American Board of Cardiovascular Perfusion

Examination Guidebook

Published by the American Board of Cardiovascular Perfusion, Inc.

A Guidebook for the Examination Process of the American Board of Cardiovascular Perfusion

Beth A. Richmond, Ph.D.

National Office
American Board of Cardiovascular Perfusion
2903 Arlington Loop
Hattiesburg, MS 39401
(601) 268-2221
Fax (601) 268-2229
www.abcp.org

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 the 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 his/her 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)*, is a 220-item, 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 from 200 to 230, depending on the scenarios used.

RECOGNIZED ACCREDITING AGENCIES

The American Board of Cardiovascular Perfusion (ABCP) recognizes the Accreditation Committee for Perfusion Education (AC-PE) in cooperation with the Commission on Accreditation of Allied Health Education Programs (CAAHEP). The official accrediting agency for perfusion programs in Canada is EQual™ Canada, a branch of Accreditation Canada and the Health Standards Organization.

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 75 cardiopulmonary bypass (CPB) procedures performed prior to graduation while in the accredited school of perfusion, (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

Applicants are required to submit the following by **July 1** for the fall examination or **December 1** for the following spring examination:

1. a notarized *PBSE* application completed in full; (Applications available: www.abcp.org > For Students > Certification > Application Forms)
2. a fee of $350.00 in the form of a **bank draft, money order, personal check, or credit card** made payable to the American Board of Cardiovascular Perfusion. Applicants **MUST:**
   (1) make fees payable in U.S. Dollars;
   (2) add a $5.00 service charge (if residing outside of the U.S.A.); and
   (3) add a $10.00 credit card processing fee if using a credit card for payment.

Applications must be postmarked no later than midnight on July 1 or December 1 and must be sent by certified mail (return receipt requested.)

Applicants must submit or arrange for submission of the following:

1. 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;
2. a current, **official** transcript of credits from the accredited school of perfusion, indicating date of graduation; and
3. a statement of satisfactory clinical competency from the Clinical Competency Committee Chairperson or program director at the accredited school of perfusion.

These items must be on file in the National Office at least four weeks prior to the examination and will be verified. Eligibility to register with Prometric 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

Applicants are required to submit the following by **July 1** for the fall examination or **December 1** for the following spring examination:

1. a notarized *CAPE* application completed in full; (Applications available: www.abcp.org > For Students > Certification > Application & Recertification Forms);
2. a fee of $350.00 in the form of a **bank draft, money order, personal check, or credit card** made payable to the American Board of Cardiovascular Perfusion.
3. Applicants **MUST:**
   (1) make fees payable in U.S. Dollars,
   (2) add a $5.00 service charge (if residing outside of the U.S.A.); and
   (3) add a $10.00 credit card processing fee if using a credit card for payment.

Applications must be postmarked no later than midnight July 1 for the fall examination or December 1 for the spring examination and must be sent by certified mail (return receipt requested).

Applicants must submit or arrange for submission of the following:

1. 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)* that may be found on page 4.

This item must be on file in the National Office at least four weeks prior to the examination and will be verified. Eligibility to register with Prometric 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, up to thirty days following the deadline, will be assessed a late filing fee of $75.00. No applications will be accepted after the LATE FILING DATE.

Table A – CAPE Primary Clinical Perfusion Activities (CAPE-PCPA) for Reporting Independent Cases for the CAPE

