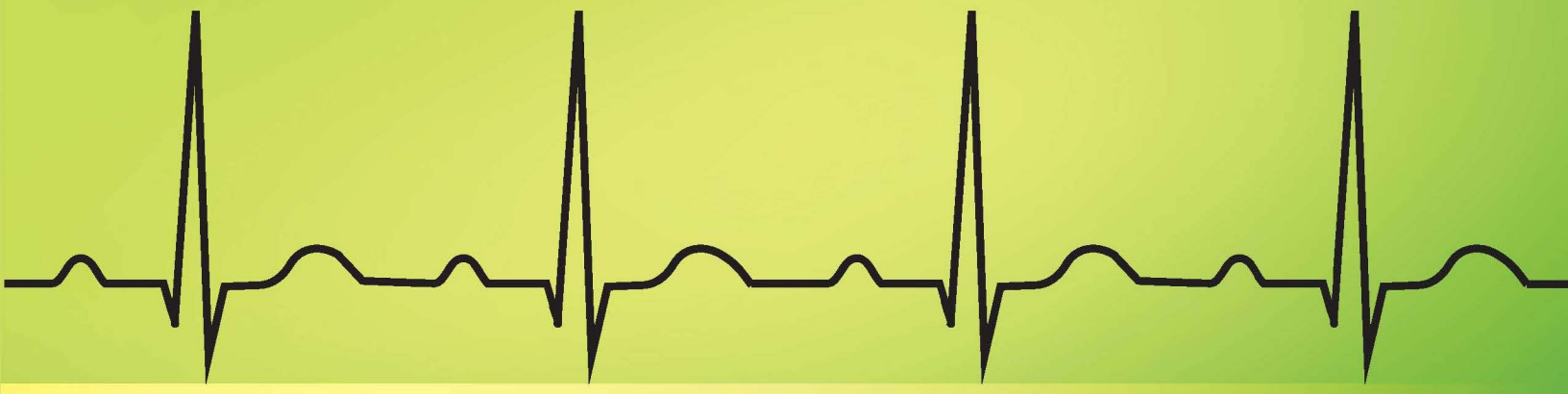
Anesthesia for Dental and Oral Maxillofacial Surgery



Spencer D. Wade

Caroline M. Sawicki • Megann K. Smiley • Michael A. Cuddy

Steven Vukas • Paul J. Schwartz

WILEY Blackwell

Anesthesia for Dental and Oral Maxillofacial Surgery

Spencer D. Wade

Caroline M. Sawicki

Megann K. Smiley

Michael A. Cuddy

Steven Vukas

Paul J. Schwartz

WILEY Blackwell

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data

Names: Wade, Spencer D., editor.
Title: Anesthesia for dental and oral maxillofacial surgery / [edited by] Spencer D. Wade, Caroline M. Sawicki, Megann K. Smiley, Michael A. Cuddy, Steven Vukas, Paul J. Schwartz.
Description: Hoboken, New Jersey : Wiley-Blackwell, [2024] | Includes bibliographical references and index.
Identifiers: LCCN 2024005300 (print) | LCCN 2024005301 (ebook) | ISBN 9781394164899 (paperback) | ISBN 9781394164905 (ePDF) | ISBN 9781394164912 (ePUB) | ISBN 9781394164929 (oBook)
Subjects: MESH: Anesthesia, Dental–methods | Oral Surgical Procedures | Tooth Diseases–surgery | Jaw–surgery | Face–surgery | Anesthetics–therapeutic use
Classification: LCC RK510 (print) | LCC RK510 (ebook) | NLM WO 460 | DDC 617.9/676–dc23/eng/20240301
LC record available at https://lccn.loc.gov/2024005300
LC ebook record available at https://lccn.loc.gov/2024005301

Cover Design: Wiley
Cover Image: © Spencer D Wade, fotograzia/Getty Images

Set in 9.5/12.5pt STIXTwoText by Straive, Pondicherry, India

Contents

Editorial Board

Editor-in-Chief

SPENCER D. WADE, DDS, MS
Dentist Anesthesiologist
Diplomate, American Dental Board of Anesthesiology
Clinical Assistant Professor
New York University College of Dentistry, New York, New York, USA
Oral Health Center for People with Disabilities

