

EVALUATION OF THE EFFECTIVENESS OF A CLOSED CIRCUIT IN COMPARISON WITH AN OPEN CIRCUIT OF CARDIOPULMONARY BYPASS

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Conflict of interest
The authors declare that they have no conflicts of interest

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Abstract

Objective is to evaluate the effectiveness of closed-loop surgeries with the planned duration of cardiopulmonary bypass more than 2 hours in the immediate postoperative period.

Materials and methods. A study was carried out in the clinic over 10 patients (average age 47-56 years) with Diagnoses: Ascending aortic aneurysm, FC 3 aortic valve insufficiency, who underwent surgery for ascending aorta replacement, aortic valve replacement with coronary artery reimplantation. The patients were divided into 2 groups, the 1st group (5 patients) is the control group using an open cardiopulmonary bypass circuit, the 2nd group (5 patients) is the patients using a closed cardiopulmonary bypass circuit. The total time of cardiopulmonary bypass in both groups was 125-187 minutes.

Results. In the 2nd study group, drainage blood loss significantly decreased, on average 60-100 ml compared to the control group, where the average drainage loss was 600-1500 ml. The need for blood transfusion was 5.1% in the 2nd group, compared with 43.4% in the control group. In the study group 2, the number of platelets in the postoperative period in patients was higher than in the control group.

Conclusion. This study shows that a closed circuit, compared to an open one, allows complex heart surgeries with a planned duration of extracorporeal circulation of more than 2-3 hours.

Keywords

cardiopulmonary bypass,
evaluation

Жасанды қан айналымының ашық схемасымен салыстырғандағы түйықталған контурдың тиімділігін бағалау

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Аңдатпа

Зерттеудің мақсаты - отадан кейінгі кезеңде жоспарланған жасанды қан айналымының ұзақтығы 2 сағаттан асатын, жабық контур арқылы операциялардың тиімділігін бағалау.

Зерттеу материалдары мен әдістері. Клиникада жүргізілген зерттеуге мынадай диагноздар қойылған 10 науқас (орта есеппен 47-56 жас) қатысты: өрлеме қолқаның аневризмасы, өрлеме қолқаны протездеу операциялары жасалған ФК 3 аорталық қақпақшасының жеткіліксіздігі, коронарлық артериялардың реимплантациясы бар қолқалық қақпақша. Науқастар 2 топқа бөлінді, 1-топ (5 науқас) – ашық жасанды қанайналым контуры пайдаланылған бақылау тобы, 2-топ (5 науқас) – жабық жасанды қанайналым контуры пайдаланылған науқастар. Екі топтағы жасанды қан айналымының жалпы уақыты 125-187 минутты құрады.

Нәтижелері. 2-топта бақылау тобымен салыстырғанда орташа 60-100 мл, қанның дренаждық шығындары едәуір төмендеді, мұнда орташа дренаждық шығындар 600-1500 мл. Бақылау тобындағы 43,4%-бен салыстырғанда, 2-науқастарда тромбоциттер саны бақылау тобына қарағанда жоғары болды.

Қорытынды. Бұл зерттеу жабық контурдың ашық контурмен салыстырғанда жоспарланған жасанды қан айналымының ұзақтығы 2-3 сағаттан асатын күрделі жүрек операцияларына мүмкіндік беретінін көрсетеді.

Түйін сөздер

жасанды қанайналым, бағалау

Оценка эффективности закрытого контура в сравнении с открытым контуром искусственного кровообращения

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Аннотация

Цель исследования - оценить эффективность операций с закрытым контуром, с планируемой длительностью искусственного кровообращения более 2-х часов, в ближайшем послеоперационном периоде.

Материалы и методы исследования. В клинике проведено исследование, в которое включили 10 пациентов (возраст в среднем 47-56 лет) с диагнозами: Аневризма восходящей аорты, недостаточность аортального клапана ФК 3, которым выполнены операции протезирование восходящей аорты, аортального клапана с реимплантацией коронарных артерий. Пациенты были разделены на 2 группы, 1-ая группа (5 пациентов) пациенты – это контрольная группа, с использованием открытого контура искусственного кровообращения, 2-ая группа (5 пациента) – это пациенты с использованием закрытого контура искусственного кровообращения. Общее время искусственного кровообращения в обеих группах составило 125-187 мин.

Результаты. Во 2-ой исследуемой группе значительно снизились дренажные потери крови, в среднем 60-100 мл по сравнению с контрольной группой, где в среднем дренажные потери 600-1500 мл. Потребности в переливании крови 5,1% во 2-ой группе, по сравнению с 43,4% в контрольной. В исследуемой 2-ой группы количество тромбозов в послеоперационном периоде у пациентов было выше, чем в контрольной группе.

