



**THE AMERICAN BOARD OF
CARDIOVASCULAR PERFUSION**

1975-2025 50th Anniversary

American Board of Cardiovascular Perfusion

Examination Guidebook

Published by the American Board of Cardiovascular Perfusion



**A Guidebook of the
American Board of Cardiovascular Perfusion**

for the

**Perfusion Basic Science
Examination (PBSE)**

and the

**Clinical Applications in Perfusion
Examination (CAPE)**

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Mission Statement

The American Board of Cardiovascular Perfusion acknowledges that peer recognition is responsible for the quality assurance involved in the credentialing process that is available to the perfusion community. The American Board of Cardiovascular Perfusion respects its position and responsibility in that process and acknowledges the many Certified Clinical Perfusionists, educational program directors, collaborating organizations, and others in the perfusion community for their continued support of the American Board of Cardiovascular Perfusion and its credentialing process. In accordance with its commitment to establish and maintain interactive communication with individuals, institutions, and organizations, the American Board of Cardiovascular Perfusion respectfully submits the following Mission Statement to guide its growth and development:

The American Board of Cardiovascular Perfusion will strive to develop and maintain quality standards in cardiovascular perfusion that promote safety and protection of the public. These standards will include attainment and enhancement of knowledge, skills, and ethical professional conduct of Certified Clinical Perfusionists by supporting preservice and inservice education. This support will emanate from the design, implementation, and administration of the credentialing process. Additionally, this support will include stimulation of innovative educational activities and promotion of ethical professional development.

The American Board of Cardiovascular Perfusion, in acknowledging the leadership role of a professional credentialing body, will aspire to provide exemplary, responsible, and ethical leadership in all of its endeavors.

Introduction to the ABCP Examination Process

PURPOSE AND DESCRIPTION OF THE ABCP EXAMINATION PROCESS

The purpose of the American Board of Cardiovascular Perfusion (ABCP) examination process is to provide certification in cardiovascular perfusion as evidence that a perfusionist's qualifications for operation of extracorporeal equipment are recognized by their peers. Application to the ABCP certification process is voluntary. Certification is not intended to define requirements for employment, to gain special recognition or privileges, to define the scope of extracorporeal circulation, or to state who may or may not engage in cardiovascular perfusion.

The examination is administered in two parts. Part I, the Perfusion Basic Science Examination (PBSE), multiple-choice examination designed to cover perfusion basic science and cardiopulmonary bypass. Part II, the Clinical Applications in Perfusion Examination (CAPE), is also of a multiple-choice format, in which a series of clinical scenarios are presented, each with a series of questions. The number of questions on Part II may vary depending on the scenarios used.

ELIGIBILITY REQUIREMENTS

Applicants for the Perfusion Basic Science Examination may be currently enrolled in an accredited School of Cardiovascular Perfusion and anticipating graduation at least four weeks prior to the date of the examination or have graduated from an accredited School of Cardiovascular Perfusion. Applicants for the PBSE must submit or arrange for submission of:

- (1) a Clinical Education Record documenting seventy-five (75) cardiopulmonary bypass (CPB) procedures performed prior to graduation while in the accredited school of perfusion (see further details below regarding case requirements);
- (2) a current, official transcript of credits from the educational institution documenting graduation; and
- (3) a statement of satisfactory clinical competency from the Clinical Competency Committee Chairperson.

Applicants for the Clinical Applications in Perfusion Examination must have conducted a minimum of 40 additional independent clinical perfusions after graduation.

Those candidates meeting all requirements for both examinations may make application to sit for both examinations at the same site.

PERFUSION BASIC SCIENCE EXAMINATION (PBSE) APPLICATION PROCEDURE

Application window opens May 15th for the fall exam.

Application window opens November 15th for the spring exam.

Applicants are required to submit or arrange for submission of the following:

1. a completed [PBSE application](#);
2. exam fee(s);
3. The [Clinical Education Record](#) documenting seventy-five (75) cardiopulmonary bypass (CPB) procedures performed prior to graduation. A minimum of 10 clinical pediatric cases requiring cardiopulmonary bypass must be observed or performed for the certification process. Pediatric cases performed may count toward the 75-minimum cardiopulmonary bypass case requirement; observational pediatric cases do not count toward the 75-minimum cardiopulmonary bypass case requirement. As of July 1, 2023, 5 of the 75 Primary Clinical Perfusion Activities (PCPA) must qualify as 3P - ECMO or 6P -VAD cases per [Table A Primary Clinical Perfusion Activities CAPE \(PCPA\)](#) and the remaining 70 (or more) PCPA must qualify as 1P - primary cardiopulmonary bypass (CPB). Credit will be considered for perfusion experience only when the following criteria are met:
 - After 08/01/24, the student performed all seventy-five (75) cases within the United States of America, U.S. Territories, and/or Canada
 - The student participated in the preoperative planning and selection of equipment used during the perfusion
 - The student performed those technical manipulations that constituted the essential parts of the procedure itself
 - An instructor must be physically present during cardiopulmonary bypass cases and that instructor must be a Certified Clinical Perfusionist (CCP)

Definitions of Qualifying Primary Clinical Perfusion Activities:

- a. 1P - Cardiopulmonary Bypass (CPB): The primary operator of the heart-lung machine, used during cardiac surgery and other surgeries that require extracorporeal circulation, used to manage the patient's physiological status. A cardiopulmonary bypass case requires the following:
 - Pre-op patient assessment
 - Equipment selection
 - Circuit Preparation
 - Initiation of Cardiopulmonary bypass
 - Physiologic management of the patient on CPB
 - Termination of CPB
 - Post bypass instructor debriefing

