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Retrospective Analysis of Bypass-Related Complications at Iran's Cardiovascular Surgical Centers

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ABSTRACT

Introduction: In addition to the well-known benefits of cardiopulmonary bypass (CPB), there are also certain possible risks, some of which are avoidable and some of which are accidental. In addition to CPB, potentially life-threatening consequences include human error and mechanical disruptions. The purpose of this study is to conduct a retrospective analysis of CPB accidents in Iranian cardiovascular surgery departments.

Methods: This study included 151 Iranian perfusionists who were evaluated using a questionnaire created by the researchers. The questionnaire recorded all participants' demographic information as well as their experiences with human errors (e.g., perfusionist fatigue and drowsiness; errors in CPB circuit arrangement; and so on) and mechanical disturbances (cooling-warming circuit, oxygenator failure, electrical disruption, and so on). SPSS Version 16 was used to analyze all of the data.

Result: 1) venous obstruction and improper venous return had the highest recurrence rate of 89.4%, 2) Removing the venous cannula and venting the venous path 86.8%, 3) 79.5% were unable to raise (ACT) more than 400. Most significant injuries were caused by clots or thrombi during CPB (2.6%), 2) failure of the oxygenator (2.6%). Most deaths were caused by an air embolism (5.29).

Conclusions: Although the occurrence of human errors and mechanical disturbances cannot be predicted, they can be mitigated by the sharing of accidents and mistakes.

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Introduction

Humanity has always been accompanied by a desire for stability and a concern for one's own safety. Throughout history, people have looked for ways to enhance their general well-being and quality of life. Despite all the human effort put into creating security measures, accidents are still not entirely avoidable. On the other hand, technological advancements have made exceedingly risky systems dependent on human existence. Risk assessment is a method resulting in lowering risk variables. (1)

Cardiovascular diseases, including coronary artery disease, are considered to be one of the leading causes of death in the modern period (1). Cardiovascular diseases killed at least 15 million people globally in 1998, accounting for 20% of all deaths, according to a World Health Organization assessment (2). According to the World Health Organization, the death toll from heart disease would reach 23.6 million by 2030 (3). According to figures from the Iranian Ministry of Health and Medical Education, cardiovascular disease is the top cause of death in Iran, accounting for more than 35% of all deaths before accidents and cancer (4).

Coronary artery disease is a leading cause of death, illness, and disability in the Iranian population (5). While in affluent countries, the death rate from coronary artery disease declines with age, there is some evidence that it is increasing in Iran (6). Due to the high mortality rate connected with heart diseases, medical research is making considerable progress in saving lives. This involves cardiac bypass surgery.

A cornerstone therapeutic option for persons with coronary artery disease globally, pre and postoperative therapies have been shown in numerous trials to boost patients' survival rates and quality of life after coronary artery bypass graft surgery. Coronary artery bypass graft surgery is the most popular form of care for people with severe coronary artery disease who meet the necessary requirements (7).

As technology has evolved in recent years, the problems and challenges created by cardiopulmonary bypass (CPB) have diminished substantially. Perfusionists, on the other hand, must be well-versed in physiology and illnesses, as well as how to cannulate, utilize tubes and circuit pumps, and prim and dilute blood to calculate blood flow, hypothermia, acid and base, and important organ reactions (8).

A cardiac surgery team would be incomplete without a cardiopulmonary perfusionist. This individual should carefully and thoroughly set up the cardiopulmonary bypass apparatus, as a mistake in management could result in serious complications or death. The use of extraterritorial circulation in cardiac surgery has increased during the last 20 years, as has knowledge of perfusion technologies.

The prevalence of serious adverse effects related to perfusion appears to have increased globally (9,10). Voluntary reporting is close to error (close to an event error in which a mistake or error could harm the patient) in health care and other high-risk professions, a proven method used to reduce the incidence of serious side effects by reporting low-level issues that frequently lead to more serious events (11). The development of a statewide voluntary reporting system is one method that has not been explored but has the potential to drastically reduce the occurrence of serious side effects in perfusion. Furthermore, the system's accident data provides real-time information on how frequently significant side effects occur in perfusion .

Because there has been no previous study in Iran to identify the rate of accidents during cardiopulmonary pump use using the reporting method, the current study sought to investigate the incidence of cardiac-pulmonary pump accidents in Iranian heart surgery centers, identify the rate and type of accidents, and reduce these accidents and facilitate their reporting.