	Primary Clinical Perfusion Activities (PCPA)	Clinical Definition	Core Elements
1P	Cardiopulmonary Bypass (CPB), Primary	A CCP candidate who is the primary operator of the heart-lung machine used during cardiac surgery and other surgeries that require extracorporeal circulation which is used to manage the patient's physiological status	Blood pump, reservoir, heat exchanger, oxygenator, extracorporeal circuit used accordingly with hemodynamic/lab value monitoring.
2P	Extra-Corporeal Membrane Oxygenation (ECMO), Primary	A CCP Candidate who is the primary operator of Extra-Corporeal Membrane Oxygenation (ECMO) circuit that provides life support for respiratory and/or cardiac failure.	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.
3P	Isolated Limb/Organ Perfusion, Primary	A CCP candidate who is the primary operator of an extracorporeal device used to deliver anticancer drugs directly to an arm, leg, or organ that manages the patient's physiological status.	Reservoir, blood pump, heat exchanger, oxygenator, extracorporeal circuit used accordingly with hemodynamic, temperature, and lab value monitoring.
4P	Veno-Venous or Left Heart Bypass, Primary	A CCP candidate 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.	Blood pump, extracorporeal circuit used accordingly with hemodynamic/lab value monitoring.
5P	Ventricular Assist Device	A CCP candidate who is the primary operator of the Ventricular Assist Device (VAD) that provides cardiac support for the failing heart.	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.

Computer-Based Testing

The *Perfusion Basic Science Examination (PBSE)* and the *Clinical Applications in Perfusion Examination (CAPE)* are administered at Prometric testing centers throughout the United States, U.S. Territories, and Canada. The examination windows are in March and October; the exact time frame will be posted to our website (www.abcp.org) and sent to each examinee by mail and 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 Prometric, the examinee must complete the ABCP application process and meet the ABCP deadlines. To complete the application process, the following items must be on file in the ABCP National Office:

- a completed application form with appropriate fee(s);
- an official transcript;
- the clinical competency form signed by the student and the program director; and
- the clinical education record that applies to the examination(s).

Once the application process has been completed, the ABCP National Office will provide you with an examination ID number, and you may visit the Prometric website (www.prometric.com/abcp) to select a test location, date, and time for the examination(s). In order to register online, you must have a valid email address. Examinees can also register using the Prometric automated voice response system at 800-894-9984. In order to insure 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).

At the testing center, you will be required to present one valid, non-expired, government-issued photo ID with a signature (e.g., driver's license or passport). If you are testing outside of your country of citizenship, you must present a valid passport. If you are testing within your country of citizenship, you must present either a valid passport, driver's license, national ID, or military ID. **The name on the Prometric reservation must match the name on your ID 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.

If you need to reschedule a testing appointment, you must do so at least **five business days** prior to your appointment using the Reschedule/Cancel option on the Prometric website or Prometric's automated voice response system at: 800-894-9984; both are available 24 hours a day, 7 days a week.

There is no charge for changing an appointment within the same testing window if the change is made at least five business days prior to your appointment.

Examination results will be mailed out from the ABCP National Office within six weeks following the examination(s).

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 and covering the six levels of cognitive skills described in Bloom's Taxonomy. The questions on the examinations are validated annually using both qualitative and quantitative item analysis procedures including current practice relevance, level of difficulty and a discrimination index. Item Response Theory derived from the Rasch model is used for further item validation and to equate the scores of various forms of the examinations.

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)*, is a 220-item 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 from 200 to 230, 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. Item Response Theory analysis and 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 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.

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 demonstrate accurately their knowledge and skill.

TIME LIMITS

Candidates are allowed four hours to complete the 220-item 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

Questions are equally weighted and there is no penalty for incorrect answers. The scoring reports include a listing of the items from the examination matrix, the number of items that must be passed for mastery and the number of items that the examinee correctly answered.

PASS-FAIL STANDARD

The pass-fail standard is set by the Directors of the ABCP with assistance from the test development specialists. The standard is related to judgments of the panel concerning the percentage of minimally-certifiable perfusionists who will answer each question correctly and the relevance of each question to perfusion practice. An adaptation of the Ebel technique is used for this process. The Directors who serve as the panel of experts are experienced, practicing, Certified Clinical Perfusionists (CCPs).

Those persons failing the examinations are given individual feedback concerning areas of deficiency. Theoretically, any individual with the motivation to remediate deficiencies may ultimately pass the examination, but it is incumbent upon the individual to determine his/her course of remediation and the length of time in which to accomplish the remediation.