Co-Authors

CAROLINE M. SAWICKI, DDS, PhD
Pediatric Dentist
Board Eligible, American Board of Pediatric Dentistry
Clinical Assistant Professor
University of North Carolina Adams School of Dentistry, Chapel Hill, North Carolina, USA
Division of Pediatric and Public Health

MEGANN K. SMILEY, DMD, MS
Dentist Anesthesiologist
Diplomate, American Dental Board of Anesthesiology
Columbus, Ohio
Nationwide Children's Hospital, Columbus, Ohio, USA
Department of Anesthesiology and Pain Medicine
The Ohio State University College of Dentistry
Division of Pediatric Dentistry, Columbus, Ohio, USA

MICHAEL A. CUDDY, DMD
Dentist Anesthesiologist
Diplomate, American Dental Board of Anesthesiology
Associate Professor
University of Pittsburgh School of Dental Medicine, Pittsburgh, Pennsylvania, USA
Department of Dental Anesthesiology

STEVEN VUKAS, DMD, MD
Oral and Maxillofacial Surgeon
Diplomate, American Board of Oral and Maxillofacial Surgery
Assistant Professor
University of Pittsburgh School of Dental Medicine, Pittsburgh, Pennsylvania, USA
Department of Oral and Maxillofacial Surgery
Department of Dental Anesthesiology

PAUL J. SCHWARTZ, DMD
Oral and Maxillofacial Surgeon
Dentist Anesthesiologist
Diplomate, American Board of Oral and Maxillofacial Surgery
Diplomate, American Dental Board of Anesthesiology
Diplomate, National Board of Dental Anesthesiology
Assistant Professor
University of Pittsburgh School of Dental Medicine, Pittsburgh, Pennsylvania, USA
Department of Oral and Maxillofacial Surgery
Department of Dental Anesthesiology

Content Editors

STEVEN GANZBERG, DMD, MS
Dentist Anesthesiologist
Diplomate, American Dental Board of Anesthesiology
Professor and Chair, Retired
The Ohio State University, Columbus, Ohio, USA
Division of Oral and Maxillofacial Surgery and Dental Anesthesiology
University of California, Los Angeles, California, USA
Division of Dental Anesthesiology

Acknowledgments and Contributors

DANIEL L. ORR II, DDS, MS Anesthesiology, PhD, JD, MD
Dentist Anesthesiologist
Oral and Maxillofacial Surgeon
Lawyer
Diplomate, American Dental Board of Anesthesiology
Diplomate, American Board of Oral and Maxillofacial Surgery
Diplomate, American Board of Legal Medicine
Professor Emeritus
University of Nevada Las Vegas School of Dental Medicine
Las Vegas, Nevada, USA

TIMOTHY M. ORR, DMD, JD
Dentist Anesthesiologist
Lawyer
Diplomate, American Dental Board of Anesthesiology
Diplomate, American Board of Legal Medicine
Austin, Texas, USA

KYLE J. KRAMER, DDS, MS
Dentist Anesthesiologist
Diplomate, American Dental Board of Anesthesiology
Clinical Associate Professor
Indiana University School of Dentistry
Indianapolis, Indiana, USA
Department of Oral Surgery and Hospital Dentistry

Preface

Message From the Authors

Anesthesia for Dental and Oral Maxillofacial Surgery was developed to provide essential information in basic medical knowledge and anesthesia care. This valuable resource will act as a convenient perioperative reference and serve as an excellent study guide in preparation for written and oral board examinations in Dental Anesthesiology and Oral and Maxillofacial Surgery.

This text is not only designed for the resident or new graduate studying for their oral or written boards, but is also useful to those out in practice who want to refresh themselves on anesthetic concepts. It is set up in bullet point format to give you, the reader, high-yield information at a glance and space to highlight, draw, and write in your own explanations to help connect the dots. This will personalize the book to your own learning style to enhance your learning experience.

This book is not going to be a substitute for residency experience and dedicated studying throughout your training. Many of the topics included here are covered in greater depth in other anesthesia textbooks. However, this text should give you solid foundational knowledge as well as guide your studying where knowledge deficits arise.

For questions regarding the content or if there are future topics you think would be beneficial, please email the Editor-in-Chief:

spencerwadedds@gmail.com

Disclaimer: This book is not a substitute for crafting an anesthetic plan on a specific patient/procedural basis.

