Extracorporeal Circulation in Consecutive Open-Heart Surgery Patients

Successful Use Without Repriming

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Introduction

Open heart surgery, using extracorporeal circulation, requires large numbers of blood donors, and obtaining these donors has been a limiting factor in some programs. One suggestion for alleviating this problem has been to increase the utilization of available donors by operating on 2 consecutive patients utilizing a single, initial blood priming volume in the pump. It is the purpose of this paper to report the successful perfusion of 2 patients with the same pump and priming blood on 3 separate occasions.

Report of Cases

Case 1.—A 10-year-old, 26 kg. girl with congenital aortic stenosis underwent open heart correction on January 20, 1960, using extracorporeal circulation. Bypass was utilized for 12 minutes with a perfusion rate of 3,740 cc. Surgical correction was successful.

Case 2.—A 9-year-old, 11 kg. girl with congenital aortic stenosis and patent ductus arteriosus was the second patient done on January 20, 1960. One hour after completion of Case 1, the patient was placed on bypass using blood remaining in the oxygenator after Case 1. Perfusion was carried out for 18 minutes with a perfusion rate of 2,040 cc. per minute. The lesions were successfully corrected.

Case 3.—A 23-year-old, 56.4 kg. woman with pulmonic stenosis underwent open heart correction on February 4, 1960, utilizing extracorporeal circulation. The patient was perfused 12 minutes at a perfusion rate of 3,500 cc. The lesion was successfully corrected.

Case 4.—A 22-year-old, 57 kg. man with mitral stenosis and mitral insufficiency secondary to rheumatic heart disease was the second patient operated on February 4, 1960. Operation was begun immediately after completion of Case 3, and perfusion was started 1 hour after completion of Case 3 using blood remaining in the oxygenator. Perfusion was carried out for 30 minutes at a rate of 3,760 cc. per minute. Mitral stenosis was corrected, and the mitral insufficiency was partially relieved.

Case 5.—An 8-year-old, 24 kg. boy with congenital aortic stenosis underwent open heart correction on February 8, 1960, utilizing extracorporeal circulation. The patient was perfused 19 minutes at a rate of 1,400 cc. per minute, and the lesion was successfully corrected.

Case 6.—A 19-year-old, 50 kg. girl with tetralogy of Fallot underwent open heart correction utilizing extracorporeal circulation on February 8, 1960, as the second patient. Operation was begun shortly after completing the procedure on Case 5, and blood remaining in the oxygenator was used. The patient was perfused for 47 minutes at a rate of 3,040 cc. per minute with successful correction of the defects.

Procedure

A Kay-Cross rotating disc pump-oxygenator 2 was used in all cases. The patients to have consecutive perfusion were selected with identical blood groups, and the donor blood was drawn the morning of surgery in heparinized plastic bags. The extracorporeal pump was assembled in the usual method prior to the first case on each dual-operating day except that a 3/8"-3/8" connector was inserted in the venous and arterial lines approximately 24 inches from the pump. These connectors were used to connect the arterial and venous lines from the patient to the pump. At the end of the first perfusion the arterial line, venous line, and coronary suction lines in the first patient were discarded with the arterial and venous lines...
being disconnected at the mentioned 3⁄4" connector. A short piece of sterile plastic tubing was then placed on the arterial line and connected to the venous line connection to close the circuit at the pump and keep the blood and connections sterile for the second procedure. Between cases the discs were left rotating to prevent blood from drying on the discs, and the oxygen was turned off. The first patient was removed to a recovery room and the operating room was cleaned and set up for the second operation which was begun as quickly as possible. For the second patient, a new arterial line, venous line, and coronary suction line were used. Plasma hemoglobin determination was obtained immediately after the first operation, before the second operation, and at the end of the second operation, as an index of the amount of blood destruction.

Comment

The results of consecutive perfusion of 2 patients on the same day without repriming the pump oxygenator have been quite satisfactory. It has been possible to do 2 patients with approximately 60% of the estimated blood required if the patients had been done separately (Table 1). The length of time for 2 operations has not been prohibitive, and both operations were completed in a maximum of 7 hours. In previous experience with the Kay-Cross apparatus, relative lack of trauma to blood has been demonstrated, and it has been possible to perfuse for up to 2 hours with very little destruction of the blood (using the plasma hemoglobin as an index of blood destruction). Plasma hemoglobin determinations in our patients are recorded in Table 2. After completion of Case 3, a total of 1,000 cc. of blood in the oxygenator was replaced because of the patient's plasma hemoglobin value of 68 mg. %. In the first and third dual perfusions the plasma hemoglobin was lower at the end of the second operation than it was at the beginning of the second operation, probably because of dilution with the patient's own blood. In the combination of Cases 1 and 2 the total perfusion time was 30 minutes. In Cases 3 and 4 the total perfusion time was 42 minutes, and in Cases 5 and 6 the total perfusion time was 66 minutes. There have been no undesirable side-effects from consecutive perfusions. There has been no describable difference in the postoperative course between these patients and patients with similar defects in whom consecutive operations were not done.

Summary and Conclusions

The use of extracorporeal circulation in 2 patients without repriming the pump is reported on 3 separate occasions. Changes in plasma hemoglobin have not been remarkable. This appears to be a safe procedure, and, as Gross suggested, this is a partial solution to the problem of large blood volume requirements in open heart surgery.

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REFERENCES