A pediatric cardiopulmonary bypass observation requires the following:

- Equipment selection briefing
- Observation of circuit preparation
- Observation of initiation of CPB
- Observation of physiologic management during CPB
- Observation of termination of CPB
- Post bypass debriefing
- Must be physically present in the room

- b. 3P - ECMO: the primary operator of Extra-Corporeal Membrane Oxygenation (ECMO) circuit that provides life support for respiratory and/or cardiac failure. The CCP candidate must be documented at the institution as a member of the patient care team for that period and a physician name must accompany the case in the Clinical Activity Report. An ECMO case requires the following:
 - ECMO patient assessment;
 - ECMO circuit preparation; and
 - ECMO initiation, stabilization, and management for four hours
 - **or** ECMO patient assessment and six hours of bedside monitoring (in place of other options above)
 - c. 6P - VAD: primary operator of the Ventricular Assist Device (VAD) that provides cardiac support for the failing heart. A VAD case requires the following:
 - VAD patient assessment;
 - VAD preparation or observation of preparation; and
 - VAD initiation, stabilization, and management for four hours
 - **or** VAD patient assessment and six hours of bedside monitoring (in place of other options above)
4. a current, official transcript of credits from the accredited school of perfusion, indicating date of graduation; and
 5. a statement of satisfactory clinical competency from the Clinical Competency Committee Chairperson or program director at the accredited school of perfusion.

These items will be verified.

Application materials due March 10th for the spring exam.

Application materials due September 15th for the fall exam.

Please note, all applications submitted after the September 15th or March 10th dates for each testing window will have a \$100 late fee applied. Eligibility to register with Pearson VUE is contingent upon all documentation being received in the National Office prior to registration.

NOTE: Candidates retaking the examination are NOT required to resubmit or arrange for resubmission of the Clinical Education Record, the official transcript, or the Clinical Competency Statement. These items will remain on file from the previous application.

CLINICAL APPLICATIONS IN PERFUSION EXAMINATION (CAPE) APPLICATION PROCEDURE

Application window opens May 15th for the fall exam.

Application window opens November 15th for the spring exam.

Applicants are required to submit or arrange for submission:

1. a completed [CAPE application](#);
2. exam fee(s)
3. a [Case Summary](#) documenting forty (40) independent Primary Clinical Perfusion Activities (PCPA) performed after graduation. Activities are defined on [Table A Primary Clinical Perfusion Activities CAPE \(PCPA\)](#).

These items will be verified.

Application materials due March 10th for the spring exam.

Application materials due September 15th for the fall exam.

Please note, all applications submitted after the September 15th or March 10th dates for each testing window will have a \$100 late fee applied. Eligibility to register with Pearson VUE is contingent upon all documentation being received in the National Office prior to registration.

NOTE: Candidates retaking the examination are NOT required to resubmit or arrange for resubmission of the Case Summary. This item remains on file from the previous application.

LATE APPLICATIONS

Applicants submitting applications for either portion of the certification examination after the deadline will be assessed a late fee of \$100.00.

COMPLETE APPLICATION CHECKLIST

- The Perfusion Basic Science Examination (PBSE) Application
- PBSE Application Fee
- Late payment of \$100 if application is submitted after deadline
- Official Transcript
- Clinical Competency Form/Letter
- PBSE Case Record of 75 cases

- The Clinical Applications in Perfusion Examination (CAPE) Application
- CAPE Application Fee
 - Late payment of \$100 if application is submitted after deadline
- CAPE Case Record of 40 cases

Table A – CAPE Primary Clinical Perfusion Activities (CAPE-PCPA)

Primary Clinical Perfusion Activities (PCPA)	Clinical Definition	Core Elements
1P Cardiopulmonary Bypass (CPB), Primary	A Certified Clinical Perfusionist (CCP) who is the primary operator of the heart-lung machine, used during cardiac surgery and other surgeries that require extracorporeal circulation, used to manage the patient's physiological status.	Blood pump, reservoir, heat exchanger, oxygenator, extracorporeal circuit used accordingly with hemodynamic/lab value monitoring. Multiple pump runs per one OR visit equal 1 primary case credit.
2P Instructor CPB Bypass, Primary (Not eligible for PBSE or CAPE examination cases.)	A Certified Clinical Perfusionist (CCP) who serves as a clinical instructor to a student enrolled in an accredited perfusion program during primary clinical perfusion activities that require extracorporeal circulation, used to manage the patient's physiological status.	Blood pump, reservoir, heat exchanger, oxygenator, extracorporeal circuit used accordingly with hemodynamic/ lab value monitoring. Primary clinical perfusion activities (PCPA) performed as clinical instructor in an accredited program are considered a primary perfusion activity and will receive full case credit. During clinical instruction in which the student is operating extracorporeal circulation equipment, there must be direct one-to-one supervision by the clinical instructor. Students may also receive credit toward certification eligibility for the same case.
3P Extracorporeal Membrane Oxygenation (ECMO), Primary	A Certified Clinical Perfusionist (CCP) who is the primary operator of Extracorporeal Membrane Oxygenation (ECMO) circuit that provides life support for respiratory and/or cardiac failure. The CCP must be documented at the institution as a member of the patient care team for that period and a physician name must accompany the case in the Clinical Activity Report.	Extracorporeal circuit, oxygenator, heat exchanger used accordingly with hemodynamic/lab value monitoring. For each ECMO case, one case credit per 24 hours will be awarded for initiating and bedside managing ECMO (4-hour minimum) or bedside managing (6-hour minimum). No simultaneous credit will be awarded for managing multiple ECMO patients in this time period.