Заключение. Это исследование показывает, что закрытый контур в сравнении с открытым, позволяет проводить сложные операции на сердце с планируемой длительностью искусственного кровообращения более 2-3 час.

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Конфликт интересов

Авторы заявляют об отсутствии конфликта интересов

Ключевые слова

искусственное кровообращение, оценка

Introduction

The closed circuit technique is that during artificial blood circulation from the right sections of the venous line enters a soft airless reservoir of the type of hemocon V 1600 ml, then through the line, which is connected through a centrifugal pump, is supplied to the oxygenator and through the arterial line to the aorta. Coronary, additional, left-hand suction is connected to a solid reservoir with a filter (V 3L) and is connected to a soft reservoir through a 1/4 "line. The flexible reservoir is installed vertically on the holder, the inlet of the venous line, the inlet of the perfusate coming from the coronary, additional left suction, the outlet to the line with a centrifugal pump to the oxygenator, the arterial line, the aorta are located at the bottom of the soft reservoir. When air enters the soft reservoir through the venous lines, they are removed through the line connected to the coronary suction, on which there are valve adapters located in the upper section of the soft reservoir. Air ingress is practically impossible [1,2,3].

At present, the issues of coagulopathy during cardiac surgery with the planned duration of artificial circulation of more than 2 hours are still becoming relevant, since this method is based on the blood flow outside the body along non-biological surfaces. Using the closed circuit method, which avoids contact of the perfusate with external air and excludes mechanical trauma to the blood in the centrifugal pump, which makes it possible to perform cardiac surgery in patients with a high risk of coagulopathy in the immediate postoperative pe-

riod and surgery with the planned duration of cardiopulmonary bypass [4,5,6,7,8,9].