Methods

This retrospective study was conducted in 2021–2022 with the help of the Iranian Association of Perfusionists. Questionnaires were sent to active perfusionists at 100 heart surgery institutions in Iran .The ethical committee of Mashhad University of Medical Sciences accepted this study: ir.mums.medical.rec.1400.364 .This study was based on a researcher-centered questionnaire (the questionnaires are at the

end of the paper), which included perfusionists' demographic information (position, degree, pump history), hospital information, and more (type of hospital, the average number of heart operations per year, number of perfusionists employed, type of surgery, etc.) Variables include defects in the treatment center's heating-cooling system, air embolism, random displacement of cannulas, venous and arterial blockage, and cardioplegia; clotting of pump circuit after separation after Pertamine injection; aortic cannula and venous cannula exit coagulation disorders following bypass-transfusion of blood products; oxygenator defects and failures; displacement of the inlet pathway connection to the aortic cannola .

It's worth noting that the cardiopulmonary pump accidents included in the questionnaire come from several studies. This study doesn't include the surgeon's procedure or skill in producing accidents .

The SPSS16 statistical software encoded and stored all encoded data in computer memory.

Results

This study included 151 Iranian Perfusionists Association members who filled out questionnaires, and SPSS 16 statistical software was used to analyze the results. The Iranian Association of Blood Circulation Technology has issued certificates to 102 (62.5%) of the population. 60 (39.7%) of those interviewed had more than ten years of professional experience (Table 1).

The vast majority of participants work in academic-educational hospitals, with only 15.9% working in private hospitals. Most pumps (74.2%) are operated by two individuals, most operations (56.7%) are on adults, and most hospitals don't undertake transplants. No heart transplants despite efforts (70.9 percent). Most of the participants in this study don't regularly employ ventricular assist devices or perform heart transplant surgery in their facilities. Additionally, 69% of surgical facilities employ micropress-style oxygenators, and 98.7% use roller arterial pumps. (Table.2)

In this study, 72 individuals experienced a massive gas embolism following Trendelenburg, cooling, and therapy; three of them suffered life-threatening injuries, and one died. In 85 individuals, air embolisms caused cardioplegia, and one of them died. Aortic cannula tip detachment occurred in 77 (51.0%) cases, causing serious injury in one case, but no deaths were reported. In 94 (62.3%) of the patients, bypass artery obstruction increased pump pressure and resulted in injury in one.

Venous obstruction and inadequate return during bypass happened in 89.4% of the patients in the trial, however, no one died and two were severely injured. Cardioplegic pathway obstructions during bypass led to injury in 119 (78.8%) of the patients. During bypass, oxygen pathways were clogged, damaged, not linked, or detached in 95 (62.9%) patients, resulting in one death and one injury.

Despite inappropriate occlusion (setting circuit resistance for blood or liquid passage), no patient died in 104 (68.9%) patients who experienced this blockage. In 95 (62.9%) of the cases where the air and oxygenmixer were not changed, one patient was injured.

Table 1. Working experience.

0-2 years	15.9%
2-5 years	12.6%
5-10 years	31.8%
10-15 years	39.7%

Table 2. Heart transplant centers.

	Yes	**No**
Performing heart transplants in centers	29.1%	70.9%
Use of ventricular assist devices in the center	31.8%	68.2%
Use of separate organ perfusion in the center	41.7%	58.3%

In 95 cases (60.9%), the surgeon changed the vent channel and induced cardioplegia. In 3 cases, the heart stopped. In 82 (54.3%) of these situations, clamping the artery route caused an accident or death.

The intake and outflow of the oxygenator were moved in 85 (56.3%) patients, causing the patient to be injured. In 93 (61.6%) cases, medical errors (wrong medicine, allergies, drug dose) affected patients. Cardioplegic defects (wrong components, expiration date, contamination, dose) caused injury in 89 (58.9%) of the cases (Table.3). Neutralizing the heparin and starting the pump again caused a protamine response in 105 (69.5%) instances. Two people (1%) were severely injured. Following cardiac bypass, 74 (49.5%) individuals were affected by coagulation disorders, 2 (1.3%) were severely injured, and 4 (2.6%) people passed away. 66 (43.7%) of individuals were affected by the contaminated circuits that needed to be replaced. This was caused by a heat exchanger leak. There were no serious injuries. Table 3 shows the cardioplegic accidents.