Oral/Written Boards

It is a great honor and significant career accomplishment to earn a board certification in your chosen specialty. Board certification is certainly worth the time and sacrifice to achieve.

Time management is the most important aspect of preparation when it comes to an oral or written board certification examination. Having an efficient strategy for finding vital topics pertinent to the exam is critical to doing well. One way to demonstrate mastery of core skills and knowledge is to show that you understand how to use resources efficiently and appropriately.

In-Service Training Examination (ITE)

These are secure examinations developed by specific specialty boards for residents in training. The content areas cover the breadth of the specialty with basic science and clinical questions. The exam tests your foundational knowledge in the entire training curriculum. These exams predominately function in gauging your knowledge among your peers, as well as track your progression in the curriculum.

The Written Board Examination

Passing this exam is a prerequisite for being able to sit for the Oral Examination.

Written Examinations are psychometrically valid computer-based exams administered to test your knowledge in core principles of the specialty. Questions range from direct, factual information to specific clinical techniques, and span from basic to complex in breadth.

The Oral Examination

Once you have successfully completed the Written Examination, you are eligible to begin your application for the Oral Examination. This exam is designed to test your clinical judgment and ability to apply and verbalize the cognitive knowledge that was successfully demonstrated on the Written Examination.

The format of the Oral Examination allows you to demonstrate your ability to assess and manage patients presenting for treatment, as well as your ability to effectively communicate these relevant issues with both patients and colleagues.

The Oral Examination seeks to evaluate your ability to analyze and act appropriately and expediently in all situations. The exam encompasses several aspects of anesthesiology practice, including perioperative management and proper responses to urgent and emergency situations.

You will be given case scenarios and asked to interpret and discuss findings, make a clinical judgment, and defend your position. You may request additional information that is relevant to aid in your assessment and management.

The focus of each discussion can change as new issues develop in a given case. You will be evaluated throughout the preoperative, operative, and postoperative periods.

Oral Board Examination Tips

The Oral Examination, in Dental Anesthesiology and Oral and Maxillofacial Surgery can be intimidating and require intense preparation. Adequate preparation is measured in many months of study post-residency. For most candidates, this will be the first oral exam they have ever encountered. Residents who participate in frequent verbal discussions with their attendings regarding clinical scenarios will find themselves better prepared to succeed in this type of exam, and such discussions are strongly encouraged throughout your training. Many residents and candidates also find it useful to take turns asking each other potential board questions to practice talking through the management of patients.

On the whole, it is wise to take the exam soon after completion of residency. You will be more likely to remember

detailed information about complicated patients and surgical management. Once you enter private practice, your scope naturally narrows, and some of these minute details can get lost and forgotten.

General Tips

- Your oral exam begins the moment you meet your examiners. Greet your examiners with a smile, look interested, pay attention to every detail of your examiner's instruction. You will be nervous and your examiners will do their best to put you at ease. They will do everything they can to help you relax and perform well.
- Make sure to look and act professional. Business casual is appropriate for the oral exam.
- Realize that your visual appearance and your body language are vital forms of communication during the exam. Your body language should be deliberate; it should exude confidence and communicate that you are happy to be there.
- Make every attempt to answer questions as rapidly and completely as you can. The clearer and more concise you are, the more likely you are to finish the cases and positively impact your grade.
- If you do not know the answer to a specific question, admit this but try to quickly offer information appropriate to the topic which demonstrates your knowledge of the subject and how you would address the situation.
- Always be prepared to articulate your rationale and be prepared to defend your course of action.
- It is important to verbalize your thought process for every stage of case management. Do not assume that the examiners know why you are ordering particular labs and tests, or how you reached a particular conclusion. When in doubt, talk it out.

The Board exam, especially the oral exam, has evolved considerably over time. They are no longer adversarial with intimidating examiners probing the candidates' cognitive and psychological limits. Specialty boards in both Dental Anesthesiology and Oral and Maxillofacial Surgery are directed by our brightest, most accomplished practitioners who truly care about presenting the exam that will fairly evaluate you to join the ranks of the specialty. To be board certified is an extraordinary accomplishment and identifies you as someone who meets the standards of training, education, and professionalism necessary to earn the title of Diplomate.

