (67)	12.30 (52)	6/24/1964	Good
3	H.S. (65/58924)	16 yrs M	Ebstein's Anomaly Tricuspid Insufficiency	12.45	11.20	1/3/1966	Good
4	F.K. (63/13961)	6 yrs F	Ebstein's anomaly Partial abnormal venous return Atrial septal defect	20.00	15.40	4/3/1964	Good
5	Y.Y. (66/31769)	4.5 yrs F	Tricuspid Atresia	20.00 (78)	16.15 (60)	7/12/1966	Good
6	G.G. (67/5883)	10 yrs F	Tricuspid Atresia	23.00	18.40	2/12/1967	Good
7	S.C. (67/3119)	15 yrs M	Tricuspid Atresia	20.00	14.07	7/12/1967	Good

Reed et al¹ reported 14 cases with ten deaths, only one of their cases having Ebstein's anomaly. Bopp and Glenn⁸ had seven deaths in 23 cases. Young⁷ reported five deaths in 25 cases, but 14 of these were tetralogy of Fallot.

Case 3, who had Ebstein's anomaly with tricuspid insufficiency and right-to-left shunt at the atrial level, had severe arrhythmia on electrocardiogram and an extremely enlarged heart. His ventricular extrasystole completely disappeared after surgery (Figure 3 b).

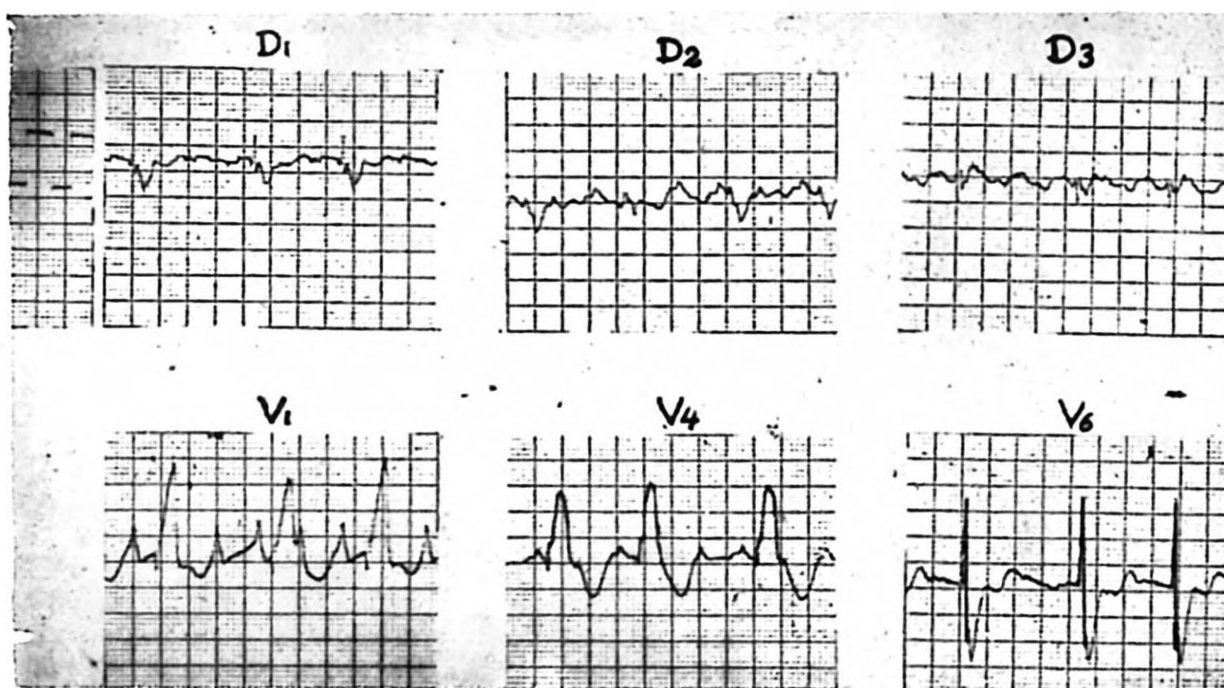


Figure 3 b. Postoperative E.C.G. of patient No. 3. (H.S.).

The use of the Glenn operation in Ebstein's anomaly is still controversial. Hunter, Lillehei and Hardy^{10 11} suggest repair of the displaced valve, whereas Barnard and Cartwright et al¹² report cases where the valve was replaced with a prosthetic lenticular or ball-type valve. In spite of this controversy, the Glenn procedure is indicated in certain cases with Ebstein's anomaly.