In 106 participants (70.25%), cooling and heating problems did not result in mortality or serious injuries. When blood was discovered in the heat exchanger water, in 44 out of the 64 instances, no serious accidents or fatalities took place. 95 accidents were brought on by poor verbal communication between the surgeon and perfusionist, but none of them were fatal. In 78 cases, perfusionist tiredness led to drowsiness. In 120 cases, the hospital couldn't increase the activated clotting time above 400, but no one was injured or died. In 73 cases, the patient received the incorrect blood transfusion, which in 5 cases resulted in the patient's death, and in 1 case resulted in significant harm. Other reasons evaluated in cardiopulmonary bypass accidents are provided in Table 4 as statistical data in this study (Table 4).

Discussion

This study aimed to identify methods for preventing cardiopulmonary pumping-related mishaps in Iranian cardiac surgery facilities. Since there has been no analogous research undertaken in Iran, we explain our findings in light of other international publications.

Table 3. Cardioplegic accidents.

Accidents	It did not happen	What happened was		
		There was no damage incurred	Resulted in severe harm	Death
Transplantation of the cardioplegic vent pathway by the surgeon	37.1%	**62.9%**		
		60.9%	2.0%	-
Moving the connection of the entrance to the oxygenator and the exit from the oxygenator	43.7%	**56.3%**		
		55.6%	0.7%	-
Hypotension and supply generation during reverse autologous prime procedure	38.4%	**61.6%**		
		60.3%	1.3%	-
Error in cardioplegia (pollution, wrong ingredients, drug dosage...)	41.1%	**58.9%**		
		56.9%	2.0%	-
Reaction to protamine followed by reverse heparin and going back on the pump	30.5%	**69.5%**		
		68.3%	1.3%	-
The presence of a clot or thrombus during the pump	43.0%	**57.0%**		
		53.1%	2.6%	**1.3%**
Coagulation disorder following bypass	51.0%	**49.0%**		
		45.1%	1.3%	**2.6%**
Circuit replacement caused by extensive contamination	56.3%	**43.7%**		
		43.7%	-	-

Australia's 1997 perfusion research found a Lack of confidence in the sample procedure and the fact that someone else may answer are reporting hurdles. The small size of Australia and New Zealand has led the ranking to drop. The response rate is higher than in Koros et al .Also, the reporting time has been decreased to 18 months from 3-6 years. This analysis reveals that there are more accidents than injuries or deaths. The perfusionist's improved rate of response and reporting of accidents during the pump and its regular feedback to increase the perfusionist's awareness of the problems, safety, scientific approaches, and new technologies have made it possible to re-evaluate (12).

A 2007 retrospective analysis of French safety devices and CPB accidents was performed.

Tblea4. Evaluation of other causes of cardiopulmonary accidents.

Accidents	It did not happen	What happened was		
		There was no damage incurred	resulted in severe harm	Death
Removal of aortic cannula	50.3%		**49.7%**	
		48.3%	0.7%	0.7%
Arterial cannula occlusion	45.0%		**55.0%**	
		53.0%	1.3%	0.7%
Removing the venous cannula and letting air into the veins	13.2%		**86.8%**	
		86.1%	0.7%	-
During cannulation, the aortic cannula tip separated.	49.0%		**51.0%**	
		50.3%	0.7%	-
Blockage of the cardioplegic pathway during a cardioplegic injection	21.2%		**78.8%**	
		77.5%	1.3%	-
A failure to adjust the air and oxygen mixer	37.1%		**62.9%**	
		62.6%	0.7%	-
Inappropriate verbal communication between the surgeon and the perfusionist causes an accident.	37.1%		**62.9%**	
		62.9%	-	-
Because of sleepiness caused by perfusionist fatigue, an error occurred during the cardiopulmonary pump.	48.3%		**51.7%**	
		51.7%	-	-
Inability to raise activated clotting time (ACT>400)	20.5%		**79.5%**	
		79.5%	-	-
Leakage of blood into the water of the heat exchanger	57.6%		**42.4%**	
		42.4%	-	-
Massive gas embolism	52.3%		**47.7%**	
		45%	0.7%	2.0%
Without connecting emergency power, there is a power failure during the bypass	33.8%		**66.2%**	
		65.5%	-	0.7%
Circulation in the circuit is interrupted due to an electrical or mechanical failure of the pump machine.	27%		**72.2%**	
		70.2%	2.0%	-
one or more pumps failing mechanically	37.1%		**62.9%**	
		60.9%	1.3%	0.7%

This study's response rate is higher than previous surveys, likely due to the communication policy before the survey and participation in the plan, and also because this possibility exists following the recommendations of the guidelines compiled by the French HAS (Health Surveillance Organization) in 2004. Since 2004, it's been tracked.