Dentist Contributions to Anesthesiology

- For millennia, the fear of the pain of surgery was not worth the procedure
- Death was often the preferred option to surgery
- Early efforts included strangulation, freezing, alcohol, opiates, and hallucinogens; none were predictably safe or effective
- Since the 1960s, a series of published articles documented dental outpatient GA safety. Initial mortality estimates of 1/400 000 are now at 1/720 000, supporting an astounding record of safety

The History of Anesthesiology

- 1799: Sir Humphry Davy published that N_2O may be an advantage in surgery
- 1842: Crawford W. Long, MD, observed, *but did not make known*, the effects of N_2O
- 1842: William E. Clark administered ether for a dental extraction, *but did not make known*
- 1844: Horace Wells, DDS, *observed and made known* ("discovered") the predictably safe and effective analgesic effects of N_2O. Wells is the Discoverer of Anesthesia
- 1846: William T.G. Morton, DDS, used ether to assist with tooth extraction and, later that year, neck tumor removal
- 1847: First sexual assault by Parisian dentist convicted on two counts of assault on two anesthetized girls
- 1848: First published anesthesia death involving chloroform for ingrown toenail surgery
- 1865: William T.G. Morton, DDS, provides over 3000 ether anesthetics during the Civil War
- 1868: Alfred Coleman, DDS, invented the first CO_2 absorber
- 1883: G.V. Black, DDS, promoted the use of bromide of ethyl as an anesthetic
- 1902: Charles Teeter, DDS, introduced the first machine capable of delivering N_2O/O_2, ether, and chloroform. Later, Teeter was elected President of both the ASA and IARS
- 1912: Jay Heidbrink, DDS, first used color-coded anesthesia gas tanks and invented the pin index safety system
- 1910: Edgar Rudolph Randolph "Painless" Parker, DDS, advocated for the routine use of local anesthesia in dentistry. The ADA did not recommend local anesthesia until the 1930s
- 1940: Adrian Orr Hubbell, DDS, introduced sodium thiopental as an effective agent for outpatient surgery
- 1944: Leonard Monheim, DDS, published "A,B,C" preanesthesia risk categories
- 1963: The ASA published the Physical Status Classification
- 1963: Hoffmann-La Roche introduced Diazepam. The oral formulation became the most prescribed drug in the world
- 1970s: Medicine begins to adopt half of the 1844 dental paradigm for outpatient anesthesia, i.e. allowing a patient to leave from and return to home after GA and surgery the same day
- 2010s: Medicine begins to adopt the other half of dentistry's 1844 model, i.e. GA in facilities outside the OR

Glossary of Abbreviations

AA	Anesthesiologist assistant
AAOMS	American Association of Oral and Maxillofacial Surgeons
AAP	American Academy of Pediatrics
ABG	Arterial blood gas
ABO/Rh	Blood group classification
ABOMS	American Board of Oral and Maxillofacial Surgery
ACC	American College of Cardiology
ACE	Angiotensin-converting enzyme
ACEi	Angiotensin-converting enzyme inhibitors
ACLS	Advanced cardiac life support
ACTH	Adrenocorticotropic hormone
ADA	American Dental Association
ADBA	American Dental Board of Anesthesiology
ADH	Antidiuretic hormone or vasopressin
ADHD	Attention-deficit/hyperactivity disorder
ADSA	American Dental Society of Anesthesiology
AED	Automated external defibrillator
AHA	American Heart Association
AHI	Apnea–hypopnea index
AIDS	Acquired immunodeficiency syndrome
AMA	American Medical Association
AMS	Altered mental status
AOP	Apnea of prematurity
APL	Adjustable pressure limiting
ARB	Angiotensin receptor blockers
ASA	American Society of Anesthesiologists
ASC	Ambulatory surgery center
ASD	Atrial septal defect **or** autism spectrum disorder
ASDA	American Society of Dentist Anesthesiologists
AV	Atrioventricular
AVNRT	Atrioventricular nodal reentrant tachycardia
AVRT	Atrioventricular reentrant tachycardia
BAR	Blunt autonomic response
BBB	Blood–brain barrier
BiPAP	Bilevel positive airway pressure
BMI	Body mass index
BMP	Basic metabolic panel
BMS	Bare metal stent
BNP	B-type natriuretic peptide
BP	Blood pressure
BPD	Bronchopulmonary dysplasia
BSSO	Bilateral sagittal split osteotomy
BUN	Blood urea nitrogen
BW	Birth weight
°C	Celsius
CABG	Coronary artery bypass grafting
CAD	Coronary artery disease
CaO_2	Arterial oxygen content
CBF	Cerebral blood flow
CBC	Complete blood count
CC	Correlation coefficient
CCB	Calcium channel blocker
CD	Cluster of differentiation (CD4 cells)
CDC	Centers for Disease Control and Prevention
CHD	Congenital heart disease
CHF	Congestive heart failure
CI	Confidence interval
CKD	Chronic kidney disease
CL	Cleft lip
CLP	Cleft palate
cm	Centimeter
CMP	Comprehensive metabolic panel
$CMRO_2$	Cerebral metabolic oxygen consumption rate
CMS	Centers for Medicare and Medicaid Services
CN	Cranial nerve
CO	Cardiac output
CO_2	Carbon dioxide
COMT	Catechol-O-methyltransferase
COPD	Chronic obstructive pulmonary disease
COX	Cyclooxygenase
CNS	Central nervous system
CPAP	Continuous positive airway pressure
CPP	Cerebral perfusion pressure
CPR	Cardiopulmonary resuscitation
CRH	Corticotropin-releasing hormone
CNRA	Certified Registered Nurse Anesthetist
CSF	Cerebral spinal fluid
CT	Computed tomography
CV	Cardiovascular
CVA	Cerebrovascular accident
CVR	Cerebrovascular resistance
DA	Dentist anesthesiologist
DAPT	
DASI	