The ABCP strongly recommends that each individual who fails the examination seek remediation in the specific areas in which he/she encounters difficulty on the examination. Without this remediation, it is highly unlikely that he/she will pass the examination at the next administration.

There is no limit to the number of times an examinee may take the examination.

REPORTING EXAMINATION RESULTS

Examination results are reported within six weeks following the examination. The reports include the pass-fail outcome and the pass-fail standards. A specific listing of deficiencies that corresponds with items in the test matrix is sent to all examinees.

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 examination results will include specific areas of deficiency. The ABCP does not offer candidates any right to appeal the results of the ABCP examination. Instead, the ABCP offers the opportunity to retake the examination an unlimited number of times.

Should any examinee feel that there were items that were not accurate on the examination, he/she should send his/her comments to the National Office of the ABCP 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.

An examinee may request hand scoring to verify the computer scoring by writing the National Office and making such a request within 30 days of receiving his/her results. A fee of $10.00 will be charged for hand scoring unless an error is found. Should an error be discovered, the fee will be refunded.

Examination Preparation

STUDY TECHNIQUES

An examination matrix is provided for each portion of the examination. 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 sup- porting 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.

RULES FOR CONDUCT OF THE EXAMINATIONS

1. Prometric examination proctors will carefully check credentials before the examination begins. **It will be necessary to present an official picture ID which has the SAME NAME as the examination registration information. This must be a valid, non-expired, government-issued ID with a signature (e.g., photo driver's license or passport). If you are testing outside of your country of citizenship, you must present a valid passport. If you are testing within your country of citizenship, you must present either a valid passport, driver's license, national ID or military ID.**

2. **Contact the ABCP National Office immediately if there is a discrepancy between the name on your registration information and your photo ID. A candidate who does not provide this WILL NOT BE ALLOWED TO SIT FOR THE EXAMINATION.**

3. Books, reference materials, or notes of any kind may NOT be taken into the computer examination room, and it is advised that you not bring them to the examination site at all. Proctors will not permit anyone having such materials to continue the test.

4. A calculator will be provided on the computer for your use during the examinations.

PRACTICE EXAMINATIONS

Practice examinations for the *PBSE* and *CAPE* are available through the Prometric website. These abbreviated practice examinations are designed to familiarize the test taker with the format and content of the examinations. The practice tests may be taken at any time and on any computer.

At the completion of each examination a score will be provided for each topic area (on the *PBSE*) or on each scenario (on the *CAPE*). Since the practice examinations are intended to provide familiarization with the format and content of the certification examinations and are not intended to be a study guide, answers to the examination items are not provided at the completion of the practice test.

The cost for each practice examination is $125.00 and may be paid by credit card at the Prometric website. First-time users should click on the "First-time registration" link when accessing the Prometric site.

To access the practice examinations information, go to www.abcp.org > For Students > Examinations > Practice.

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 Benzodiazapenes, nitroprusside, and hydroxyethel 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 CPB, 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 Hg
Pulmonary artery pressure:	60/35 mm Hg
Pulmonary wedge pressure:	30 mm Hg
Central venous pressure:	15 mm Hg
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.

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.

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 Hg
Pulmonary artery pressure:	60/35 mm Hg
Pulmonary wedge pressure:	30 mm Hg
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 CPB, 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:	1.5 l/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 <u>first</u> 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.

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.

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:	1.5 l/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

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/m^2.

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

Fuster V, Walsh R, Harrington R, eds. *Hurst's The Heart, 13th ed.* New York, NY: McGraw-Hill Medical; 2008.

Marieb EN, Hoehn K. *Essentials of Human Anatomy and Physiology, 10th ed.* San Francisco CA: Pearson/Benjamin Cummings; 2012.

Martini F, Nath J. *Fundamentals of Anatomy and Physiology, 9TH ed.* New York, NY: Benjamin Cummings; 2012.

Standring S, ed. *Gray's Anatomy: The Anatomical Basis of Medicine and Surgery, 4th ed.* New York, NY: Churchill Livingston; 2009.