<p>4P</p> <p>Normothermic Regional Perfusion (NRP), Ex Vivo Organ Perfusion, Primary</p> <p>(Not eligible for PBSE examination cases.)</p>	<p>A Certified Clinical Perfusionist (CCP) who is the primary operator of an (1) extracorporeal device/system used during organ recovery that require extracorporeal circulation, used to manage the patient's physiological status or of an (2) extracorporeal device, including an oxygenator/de-oxygenator and pump, used to manage the physiologic state of isolated and separated human organs from the body, for potential transplant opportunities.</p>	<p>Reservoir, blood pump, heat exchanger, oxygenator, extracorporeal circuit used accordingly with hemodynamic, temperature, and lab value monitoring. No simultaneous credit will be awarded for managing multiple organs.</p>
<p>5P</p> <p>Veno-Venous or Left Heart Bypass, Isolated Limb, Primary</p> <p>(Not eligible for PBSE examination cases.)</p>	<p>A Certified Clinical Perfusionist (CCP) who is the primary operator of an extracorporeal device used to perfuse specific vascular regions within the circulatory system or recirculate venous blood for purposes such as clot/tissue removal. the primary operator of an extracorporeal device used to deliver anticancer drugs directly to an arm, leg, or organ and manages the patient's physiological status.</p>	<p>Blood pump, extracorporeal circuit used accordingly with hemodynamic/lab value monitoring.</p>
<p>6P</p> <p>Ventricular Assist Device (VAD), Primary</p>	<p>A Certified Clinical Perfusionist (CCP) who is the primary operator of the Ventricular Assist Device (VAD) that provides cardiac support for the failing heart.</p>	<p>For each VAD case, one case credit per 24 hours will be awarded for initiating and managing VAD or bedside managing (6-hour minimum). No simultaneous credit will be awarded for managing multiple VAD patients in this time period.</p>

Computer-Based Testing

The Perfusion Basic Science Examination (PBSE) and the Clinical Applications in Perfusion Examination (CAPE) are administered at Pearson VUE testing centers in the United States, U.S. Territories, and Canada. The examination windows are in April and October; the exact time frame will be posted to the [website](#) and sent to each examinee by email. Examinations may be taken during that time period only. The duration of each examination is four hours and both examinations may be taken on the same day, depending on test site availability.

Prior to registering for the examination(s) with Pearson VUE, the examinee must complete the ABCP application process and meet the ABCP deadlines.

Once the application process has been completed, the ABCP National Office will upload applicant information to Pearson VUE. Once approved, Pearson VUE will issue an approval email to the email address provided with your applications where you may schedule, cancel, or reschedule your test online. Available test sites, times, and locations will be identified upon scheduling.

In order to register online, you must have a valid email address. Examinees can also register using the Pearson VUE telephone system 877-839-7768 in U.S./Canada (Monday–Friday 7 a.m. to 7 p.m. U.S. Central Time). In order to ensure the best selection of testing sites and times, please register as soon as possible after being notified by the ABCP National Office that you have been accepted for the examination(s).

The candidate is required to present one form of original (no photocopy or digital ID), valid (unexpired) ID; government-issued with name, recent recognizable photo, and signature. You can find a list of acceptable ID's here: [Acceptable Identification](#).

The name on the Pearson VUE reservation must match the name on your IDs or you may be denied admission. For example, if your driver's license is issued to Robert L. Doe and you have registered with ABCP using your nickname Larry Doe, you will be denied admission. Contact the ABCP National Office immediately if there is a discrepancy between the name on the reservation and your photo ID.

You may cancel or reschedule up to 24 hours before your appointment at no cost (via online or phone). Pearson VUE will send you a confirmation email each time you reschedule or cancel an appointment. There are multiple steps to reschedule online, so be sure that you complete all steps until the "Your appointment is rescheduled" screen is displayed. If you do not receive a confirmation email, please recheck the status of your appointment.

If you fail to cancel 24 hours prior to your appointment, or if you miss your appointment, show up late, or provide inadequate identification, you will not be able to make a new appointment without paying the ABCP exam retest fee.

Additional information is available via the links provided in your email from Pearson VUE.

Preliminary examination results will be provided at the end of each testing session. Official examination results will be provided by the ABCP National Office four to six weeks following the exam.

Examination Information

PRACTICE-RELATED CONTENT

The ABCP examinations are criterion-referenced, based on an ongoing task/practice-related analysis using recognized procedures for task analysis and examination development. The ABCP Knowledge Base is designed to cover the scope of perfusion practice required of a minimally certifiable perfusionist. Test specifications are derived from the current practice-related knowledge base using the content objectives. The questions on the examinations are validated annually using both qualitative and quantitative item analysis procedures including current practice relevance, level of difficulty and an item discrimination index.

The ABCP Knowledge Base is revalidated, every five to seven years by practicing CCPs who are asked to respond to each item on the knowledge base according to the frequency with which each item is used and the importance of each for public protection. The responses are subsequently reviewed and the document is revised and revalidated in accordance with the data from the survey.

THE ITEM POOL, KNOWLEDGE BASE, AND EXAMINATION ARE INDIVIDUALLY COPYRIGHTED; THEREFORE, ANY DISTRIBUTION OF THE EXAMINATION CONTENT THROUGH ANY FORM OF REPRODUCTION, ORAL OR WRITTEN COMMUNICATION WITHOUT THE EXPRESS WRITTEN CONSENT OF THE AMERICAN BOARD OF CARDIOVASCULAR PERFUSION IS STRICTLY PROHIBITED.