None of our patients showed evidence of thrombosis of the anastomosis during follow-up. Postoperative angiograms were done in two cases (Cases 1 and 4) and both showed a well-functioning anastomosis (Figure 4).

Pressures in the superior vena cava before and after clamping at the site of right atrial entry were measured in four cases (Table 2). In only one case (Case 1) did the pressure rise to 40 cm of water. Even in this case the superior vena cava was cut and sutured at the entry to the right atrium without any postoperative complica-

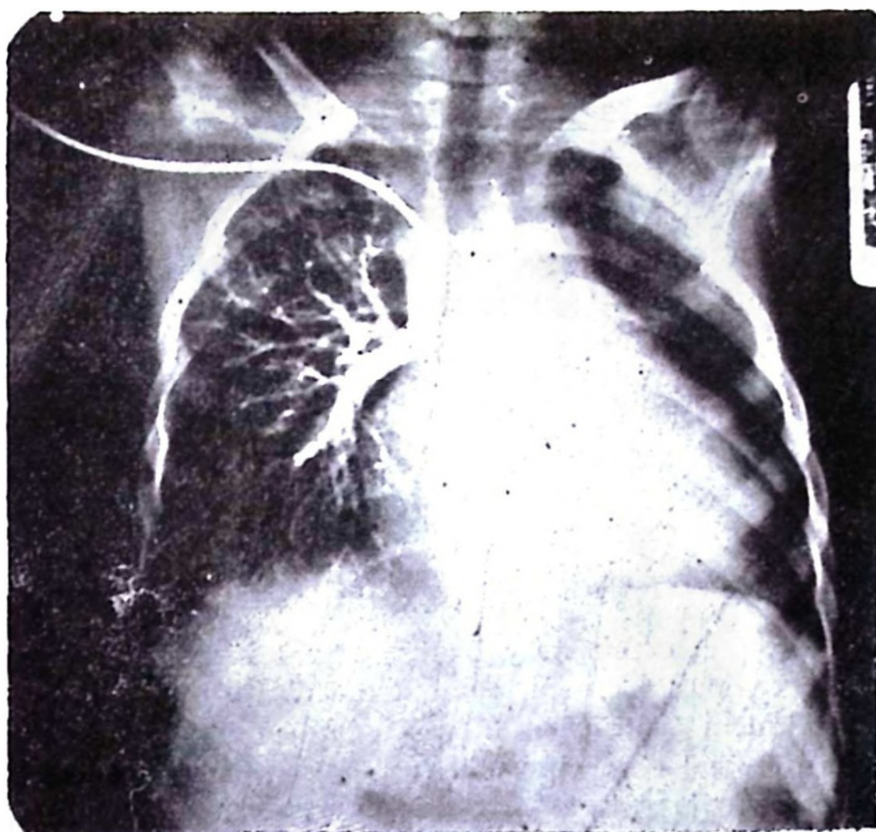


Figure 4. Postoperative angliogram of patient No. 1 (N.K.) showing a well-functioning anastomosis.

TABLE 2
SUPERIOR VENA CAVA PRESSURES BEFORE AND
AFTER CLAMPAGE

	Before	After
N.K.	18 cm/water	40 cm/water
H.S.	20 »	24 »
F.K.	10 »	20 »
Y.Y.	19 »	36 »

tion. We believe that it is necessary to suture the superior vena cava at the site of right atrial entry in order to obtain a well-functioning shunt through the anastomosis. Another factor in obtaining a good shunt is the size of the anastomosis, which should not be less than five to six mm in diameter. If the patient develops facial edema postoperatively, it usually indicates that the anastomosis is of inadequate size.

Summary

The Glenn operation has been performed on seven patients between 1964 and 1967 at Hacettepe Medical Center. Five of them

had congenital tricuspid atresia and two complicated Ebstein anomalies. The cases have been followed six months to four years with no mortalities. Cyanosis improved in all cases and thrombosis of the anastomosis has not developed in any. This procedure has been successful in cases with tricuspid atresia. Two points are essential to obtain a good result: 1) the anastomosis should be large enough to achieve a well-functioning shunt and 2) the superior vena cava should be cut and sutured at the site of right atrial entry.

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