2. Anesthesia

Gravlee GP, Hensley FA, Martin DE. *A Practical Approach to Cardiac Anesthesia, 5th ed.* Philadelphia, PA: Williams & Wilkins; 2013.

Kaplan JA, Augoustides J, Manecke G, Maus T, Reich D, eds. *Kaplan's Cardiac Anesthesia, 7th ed.* Philadelphia, PA: Elsevier/Saunders; 2017.

3. Cardiopulmonary Bypass

Davis RF, Gravlee GP, Utley JR, eds. *Cardiopulmonary Bypass: Principles & Practice, 3rd ed.* Philadelphia, PA: Lippincott, Williams & Wilkins; 2008.

Kay PH, Munsch CM. *Techniques in Extracorporeal Circulation, 4th ed.* London, UK: Oxford University Press; 2004.

Mangano-Mora C, ed. *Cardiopulmonary Bypass, Principles and Techniques of Extracorporeal Circulation.* New York, NY: Springer; 1995.

Mongero LD, Beck JR. *On Bypass: Advanced Perfusion Techniques.* Totowa, NJ: Humana Press; 2008.

Sunit G, Falter F, Perrino AC. *Cardiopulmonary Bypass 2nd ed.* Oxford, UK: Cambridge University Press; 2015.

4. ECMO

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

AABB. *Blood Bank Regulations.* Bethesda, MA: American Association of Blood Banks; 2003.

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

Dailey JF. *Dailey's Notes on Blood*, 4th ed. Arlington, MA: Medical Consulting Group; 2002.

6. Intraaortic Balloon Pumping

Quaal S. *Comprehensive Intraaortic Balloon Counterpulsation, 2nd ed.* Philadelphia, PA: Elsevier/Mosby; 1993.

7. 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, 3rd ed.* Hoboken, NJ: Wiley-Blackwell; 2013.

8. Pharmacology

Brunton L, Lazo JS, Parker K, eds. *Goodman & Gilman's Pharmacological Basis of Therapeutics, 11th ed.* New York, NY: McGraw-Hill Medical; 2006.

Champe PC, Clark M, Cubeddo L, Finkel R, Harvey RA. *Lippincott's Illustrated Reviews: Pharmacology, 4th ed.* Philadelphia, PA: Lippincott Williams & Wilkins; 2008.

Katzung B, ed. *Basic and Clinical Pharmacology, 10th ed.* New York, NY: McGraw-Hill Medical; 2006.

Opie L, Gersh B, *Drugs for the Heart 8th ed.* Philadelphia, PA: Elsevier/Saunders; 2017.

9. Physiology

Berne RM, Levy MN. *Cardiovascular Physiology, 8th ed.* St. Louis, MO: Elsevier/Mosby; 2001.

Guyton AC, Hall JE. *Textbook of Medical Physiology, 11th ed.* Philadelphia, PA: Elsevier/Saunders; 2006.

Thaler M. *The Only EKG Book You'll Ever Need.* Philadelphia, PA: Lippincott, Williams &Wilkins; 2017.

10. Surgical Techniques

Baue AE, Geha AS, Hammond GL, Laks H, Naunheim KS. *Glenn's Thoracic & Cardiovascular Surgery, Volume 6.* Stanford, CA: Appleton & Lange; 1996.

Bojar RM. *Manual of Perioperative Care in Adult Cardiac Surgery, 4th ed.* Boston, MA: Blackwell Publishing; 2005.

Cohn LH, Edmunds H, eds. *Cardiac Surgery in the Adult, 3rd ed.* New York, NY: McGraw-Hill Medical; 2008.

del Nido PJ, Seillke FW, Swanson SJ. *Sabiston & Spencer Surgery of the Chest, 8th ed.* Philadelphia, PA: Elsevier/Saunders; 2010.

11. 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 his/her 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 his/her 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 person making the complaint should identify him-/herself 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.