TEST CHARACTERISTICS

The American Board of Cardiovascular Perfusion certification examination is composed of two parts, both of which must be passed prior to the granting of the Certified Clinical Perfusionist (CCP) credential. Part I of the examination, the Perfusion Basic Science Examination (PBSE), multiple-choice examination designed to cover perfusion basic science and cardiopulmonary bypass procedures. Part II of the examination, the Clinical Applications in Perfusion Examination (CAPE), is a clinical applications examination in multiple-choice format. A series of clinical scenarios are presented, each with a series of questions. The number of questions on Part II may vary, depending on the scenarios used. The examination items are drawn from the ABCP item banks. Each item has been constructed to measure specific content from the knowledge base. Conventional item analysis techniques are employed to ensure reliability and validity of measurement for all items.

TEST QUESTION EVALUATION

Each item in the test bank is reviewed annually by Directors of the ABCP with assistance from test development specialists. The test development specialists assist the Directors in planning and constructing the questions, editing the technical aspects of the questions and conducting statistical analyses of the test questions to determine their validity and reliability. Item analysis procedures include examining the level of difficulty and the item discrimination indexes for each question. Items which are not determined to meet both quantitative (statistical) and qualitative (content) standards are removed from the test bank.

BIAS

Questions are written to avoid racial, ethnic or gender bias. Careful consideration is given to each question during the annual qualitative evaluation of the items in the test bank. Any words or phrases that may be considered offensive or harmful to any racial, ethnic, or gender subgroup are removed. There is a section at the end of the exam for any comments.

CANDIDATES WITH DISABILITIES

Candidates who seek reasonable accommodations under the Americans with Disabilities Act will be required to provide four weeks' notice and appropriate documentation of the disability and need for accommodation. The test site will be fully accessible, and reasonable accommodations of test administration procedures will be provided to enable such candidates to accurately demonstrate their knowledge and skill. If you need to request accommodations, please contact info@abcp.org.

TIME LIMITS

Candidates are allowed four hours to complete the examinations. The time limit has been established from the past years of administering the PBSE and the CAPE. It has been clearly demonstrated that over 95% of the candidates complete the examination within the 4-hour period for both examinations.

SCORING

Scaled scores are created when the number of questions that candidates answer correctly is mathematically transformed. Scaled scoring is utilized by many other prominent exams, such as the SAT, ACT, LSAT, and MCAT. The ABCP has implemented scaled scoring for both the CAPE and PBSE examinations using a scaled score with a range of 120 to 480, with the cut score set at 400.

The use of scaled scores does not affect whether or not individuals pass or fail the examination. The pass/fail decision is always made by comparing the number of questions answered correctly to the passing score that was established using a criterion referenced process. All candidates who correctly answer more items than are required to pass the examination form that they took will obtain scaled scores that are between 400 and 480. Candidates who did not answer enough items to pass will obtain scaled scores between 120 and 399.

The use of scaled scores allows for the direct comparison of scores from one examination form to another because the passing standard will remain constant at a scaled score of 400. This process will allow candidates to better understand their exam performance when comparing their score from one exam form to another, regardless of when they test.

Immediately after completing the examination, examinees will receive a preliminary pass/fail result as a print-out from the Pearson VUE location administering the exam. This result is not used for credentialing. The National Office must receive final, numbered scores from the test company for credentialing purposes. The final, official scores will be provided to examinees on an individual basis by the National Office four to six weeks after the exam(s).

PASS-FAIL STANDARD

The pass-fail standard is set by the Directors of the ABCP with assistance from the test development specialists. The Directors who serve as the panel of experts are experienced, practicing, Certified Clinical Perfusionists (CCPs).

The ABCP strongly recommends that individuals who fail the examination seek remediation in the specific areas in which they encounter difficulty on the examination. Without this remediation, it is highly unlikely that they will pass the examination at the next administration.

Theoretically, any individual with the motivation to remediate deficiencies may ultimately pass the examination, but it is incumbent upon individuals to determine their course of remediation and the length of time in which to accomplish the remediation.

There is no limit to the number of times an examinee may take the examination. However, candidates may only take an exam one time within the same exam window.

Please note: Some states do have limitations for licensure purposes on the number of times an examinee takes each examination. Please review all licensure requirements before reaching out to the ABCP National Office for verification.

REPORTING EXAMINATION RESULTS

Preliminary examination results will be provided at the end of each testing session. Certification status will be provided by the ABCP National Office four to six weeks following the exam.

CONFIDENTIALITY OF EXAMINATION RESULTS

Examination results are released only to the individual candidate and only in writing. No other individuals or institutions may receive the scores identified by candidate name without the candidate's written permission. Perfusion schools receive individual anonymous reports of their students' results.

CANDIDATE CHALLENGES AND APPEALS

The ABCP offers the opportunity to retake the examination an unlimited number of times. Candidates may only take an exam one time within the same exam window.

Should examinees feel that there were items that were not accurate on the examination, they should send their comments to info@abcp.org within 30 days of the test. The ABCP will review all comments submitted. Should an error be found, every examinee will be given the benefit of the correction.

RULES FOR CONDUCT OF THE EXAMINATIONS

1. Pearson VUE proctors will carefully check credentials before the examination begins.
2. Candidate is required to present two forms of original (no photocopies or digital IDs), valid (unexpired) IDs; one form as a primary ID (government issued with name, recent recognizable photo, and signature) and one form as a secondary ID (with at least a name and signature, or name and recent recognizable photo). You can find a list of acceptable ID's here: [Acceptable Identification](#).