DBP	Diastolic blood pressure
DDAVP	Desmopressin
DDS	Doctorate of Dental Surgery
DEA	Drug Enforcement Agency
DES	Drug eluting stent
DHEA	Dehydroepiandrosterone
dL	Deciliter
DMARD	Disease-modifying antirheumatic drugs
DMD	Doctor of Medicine in Dentistry
DNA	Deoxyribonucleic acid
DO	Doctor of Osteopathic Medicine
DO_2	Oxygen delivery
DOS	Day of surgery
DPG	2,3 diphosphoglyceric acid
DPP-4	Dipeptidyl peptidase-4 inhibitors
DVT	Deep vein thrombosis
ECG	Electrocardiography
Echo	Echocardiogram
ED	Emergency department
EDV	End diastolic volume
EEG	Electroencephalogram
EGD	Esophagogastroduodenoscopy
ESRD	End-stage renal disease
ESV	End systolic volume
$ETCO_2$	End tidal carbon dioxide
ETT	Endotracheal tube
FA	Alveolar concentration of anesthetic gas
FDA	Food and Drug Administration
FEV_1	Forced expiratory volume over one second
FGF	Fresh gas flow
FI	Inspired concentration of inhaled anesthetic
FIO_2	Fraction of inspired oxygen
FOI	Fiberoptic intubation
FRC	Functional residual capacity
FVC	Forced vital capacity
g	Gram
G6PD	Glucose-6-phosphate dehydrogenase
G_A	Gestational age
GA	General anesthesia
GABA	γ-Aminobutyric acid
GER	Gastroesophageal reflux
GERD	Gastroesophageal reflux disease
GFR	Glomerular filtration rate
GI	Gastrointestinal
GLP-1	Glucagon-like peptide 1 receptor agonists
h	hour(s)
HAART	Highly active antiretroviral therapy
HbA1c	Hemoglobin A1c
HBF	Hepatic blood flow
HCL	Hydrochloric acid
HIV	Human immunodeficiency virus
HMG-CoA	3-hydroxy-3-methylglutaryl coenzyme A
HR	Heart rate
HTN	Hypertension
IANB	Inferior alveolar nerve block
ICD	Implantable cardioverter defibrillator
ICP	Intracranial pressure
IDDM	Insulin-dependent diabetes mellitus
IE	Infective endocarditis
IM	Intramuscular
IN	Intranasal
INR	International normalized ratio
IV	Intravenous
IVH	Intraventricular hemorrhage
J	Joule
kg	Kilogram
l	Liter
LBW	Lean body weight
LFT	Liver function tests
LMA	Laryngeal mask airway
LMWH	Low molecular weight heparin
LR	Lactated ringer's
LV	Left ventricle
LVAD	Left ventricular assist device
LVEF	Left ventricular ejection fraction
LVF	Left ventricular function
LVH	Left ventricular hypertrophy
m	Meter
m.	Muscle
MAC	Minimum alveolar concentration **or** monitored anesthesia care
MACE	Major adverse cardiac events
MAOIs	Monoamine oxidase inhibitors
MAP	Mean arterial pressure
MD	Doctor of Medicine
MDI	Metered dose inhaler
MET	Metabolic equivalent
mEq	Milliequivalent
MH	Malignant hyperthermia
MI	Myocardial infarction
MIO	Mean incisal opening
ml	Milliliter
mm	Millimeter
mm.	Muscles
MMA	Maxillary and mandibular advancement
MMF	Maxillomandibular fixation
mmHg	Millimeters of mercury
MRI	Magnetic resonance imaging
MRSA	Methicillin-resistant staphylococcus aureus
MTHFR	Methylenetetrahydrofolate reductase
ms	Millisecond
mV	Millivolt
MV	Minute ventilation
n.	Nerve
N_2O	Nitrous oxide
N/A	Not applicable
NAS	Neonatal abstinence syndrome
NEC	Necrotizing enterocolitis
NETT	
NG	Nasal-