2020 free and voluntary perfusion incident report (PIRS-2) study concern for the region's identity was cited as a major barrier to reporting occurrences. In Australia, culture was another barrier, whereas, in New Zealand, a single culture posed no barrier. Perfusionists need greater human and safety-related training. No precise theoretical model exists to handle the reporting challenge, and a review is underway. Online and voluntary reporting systems are better than the old PIRS approach. Fear of forensic medicine, lack of feedback, system complexity, time constraint, unimportance, lack of trust in hospital reporting systems, lack of sources to analyze incident reports, blaming, and amnesia are hurdles.

According to a qualitative study from 2000, incident reporting in health hasn't fulfilled its potential due to inadequate processing, low and insufficient clinician interaction, insufficient follow-up actions, insufficient funding, and lack of institutional support (14).

According to this study, heart pump incidents in Iran are prevalent and lead to major injuries and death. Future studies should be undertaken to better explore these results. By comparing country-specific studies with Iranian Perfusionist Association feedback, cardiac pump failure in Iran can be reduced, Considering the small number of participants in this study, surgery centers in Iran and other nations. Since this was the first study in Iran, there was nothing to compare, review, or discuss. This section reviews the studies. Soon enough. Australia's 1997 perfusion research found Lack of confidence in the sample procedure and the fact that someone else may answer is reporting hurdles. The small size of Australia and New Zealand has led the ranking to drop. The response rate is higher than in Koros et al. Also, the reporting time has been decreased to 18 months from 3-6 years. This analysis reveals that there are more accidents than injuries or deaths. The perfusionist's improved rate of response and reporting of accidents during the pump and its regular feedback to increase the perfusionist's awareness of the problems, safety, scientific approaches, and new technologies have made it possible to re-evaluate (12). A 2007 retrospective analysis of French safety devices and CPB accidents was performed. This study's response rate is higher than previous surveys, likely due to the communication policy before the survey and participation in the plan, and also because this possibility exists following the recommendations of the guidelines compiled by the French HAS (Health Surveillance Organization) in 2004. Since 2004, it's been tracked. The shorter the time span (one year), the less likely incidents are to be forgotten. Accident studies from different orientations aren't comparable. Due to attention to safety devices, this study's side effects and injuries are less severe than earlier ones. Considering the frequency of CPB procedures French perfusionists perform, the low incidence rate can provide the misleading impression that CPB is safe. It's safe, however, CPB protocols need improvement (13). 2020 free and voluntary perfusion incident report (PIRS-2) study Concern for the region's identity was cited as a major barrier to reporting occurrences. In Australia, culture was another barrier, whereas in New Zealand, a single culture posed no barrier. Perfusionists need greater human and safety-related training. No precise theoretical model exists to handle the reporting challenge, and a review is underway. Online and voluntary reporting systems are better than the old PIRS approach. Fear of forensic medicine, lack of feedback, system complexity, time constraint, unimportance, lack of trust in hospital reporting systems, lack of sources to analyze incident reports, blaming, and amnesia are hurdles. According to a qualitative study from 2000, incident reporting in health hasn't fulfilled its potential due to inadequate processing, low and insufficient clinician interaction, insufficient follow-up actions, insufficient funding, and lack of institutional support. I.T. (14).

Lack of a free reporting system, easy access, and feedback may be the key reasons for the low number of participants in Iran and other nations.

Conclusion

In this study, 1) venous obstruction and inappropriate venous return had the highest recurrence rate, 2) removing the venous cannula and venting the venous channel, and 3) being unable to increase (ACT) by more than 400 were the most common. Clots or thrombi during CPB caused the majority of serious injuries, as did oxygenator failure. The following were the leading causes of death: 1) an air embolism 2) Coagulation disorders (DIC) and blood product transfusion reactions, each with. The data revealed that human errors and technical flaws during cardiopulmonary bypass surgery are common throughout Iran. Because there is no standard reporting process in place, and the statistical population of participants is small, this study could serve as a foundation for larger studies on a variety of topics, including accident causes and resolutions, to find and fill current gaps in this field, as well as to help patients survive by removing human errors.