The name on the Pearson VUE reservation must match the name on your IDs or you may be denied admission. For example, if your driver's license is issued to Robert L. Doe and you have registered with ABCP using your nickname Larry Doe, you will be denied admission. Contact the ABCP National Office immediately if there is a discrepancy between the name on the reservation and your photo ID.

Examination Preparation

STUDY TECHNIQUES

Studying for the ABCP examinations should be regarded as an important learning tool, in that it provides an opportunity to synthesize knowledge of the entire perfusion practice-related knowledge base, thus providing an overall picture of perfusion.

The examinations should be approached seriously, but without undue worry. Although some anxiety has been indicated to be beneficial in test taking, it is inadvisable to become upset and unduly nervous, as this may prevent methodical thought processes.

The most effective way to remove anxiety regarding the ABCP examinations is to study the content areas in the test matrix thoroughly. In preparing for the examinations, it will be necessary to recall and comprehend a vast amount of factual data. You must also be able to analyze, synthesize, and evaluate scientific information and apply it in clinical situations. In order to develop the interrelationships for successful completion of the examination, it is essential to develop effective study techniques.

Study techniques vary from person to person, depending on the learning style (listening, reading, writing, or verbalization) that produces the most effective study for the individual. Generally, techniques utilizing a combination of learning modes are the most effective methods of study.

To organize written materials, it is effective to survey textbook chapters, journal articles, reading notes, and lecture notes, and pick out the main topics as listed in the test matrix. Once you have an overall view of how the main ideas combine into a logical whole, you will be able to study details and supporting materials, since there will be main points around which they can be organized.

Once the material has been surveyed and supporting data have been organized around the main content areas, it will be useful to recite and review the material that you have covered. Reciting or reflecting upon the material requires restating the information from your own point of view and manipulating the facts and ideas in your mind.

Reviewing involves rereading and making sure that you understand the relationships that exist in the material. In addition, reviewing can be effectively accomplished by using electronic study techniques, developing individual study materials, and/or forming study groups.

In planning for studying, it is important that you do not cram weeks of work into a few hours. It will be more productive if you study and review portion by portion over a long period of time, as spaced studying over a period of time has been shown to be more effective than massed studying.

In summary, you should review the examination matrix, collect the resources you will use in your study, determine your best mode(s) of learning, and plan specific study sessions over a period of time scheduled around the time and method of study that is most effective for you individually.

In addition, after much consideration by the Board and support by the community, the ABCP has relaunched the practice exams on a new platform. These online practice exams have been created to mirror the format of the actual exams and aim to reduce testing anxiety by giving candidates a feel for the actual exams. To learn more or order a practice exam, please visit the [PRACTICE EXAM](#) shopfront.

Samples of Test Items

Perfusion Basic Science Examination

1. An advantage of continuous warm blood cardioplegia is:
 - A. increased oxygen delivery.
 - B. significantly decreased myocardial oxygen tension.
 - C. a shift of the oxygen dissociation curve to the left.
 - D. lower myocardial oxygen consumption.

2. Intra-aortic balloon augmentation is contraindicated in patients with:
 - A. prosthetic aortic valves.
 - B. aortic insufficiency.
 - C. ventricular septal defects.
 - D. peripheral atherosclerosis.

3. When using a roller pump, aortic dissection caused by the aortic cannula may be detected by:
 - A. elevated venous return.
 - B. elevated arterial line pressure.
 - C. elevated left radial artery pressure.
 - D. increased venous saturation.

4. The most significant advantage of venovenous ECMO over venoarterial ECMO is:
 - A. improved cardiac support.
 - B. unaffected pulmonary hemodynamics.
 - C. superior arterial oxygenation.
 - D. reduced pulmonary blood flow.

5. When compared to true membranes, hydrophobic microporous membrane oxygenators may exhibit which of the following characteristics?
 - A. increased oxygen transfer.
 - B. fluid passage to the gas compartment.
 - C. decreased carbon dioxide transfer.
 - D. reduced surface boundary layer

6. Polyvinyl Chloride tubing in the roller pump usually deteriorates by:
 - A. crumbling away from the outside in.
 - B. crumbling away from the inside out.
 - C. cracking and breaking from the outer edge in.
 - D. cracking and breaking from the inner edge out.

7. Activated Factor X is the first step in which of the following coagulation stages?
- A. intrinsic pathway.
 - B. common pathway.
 - C. waterfall sequence.
 - D. extrinsic pathway.
8. Under normal physiological conditions, which organ has the lowest oxygen consumption per unit weight?
- A. brain.
 - B. kidney.
 - C. lungs.
 - D. liver.
9. The release of norepinephrine by the nerve impulses causes interaction with:
- A. alpha receptors.
 - B. beta receptors.
 - C. baroreceptors.
 - D. chemoreceptors.
10. In a patient with a chronic hypoxic condition, the oxyhemoglobin dissociation curve is shifted to the right by:
- A. the Haldane effect.
 - B. increased 2,3 DPG levels.
 - C. the Bohr effect.
 - D. increased ADP.
11. The use of Citrate Phosphate Dextrose (CPD-A) blood in the perfusate affects which parameter?
- A. potassium.
 - B. ionized calcium.
 - C. total carbon dioxide.
 - D. blood sugar.
12. Dexamethasone is a potent, synthetic:
- A. curarizing agent.
 - B. anti-arrhythmic.
 - C. adrenocortical steroid.
 - D. beta blocker.