NGA	Natural guarded airway
NICU	Neonatal intensive care unit
NIDDM	Non-insulin dependent diabetes mellitus
NIV	Noninvasive ventilation
NMB	Neuromuscular blockade
NMDA	N-methyl-D-aspartate
NMJ	Neuromuscular junction
NNT	Numbers needed to treat
NOE	Nasal-orbital-ethmoid
NPA	Nasal pharyngeal airway
NPH	Neutral Protamine Hagedorn
NPO	Latin "Nil per os" or nothing by mouth
NSAID	Nonsteroidal anti-inflammatory drugs
NYHA	New York Heart Association
OB	Obstetrics
ODD	Oppositional defiant disorder
OETT	Oral endotracheal tube
OG	Oral-gastric
OM	Otitis media
OMS	Oral and maxillofacial surgeon
OPA	Oral pharyngeal airway
OR	Operating room
OSA	Obstructive sleep apnea
$PaCO_2$	Arterial partial pressure of carbon dioxide
PACU	Post-anesthesia care unit
PaO_2	Arterial partial pressure of oxygen
P_AO_2	Alveolar partial pressure of oxygen
PAP	Pulmonary arterial pressure
P_{atm}	Barometric pressure (760 mmHg)
PCI	Percutaneous coronary intervention
PDEi	Phosphodiesterase inhibitors
PE	Pulmonary embolism
PEA	Pulseless electrical activity
PEEP	Positive end-expiratory pressure
PEG	Percutaneous endoscopic gastrostomy
PFO	Patent foramen ovale
PFT	Pulmonary function test
pH	Potential of hydrogen (Measuring degree of acidity)
PH_2O	Partial pressure of water (47 mmHg)
PO	Latin "Per os" or by mouth
PONV	Postoperative nausea vomiting
PPE	Personal protective equipment
PPM	Permanent pacemaker
pRBCs	Packed red blood cells
PRN	Latin "Pro re nata" or as needed
PPIs	Proton pump inhibitors
PPV	Positive pressure ventilation
PSI	Pounds per square inch
PT	Prothrombin time
PTT	Partial thromboplastin time
PVC	Polyvinyl chloride
PVCs	Premature ventricular contractions
PVR	Pulmonary vascular resistance
pVT	Pulseless ventricular tachycardia
q	Latin abbreviation of "quaque" or every
RAD	Reactive airway disease
RAE	Right angle endotracheal
RBCs	Red blood cells
RBF	Renal blood flow
RDS	Respiratory distress syndrome
RQ	Respiratory quotient (Typically ~0.8)
Rh	Rh immunoglobulin
ROM	Range of motion
ROP	Retinopathy of prematurity
ROSC	Return of spontaneous circulation
RR	Respiratory rate
RSI	Rapid sequence induction
RSV	Respiratory syncytial virus
RV	Right ventricle
RVH	Right ventricular hypertrophy
RVOT	Right ventricular outflow tract
RVR	Rapid ventricular response
SA	Sinoatrial
SBP	Systolic blood pressure
SDB	Sleep disordered breathing
SGA	Supraglottic airway
SGL2	Sodium glucose cotransporter-2 inhibitors
SHS	Secondhand smoke
SIDS	Sudden infant death syndrome
SL	Sublingual
SpO_2	Percent of oxygen-saturated hemoglobin
SNRIs	Serotonin norepinephrine reuptake inhibitors
SSRIs	Selective serotonin reuptake inhibitors
SV	Stroke volume
SVR	Systemic vascular resistance
SVT	Supraventricular tachycardia
T&A	Tonsillectomy and/or adenoidectomy
T_3	Triiodothyronine
T_4	Thyroxine
TAAA	Thoracoabdominal aortic aneurysm
TCAs	Tricyclics
TIA	Transient ischemic attack
TIVA	Total intravenous anesthesia
TMJ	Temporomandibular joint
TSH	Thyroid-stimulating hormone
TV	Tidal volume
TZDs	Thiazolidinediones
UPPP	Uvulopalatopharyngoplasty
UTI	Urinary tract infection
URI	Upper respiratory infection
URTI	Upper respiratory tract infection
VF	Ventricular fibrillation
V/Q	Ventilation/perfusion
VSD	Ventricular septal defect
VT	Ventricular tachycardia
VTE	Venous thromboembolism
vWF	von Willebrand factor
WBCs	White blood cells
WPW	
ZMC	