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Supplement

Regards, Respondent

Respectfully, the questionnaire you are about to complete was created and assembled in order for a research project titled "**Retrospective Analysis of Bypass-Related Complications at Iran's Cardiovascular Surgical Centers**" to be completed .

The study's goal is to "detect and rate heart-lung pump incidents in cardiac surgical centers." Obviously, the accuracy with which you complete the questionnaire determines the validity of the research outcomes. Your responses will be kept private, and the results will be published anonymously.

- Personal information of the perfusionist:

1. What is your official title or position ?
   A) Charged Perfusionist
   B) Perfusionist
   C) Blood Circulation Technology Student

2. Do you have a Master of Blood Circulation Technology degree ?
   A) Yes
   B) No

3. Do you have an Iranian Blood Circulation Technology Association certificate ?
   A) Yes
   B) No

4. How long have you been working in this field ?
   A) less than two years
   B) two to five years
   C)five to ten years
   D)ten to fifteen years Hospital details (perfusionist working there)

5. Tell me about the hospital or clinic where you work .
   A) Educational Establishment
   B) Government Center
   C) Private

6. How many cardiac operations are conducted each year ..... ?

7. How many perfusionists are employed at the hospital where you work ..... ?

8. How many perfusionists are in charge of the cardiopulmonary machine during each heart surgery ?
   A) two perfusionists and one assistant
   B) two perfusionists
   C) one perfusionist and one helper

9. What types of operations do you perform in your hospital ?
   A) Adult surgical procedures
   B) pediatric surgical procedures
   C)Adult and pediatric surgery procedures

10.Does your hospital perform heart transplants ?
   A) Yes
   B) No

11. Does your hospital use ventricular assist devices ?
   A) Yes
   B) No

12. Does your hospital conduct minimally invasive cardiac surgery (catheter ablation, pacemaker installation, implantable cardiac defibrillators)?
   A) Yes
   B) No

13. Do you employ venous return assisted suctioning (VAVD)?
   A) Yes
   B) No

14. Do you undertake organ perfusion separately ? (Abdominal aortic aneurysm surgery, lower limb ischemia after insertion of an intra-aortic pump balloon in the femoral artery).
   A) Yes
   B) No
   In the hospital, disposable equipment is available . ……..

15. How many cardiopulmonary machines do you currently have in your cardiac surgery center ? .....

16. What kind of arterial pump does your heart surgery center use ?
   A) Roller pump
   B) Centrifugal pump
   C)Both

17. What form of extracorporeal membrane oxygenator (ECMO) is used ?
   A) genuine membrane oxygenator
   B) microporous membrane oxygenator
   C) both

18. Is the perfusionist in charge of preparing and operating the intra-aortic balloon pump in the operating room ?
   A) Yes
   B) No

19. Does the operating room have an arterial blood gas analyzer (ABG)?
   A) Yes
   B) No

20. Is the pump started with the checklist checked ?
A) Yes
B) No

21. Using the circuit's pre-bypass filter during priming :
A) Yes
B) No

22.Application of the Babylon alarm along the arterial route :
A) Yes
B) No

23.Application of a venous reservoir level warning :
A) Yes
B) No

24.Is there an arterial pressure manometer in the arterial path ?
A)Yes
B)No

25. fitted with an arterial blood gas monitor in the entryway:
A) Yes
B) No

26. Using a lamp or lighting on the pump:
A) Yes
B) No

27. Babbel trap along the path of cardioplegia:
A) Yes
B) No

28. Is there a pressure manometer on the cardioplegia track ?
A) Yes
B) No

29.Does the cardioplegia path have a Babbel alarm ?
A) Yes
B) No

30.Is the rotating handle of the roller pump or centrifugal pump available in the operating room?
A) Yes
B) No

31. Does the cardiopulmonary machine have a battery or a UPS device ?
A) Yes
B) No

32. Are the disposable cardiopulmonary machine devices retained in the operation room ?
A) Yes
B) No

33.Is the oxygen capsule available in the operating room in case of an emergency ?
A) Yes
B) No

34.Do you turn on the tank's pressure control valve ?
A) Yes
B) No

Answer the following questions regarding cardiopulmonary pumping accidents that may occur during cardiac surgery:

35. massive gas embolism in the patient, followed by Trendelenburg position, cooling, and administration of medication:
A)It did not occur .
B) What happened was: B-1) No harm was done; B-2) Inflicted substantial harm; B-3) Death

36. An air embolism was induced for the patient via cardioplegia :
A) It did not occur .
B) What happened was: B-1) No harm was done; B-2) Inflicted substantial harm; B-3) Death

37. Air embolism generated by vent or suction reversal rotation :
A) It did not occur .
B) What happened Was: B-1) No one was hurt ; B-2) Inflicted substantial harm; B-3) Death

38.The air in the artery channel or cardioplegia did not reach the patient during CPB :
A) It did not occur .
B) What happened was: B-1) no damage was done; B-2) substantial damage was done

39. Pipes in the circuit path damaged or ruptured, or connectors disconnected :
A) It did not happen .
B) What happened was: B-1) There was no damage incurred B-2) resulted in severe harm .B-3) Death

40.During the bypass, the power cut out at the hospital, and neither the emergency power of the hospital nor the pump device's battery were connected .
A) This did not occur .
B) Happened: B-1) No injury; B-2) resulted in severe harm; B-3) Death

41. Circulation has ceased due to a mechanical or electrical malfunction in the cardiopulmonary machine :
A) This did not occur .
B) Happened: B-1) No injuries incurred; B-2) Causing severe damage; B-3) Demise

42. Failure of one or more pumps (arterial, cardioplegic, or suction) during CPB :
A) This did not occur.
B) Happened: B-1) no harm was caused; B-2) caused severe harm; B-3) demise

43. How many minutes have you manually turned the pump shaft handle ?
A) Less than 1 minute
B) 1-5 minutes
C) 6-20 minutes
D) Over twenty minutes

44.Removal of the aortic catheter :
A) This did not occur.
B) Happened: B-1) No injuries incurred B-2) A severe injury was caused B-3) Death

45.Obstruction of arterial cannula (femoral or aortic):
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

46.Removing the intravenous cannula and pushing air into the venous pathway (air lock)?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

47.Aortic cannula tip detachment during cannulation?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

48. Obstruction of the arterial pathway during bypass and elevated blood pressure?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

49. Obstruction of the venous path and lack of appropriate return during bypass:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

50.Obstruction of the cardioplegic pathway during the administration of cardioplegic injection:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

51.Obstruction, perforation, absence of connection, and disconnection of the oxygen path during bypass:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

52.Non-occlusion (regulation of circuit resistance for the passage of blood or liquid) is suited for any pump:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

53.Not connecting the oxygen and air sockets:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

54.The air and oxygen mixer (blender) were not adjusted:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

55. The surgeon changed the vent and cardioplegia's direction:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

56.Was an accident caused by clamping the arterial pathway instead of the venous pathway during the pump?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

57. Relocating the oxygenator's exit path's link to the inlet path:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

58. Blood pressure drop and RAP (reverse autologous perim) complications:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

59. Medical error (incorrect medication, medication allergy, and medication dosage):
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

60. Error in cardioplegia (incorrect components, expired date, contamination, and excessive dose):
A) This did not occur.
B) Happened: B-1) No injuries incurred B-2) A severe injury was caused B-3) Death

61. Protamine reaction following the reversal (neutralization) and reinfusion of heparin:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

62. Clot or thrombus presence during CPB:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

63.Coagulation disorders (DIC) after bypass:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

64.The circuit must be changed due to extensive contamination (water pouring from the heat exchanger into the oxygenator):
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

65.A heater-cooler defect:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

66.Water leaking from the heat exchanger into the blood
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

67.Blood leaking into the heat exchanger's water:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

68.Oxygenator defects and malfunctions:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

69.The situation in which it is essential to replace the oxygenator.....

70.Reaction following blood product transfusion:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

71.The patient received the wrong blood transfusion:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

72.Inability to raise ACT (activated clotting time) above 400:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

73. Heparin's inadequacy as an anticoagulant in the CPB circuit:
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

74.Did a patient accident result from improper cooling or heating adjustments made when going to the pump or disconnecting from the pump?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

75. Did sleepiness brought on by the perfusionist's exhaustion create a mishap during the heart-pulmonary pump?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death

76.Has a misunderstood verbal communication between the perfusionist and the surgeon resulted in an accident?
A) This did not occur.
B) Happened: B-1) No injuries incurred; B-2) A severe injury was caused; B-3) Death