13. Deferoxamine (desferrioxamine) administered in large doses is a(an):
- A. diuretic.
 - B. calcium channel blocker.
 - C. antiarrhythmic agent.
 - D. hydroxyl radical scavenger.
14. Iloprost is an analog of:
- A. IgA.
 - B. aprotinin.
 - C. prostacyclin.
 - D. thromboxane.
15. With normal renal function, the half-life of Cephalexin is:
- A. 1 hour.
 - B. 3 hours.
 - C. 6 hours.
 - D. 12 hours.
16. Treatment for a blood transfusion reaction should include which modalities?
- A. administration of Benzodiazepines, nitroprusside, and hydroxyethyl starch solution.
 - B. administration of platelets, fresh frozen plasma, and cryoprecipitate.
 - C. administration of steroids, diuretics, and heparin.
 - D. administration of vasopressors, antibiotics, and cryoprecipitate.
17. The treatment for an antithrombin III deficiency is:
- A. fresh frozen plasma.
 - B. packed red cells.
 - C. cryoprecipitate.
 - D. platelet concentrate.
18. The major branches of the left coronary artery are:
- A. the anterior descending and posterior descending.
 - B. the marginal branch and the circumflex branch.
 - C. the circumflex branch and the anterior descending branch.
 - D. the marginal branch and the anterior descending branch
19. During congenital intracardiac surgery, excessive venous blood draining into the right atrium may indicate the presence of a/an:
- A. patent ductus arteriosus.
 - B. patent foramen ovale.
 - C. persistent left superior vena cava.
 - D. anomalous pulmonary venous return.

Answer Key

Perfusion Basic Science Examination

- | | |
|-----|---|
| 1. | a |
| 2. | b |
| 3. | b |
| 4. | b |
| 5. | b |
| 6. | c |
| 7. | b |
| 8. | b |
| 9. | a |
| 10. | b |
| 11. | b |
| 12. | c |
| 13. | d |
| 14. | c |
| 15. | a |
| 16. | c |
| 17. | a |
| 18. | c |
| 19. | c |

Samples of Test Items

Clinical Applications in Perfusion Examination

The patient is a 67 year-old male weighing 102 Kg who has been previously diagnosed with coronary artery disease, an apical left ventricular aneurysm, and chronic renal failure. Laboratory values from the referring hospital indicate a BUN of 62 mg/dL and a creatinine of 2.4 mg/dL.

Thirty (30) minutes after initiating CPB, it is noted that urine output has decreased significantly.

1. Given a pre-operative creatinine of 2.4 mg/dL, this patient has approximately what percentage of normal renal function?
 - A. 20%.
 - B. 40%.
 - C. 60%.
 - D. 80%.

2. Which of the following modifications in perfusion technique could be used to enhance urine output?
 - A. administration of a chlorpromazine to increase renal blood flow.
 - B. priming the circuit with a hypertonic solution.
 - C. use of a hemoconcentrator.
 - D. utilizing a pulsatile flow pump.

3. The most effective intervention in treating acute hyperkalemia after removal of the aortic clamp would be:
 - A. ultrafiltration.
 - B. administering 1 mg/kg of butanenide.
 - C. administering dextrose and insulin.
 - D. beginning a 3 ug/kg dopamine drip.

4. A hemodialyzer differs primarily from a hemoconcentrator in:
 - A. size and number of pores.
 - B. effective surface area.
 - C. maximum allowed transmembrane pressure.
 - D. ability to remove urea nitrogen.

5. Total clearance of urea and creatinine by an ultrafiltrator:
 - A. is identical.
 - B. is not affected by temperature.
 - C. increases with increasing hematocrit.
 - D. is proportional to their sieving coefficients.

The patient is a 67 year-old male weighing 102 Kg who has been previously diagnosed with coronary artery disease, an apical left ventricular aneurysm, and chronic renal failure. Laboratory values from the referring hospital indicate a BUN of 62 mg/dL and a creatinine of 2.4 mg/dL.

Thirty (30) minutes after initiating cardiopulmonary bypass, it is noted that urine output has decreased significantly.

Upon weaning this patient from cardiopulmonary bypass, the following observations are noted:

Cardiac index:	1.71/min/m ²
Arterial blood pressure:	80/45 mm
Pulmonary artery pressure:	Hg 60/35
Pulmonary wedge pressure:	mm Hg 30
Central venous pressure:	mm Hg 15
Heart rate:	120 BPM

6. The above data are suggestive of:
- A. inadequate preload.
 - B. increased afterload.
 - C. biventricular failure.
 - D. left heart failure.
7. In treating the above parameters, one of the first interventions to be considered would be to:
- A. start a dobutamine infusion.
 - B. start a nitroprusside infusion.
 - C. insert an intra-aortic balloon pump.
 - D. give a 500 cc fluid bolus.
8. Which of the following is considered a direct physiologic effect of using an intra-aortic balloon pump?
- A. decreased diastolic pressure time index (DPTI).
 - B. increased preload.
 - C. afterload reduction.
 - D. decreased oxygen consumption.
9. Although use of an intra-aortic balloon decreases end-diastolic pressure, coronary perfusion is enhanced because:
- A. afterload is decreased.
 - B. systolic pressure is increased.
 - C. mean diastolic pressure is increased.
 - D. mean diastolic pressure is unchanged.

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Central venous pressure:	15 mm Hg
Heart rate:	120 BPM

10. To approximate the insertion length of the balloon catheter, the tip of the balloon should be aligned with the:

- A. sternal notch.
- B. base of the manubrium.
- C. xiphoid process.
- D. the left sternal border.