1.1 Statistics

- Sampling
  - Samples are subsets of the population
  - Ideal samples are truly representative of the population
- Probability
  - The possibility of an outcome from any random event
  - Numerical value between 0 and 1
- Mean
  - The average value of a data set
- Median
  - The middle value of a set of data which has been arranged in order of magnitude
- Mode
  - The most frequent value in a data set
- Standard Deviation
  - Quantifies the variability of values from the mean
- Standard Error
  - Measures the accuracy of the sample mean to the population mean
- Correlation Coefficient
  - The strength of linear relationship between two variables
- Confidence Interval
  - A range of values defined that there is a specific probability that the true value of a parameter lies within it
- Number Needed to Treat
  - The estimated number of patients that need to be treated to impact one patient
- P-value
  - The primary goal of any statistical test/analysis is to determine if a result is statistically significant which is done by a p-value
  - A p-value less than 0.05 is generally considered statistically significant

Normal Distribution (Figure 1.1)

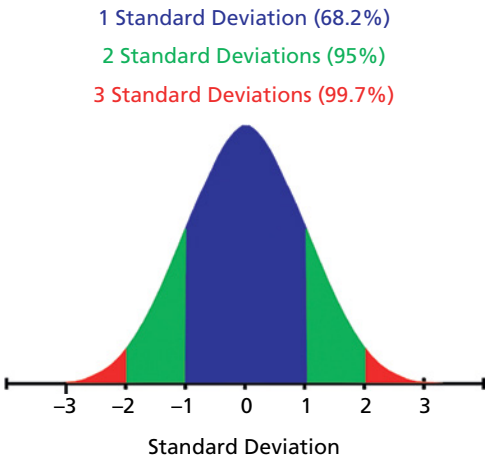


Figure 1.1

Variables

- Independent Variable
  - The variable being manipulated in a study
  - Typically on the X-axis
- Dependent Variable
  - The variable whose measurements depend on the independent variable
  - Typically on the Y-axis
- Continuous Variable
  - Numerical value that can include decimals
  - Examples
    - Income
    - Distance

Anesthesia for Dental and Oral Maxillofacial Surgery, First Edition. Spencer D. Wade, Caroline M. Sawicki, Megann K. Smiley, Michael A. Cuddy, Steven Vukas, and Paul J. Schwartz.

- Categorical Variable
  - Distinct categories of data
  - Examples
    - Demographics
    - Days of the week
  - Can include a number range

Basic Statistical Tests

- Student's T-test
  - Used when two categorical variables are tested against a continuous variable
    - Drug 1 vs. drug 2's (Categorical) effect on tumor size (Continuous)
- Chi-Square (χ^2) Test
  - Used when ≥2 categories are tested against ≥2 categorical outcomes
    - Drug 1 vs. drug 2's (Categorical) in eliminating depression (Categorical)
- Analysis of Variance
  - Used when >2 categorical variables are tested against a continuous variable
    - Drug 1 vs. drug 2 vs. drug 3's (Categorical) effect on tumor size (Continuous)