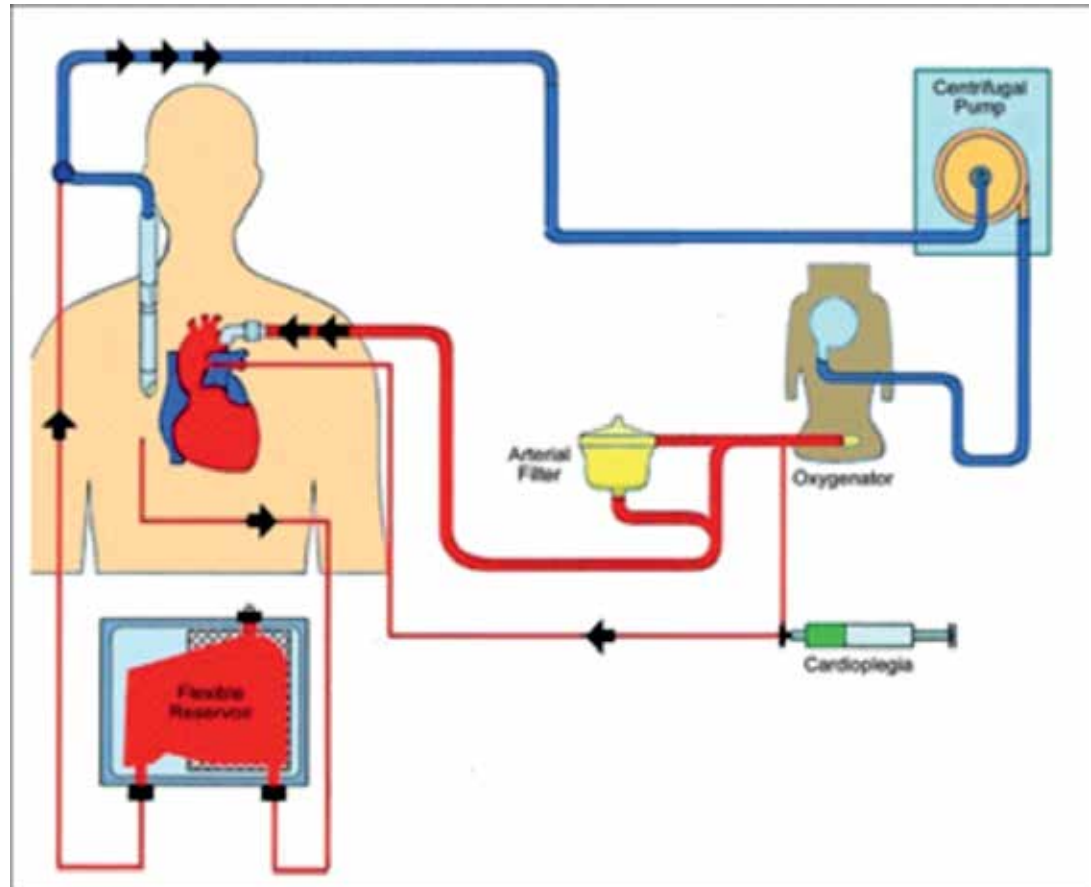
Materials and methods

In the clinic of JSC "National Scientific Center of Surgery named after A.N. Syzganov" a study was conducted, which included 10 patients (average age 47-56 years) with Diagnoses: Aneurysm of the ascending aorta, aortic valve insufficiency FC 3. Patients were divided into 2 groups, the 1st group (5 patients) patients are the control group, using an open circuit of artificial blood circulation, the 2nd group (5 patients) - these are patients using a closed circuit of artificial blood circulation. The average time of cardiopulmonary bypass in both groups is 125-187 minutes.

Results

A comparison of the two groups revealed a significant decrease in hemoglobin, hematocrit, erythrocytes after surgery with an open circuit of artificial circulation. Blood loss after sternum closure up to 12 hours after surgery in the control group and the comparison group was $900 \text{ ml} \pm 78$ and 200 ± 74 . The hematocrit level (1 hour after surgery) in the control group and the comparison group was 27 ± 3.25 and 35 ± 3.89 . The hemoglobin level (1 hour after surgery) in the control group and in the comparison group was $103 \text{ g/l} \pm 10.55$ versus $115 \text{ g/l} \pm 13.16$. The level of erythrocytes (1 hour after surgery) in the control group and in the comparison group was $3.4 \times 10^{12} / \text{l} \pm 0.35$ and $4.3 \times 10^{12} / \text{l} \pm 0.52$. The level of platelets (1 hour after surgery) in

Figure 1.
Connection scheme for closed cardiopulmonary bypass (Raed A., 2012)



the control group and in the comparison group was $126 \times 10^9 \text{ l} \pm 10.0$ and $234 \times 10^9 \text{ l} \pm 12.4$. The creatinine level (1 hour after surgery) in the control group and in the comparison group was $0.272 \text{ mg / dL} \pm 72$ and $0.275 \text{ mg / dL} \pm 71$. The urea level (1 hour after surgery) in the control group and in the comparison group was $34.5 \text{ mg / dL} \pm 7.2$ and $37.7 \text{ mg / dL} \pm 9.5$. Control laboratory tests: (16 hours after surgery) the hematocrit level in the control group and in the comparison group was 37 ± 3.2 and 44 ± 3.6 ; the hemoglobin level in the control group and in the comparison group was $105 \text{ g / l} \pm 10.2$ and $115 \text{ g / l} \pm 12.4$; the level of erythrocytes in the control group and in the comparison group was 3.74×10^{12} and $4.4 \times 10^{12} \pm 0.446$; the level of creatinine in the control group and in the comparison group was $1.030 \text{ mg / dl} \pm 0.192$ and $1.034 \text{ mg / dl} \pm 0.213$; the level of urea in the control group and in the comparison group was $32.3 \text{ mg / dl} \pm 9$ and $38.5 \text{ mg / dl} \pm 10$; the level of leukocytes in the control group and in the comparison group was $11.8 \times 10^9 \text{ l} \pm 2.3$ and $8 \times 10^9 \text{ l} \pm 10.3$; the level of platelets in the control group and in the comparison group was $220 \times 10^9 \text{ l} \pm 7.9$ and $278 \times 10^9 \text{ l} \pm 13.1$. Transfusion of erythrocyte mass and fresh frozen plasma, platelet suspension was performed in the immediate postoperative period for all 5 patients from the control group, and in the 2nd experimental group 2 patients underwent trans-

fusion of erythrocyte mass associated with blood hemodilution in the postoperative period. There was no lethality in both groups. In the 2nd study group, drainage blood loss significantly decreased, on average 60-100 ml compared to the control group, where the average drainage loss was 600-1500 ml. The need for transfusion of blood components was 5.1% in the 2nd group, compared with 43.4% in the control group.

Conclusion

The closed circuit technique allows avoiding contact of perfusate in a soft reservoir (hemocon) with external air, which is more physiological and less traumatic for blood cells, in contrast to oxygenators with a solid reservoir, as well as using a centrifugal pump that pumps perfusate into the oxygenator. arterial line, the aorta without mechanical clamping, which protects the blood from injury, in contrast to the clamping mechanical pump, which helps to prevent postoperative complications (hemolysis, hepatic, renal, pulmonary failure, reduction of the general inflammatory response, etc.). Reduces the risks of postoperative bleeding, reduces the need for transfusion of blood and its components, which allows complex heart surgeries with the planned duration of cardiopulmonary bypass more than 2-3 hours [4,5,9,10].

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