After maximizing inotropic support and insertion of an intra-aortic balloon pump, the following conditions are noted:

Cardiac index:	1.51/min/m ²
Arterial blood pressure:	70/85/35 mm Hg
Pulmonary artery pressure:	65/35 mm Hg
Pulmonary wedge pressure:	35 mm Hg
Central venous pressure:	25 mm Hg
Heart rate:	120 BPM
IABP assist ratio:	1:1

11. The above data are indicative of:

- A. improper balloon pump timing.
- B. left heart failure.
- C. right heart failure.
- D. biventricular failure.

The patient is a 67 year-old male weighing 102 Kg who has been previously diagnosed with coronary artery disease, an apical left ventricular aneurysm, and chronic renal failure. Laboratory values from the referring hospital indicate a BUN of 62 mg/dL and a creatinine of 2.4 mg/dL.

Thirty (30) minutes after initiating cardiopulmonary bypass, it is noted that urine output has decreased significantly.

After maximizing inotropic support and insertion of an intra-aortic balloon pump, the decision was made to place an LVAD. The following conditions are noted:

Cardiac index:	1.51/min/m ²
Arterial blood pressure:	70/85/35 mm Hg
Pulmonary artery pressure:	65/35 mm Hg
Pulmonary wedge pressure:	35 mm Hg
Central venous pressure:	25 mm Hg
Heart rate:	120 BPM
IABP assist ratio:	1:1

12. If bleeding occurs during the early phases of ventricular assist, the most common cause is:

- A. inadequate surgical hemostasis at the cannulation site.
- B. heparin-induced thrombocytopenia.
- C. dilution of clotting factors as a result of cardiopulmonary bypass.
- D. decreased platelet count and function due to prolonged bypass times.

13. Infection rate associated with ventricular assist is directly related to the:

- A. duration of circulatory support.
- B. location of cannulation sites.
- C. type of assist device used.
- D. degree of antibiotic binding to free hemoglobin

14. The first intervention to re-establish flow inhibited by an “entrapped” inflow cannula would be to:

- A. administer a 300 cc fluid bolus.
- B. temporarily decrease pump flow rate.
- C. temporarily increase pump flow rate.
- D. administer a vasodilator.

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IABP assist ratio:	1:1

15. Upon weaning a ventricular assist device:

- A. inotropic agents should not be used.
- B. heparin dosage should be decreased to aid hemostasis upon removal.
- C. heparin dosage should be increased to prevent thromboembolism.
- D. cardiac index must not fall below 3 lpm/m².

Answer Key

Clinical Applications in Perfusion Examination

- | | |
|-----|---|
| 1. | b |
| 2. | d |
| 3. | c |
| 4. | a |
| 5. | d |
| 6. | d |
| 7. | a |
| 8. | c |
| 9. | c |
| 10. | a |
| 11. | d |
| 12. | d |
| 13. | a |
| 14. | b |
| 15. | c |

Suggested Study List for ABCP Examinations

The bibliography for the ABCP examinations is drawn from multiple sources. The following is a list of suggested resources you may wish to consult in preparing for the examination.

1. Anatomy

- Bartholomew E, Martini F, Nath J. *Fundamentals of Anatomy and Physiology*, 12th ed. New York, NY: Pearson; 2023.
- Callans DJ, Fuster V, Leon MB, Narula J, Poppas A, Rumsfeld JS, Vaishnava P, eds. *Fuster and Hurst's The Heart*, 15th ed. New York, NY: McGraw-Hill Medical; 2022.
- Marieb EN, Keller SM. *Essentials of Human Anatomy and Physiology*, 13th ed. San Francisco CA: Pearson; 2022.
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2. Anesthesia

- Bartels K, Fox AA, Howard-Quijano K, Shaw AD, Thiele RH. *Hensley's Practical Approach to Cardiothoracic Anesthesia*, 7th ed. Philadelphia, PA: Wolters Kluwer; 2024.
- Kaplan JA, Augoustides J, Gutsche JT, Manecke G, Maus T, Pagel, PS, Ramakrishna H, eds. *Kaplan's Cardiac Anesthesia*, 8th ed. Philadelphia, PA: Elsevier; 2023.

3. Cardiopulmonary Bypass

- Davis RF, Gravlee GP, Hammon JW, Kussman BD, eds. *Cardiopulmonary Bypass and Mechanical Support: Principles & Practice*, 4th ed. Philadelphia, PA: Wolters Kluwer/Lippincott, Williams & Wilkins; 2015.
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4. ECMO

Brodie D, Lorusso R, MacLaren G, Peek G, Thiagarajan R, Vercaemst L, eds. *Extracorporeal Life Support: the ELSO Red Book, 6th ed.* Ann Arbor, MI: Extracorporeal Life Support Organization; 2022.

Annich G, Lynch W, MacLauren G, Wilson J, Bartlett R. *ECMO: Extracorporeal Cardiopulmonary Support in Critical Care, 4th ed.* Ann Arbor, MI: Extracorporeal Life Support Organization; 2012.

5. Hemostasis

Aryeh S, Spence RK, Spiess BD, eds. *Perioperative Transfusion Medicine, 2nd ed.* Philadelphia, PA: Lippincott/Williams & Wilkins; 2005.

6. Pediatrics

Matte GS. *Perfusion for Congenital Heart Surgery: Notes on Cardiopulmonary Bypass for a Complex Patient Population.* Hoboken, NJ: John Wiley & Sons; 2015.

Mavroudis C, Backer CL. *Atlas of Pediatric Cardiac Surgery,* London UK: Springer Verlag; 2015.

Mavroudis C, Backer CL. *Pediatric Cardiac Surgery, 5th ed.* Hoboken, NJ: Wiley-Blackwell; 2023.

7. Pharmacology

Bhatt DL, *Opie's Cardiovascular Drugs: A Companion to Braunwald's Heart Disease, 9th ed.* Philadelphia, PA: Elsevier; 2020.

Brunton LL, Knollmann BC, eds. *Goodman & Gilman's Pharmacological Basis of Therapeutics, 14th ed.* New York, NY: McGraw-Hill Medical; 2022.

Whalen K, Field C, Radkrishnan R. *Lippincott's Illustrated Reviews: Pharmacology, 7th ed.* Philadelphia, PA: Lippincott Williams & Wilkins; 2018

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8. Physiology

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9. Surgical Techniques

Bojar RM. *Manual of Perioperative Care in Adult Cardiac Surgery*, 6th ed. Oxford, UK: John Wiley & Sons; 2021.

Cohn LH, Adams DH, eds. *Cardiac Surgery in the Adult*, 5th ed. New York, NY: McGraw-Hill Medical; 2017.

del Nido PJ, Seillke FW, Swanson SJ. *Sabiston & Spencer Surgery of the Chest*, 10th ed. Philadelphia, PA: Elsevier; 2023.

10. Journals

Annals of Surgery

Annals of Thoracic Surgery

Journal of the American Society for Artificial Internal Organs *Journal of Cardiac Surgery*

Journal of Cardiovascular Anesthesia *Journal of Extracorporeal Technology*

Journal of Thoracic and Cardiovascular Surgery *Perfusion*

Ethical Standards of The American Board of Cardiovascular Perfusion

The American Board of Cardiovascular Perfusion (ABCP) is dedicated to the provision of safe, competent medical care for any and all patients. To that end, the ABCP administers certification examinations and monitors recertification, and therefore requires those participating in these credentialing processes to ascribe to the following ethical standards.

- I. Each Certified Clinical Perfusionist (CCP) and applicant (or candidate for certification), (hereinafter, referred to as "individual,") shall comply with all existing and future rules, regulations, and standards of the ABCP and will bear responsibility for demonstrating compliance with same. An individual is eligible to apply for and maintain certification/recertification **only** when in compliance with **all** the ABCP rules, regulations, and standards.

If an individual is not in compliance with the ABCP rules, regulations, or standards, the ABCP may impose one or more of the following sanctions: deny or suspend eligibility; deny, revoke, refuse to renew, or suspend certification; issue a reprimand; or take other corrective action regarding certification or recertification.

- II. The individual shall not willfully fail to promote the safety and welfare of the public, whether through negligent acts, acts of omission or through misrepresentation. Failure to promote public safety and welfare or the provision of safe, competent medical care includes (but is not limited to):
 - A. impairment of professional performance because of habitual use of alcohol, drugs, or other substance, or any physical or mental condition;
 - B. gross or repeated negligence or malpractice in professional work;
 - C. noncompliance with laws related to the profession;
 - D. failure to maintain a current professional credential as required by the jurisdiction in which the individual practices (this may include a license, certificate, or registration);
 - E. the conviction of, plea of guilty to, or plea of nolo contendere to a felony related to public health and safety or the profession; and
 - F. disciplinary action by a licensing board or professional organization other than the ABCP.
- III. The individual convicted of, or pleading guilty or nolo contendere to, a felony directly related to public health and safety or the provision of safe, competent medical care shall be considered ineligible to apply for certification/recertification for a period of one year from the exhaustion of the appeals, proceeds or final release from confinement (if any), or the end of probation, whichever is later. An individual who is incarcerated, or for whom incarceration is pending, as of the application deadline date is ineligible for certification or recertification to the end of incarceration.

Felony convictions considered for this standard include, but are not limited to, fraud, actual or threatened use of a weapon or violence, rape, sexual abuse of a patient or child, or prohibited sale, distribution, possession, or misuse of controlled substances.

- IV. The individual shall not engage in unauthorized possession or misuse of the ABCP's credential, examinations, and other intellectual property. The individual shall respect the ABCP's intellectual property rights and comply with the ABCP use of Credential Trademark Policy.
- V. The individual shall not misrepresent their certification status or misuse any title or membership

in any professional organization or community.

- VI. The individual shall abide by the ABCP's reasonable test administration rules. The individual shall have had no unauthorized possession of, use of, or access to any examination documents or materials, nor shall the individual receive any unauthorized assistance, copy examination materials, or cause a disruption in the testing area during a test administration or the conduction of any portion of the certification examination. The individual shall not subsequently use or divulge information gained from their examination experience for any reason.
- VII. The individual must truthfully complete and sign an application in the form provided by the ABCP, pay the required fees, and provide additional information as requested. The individual shall not make any material misrepresentation of fact during application for certification/recertification. Ineligibility for certification, regardless of when the ineligibility is discovered, is grounds for disciplinary action.
- VIII. The individual shall report possible violations of these Ethical Standards and any other development bearing on certification in writing to the Executive Director of the ABCP.

Other persons concerned with possible violation of the ABCP rules are encouraged to contact the ABCP. The persons making the complaint should identify themselves by name, address, email address, and telephone number. However, the ABCP may consider anonymous complaints.

This report should include information regarding the identity of the person(s) involved in the alleged misconduct with as much specific detail and documentation as possible. The identity of the person making the report must be made known as well as others with knowledge of the facts and circumstances surrounding the alleged misconduct.