Research Methodologies (Figure 1.2)

- Systematic Review
  - Synthesizing summaries and conclusions from the results of independent studies
- Randomized Controlled Clinical Trial
  - Randomly assigns participants to two or more groups where at least one group receives treatment
    - E.g. The treatment group(s) receive a drug and the control group receives a placebo

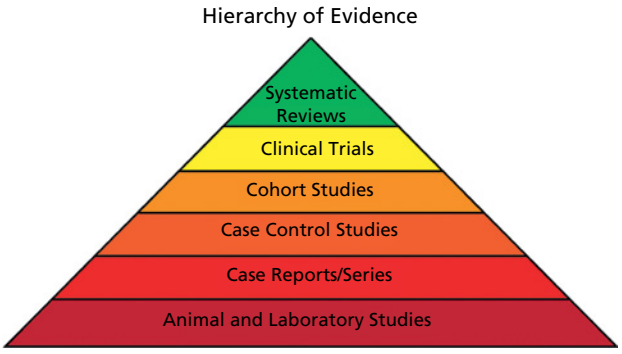


Figure 1.2

- Cohort Study
  - Subjects are grouped based on a risk factor to evaluate disease presence
  - Retrospective cohort
    - Risk factor exposure and disease prevalence are recorded
  - Prospective cohort
    - Following patients forward to see if disease will develop after exposure to a risk factor
- Case Control Study
  - Subjects with a disease are investigated to find cause or risk factors and compared to subjects who do not have the disease
- Case Series
  - Subjects with a disease are investigated to find cause or risk factors
  - There is no control group

1.2 Anesthetic Monitoring Standards

From The Committee of Origin: Standards and Practice Parameters on the Standards for Basic Anesthetic Monitoring by the American Society of Anesthesiologists

Standard I (Figure 1.3)

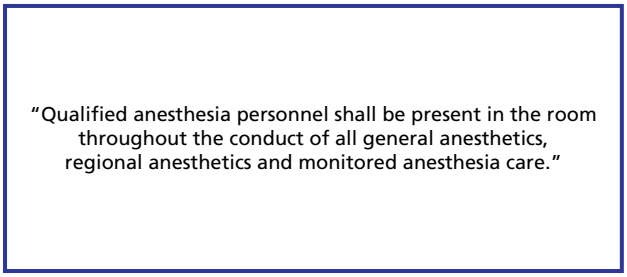


Figure 1.3

Standard II (Figure 1.4)

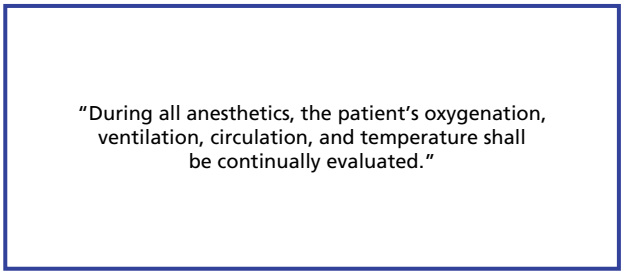
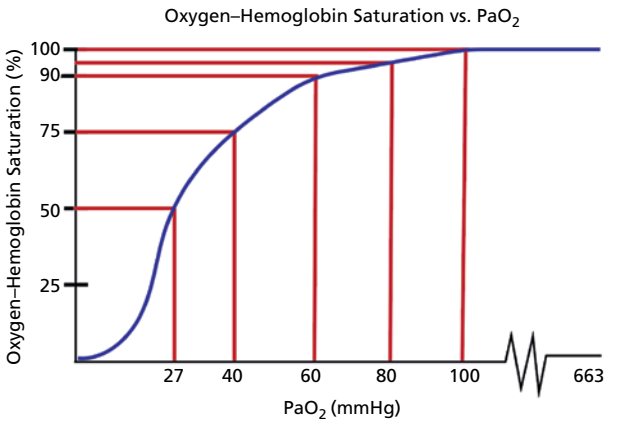


Figure 1.4

1.3 Pulse Oximetry

Function

- Uses photoplethysmography and pulsatile blood flow to derive oxygen saturation of hemoglobin (Figure 1.5)
  - Deoxyhemoglobin 660 nm
  - Oxyhemoglobin 940 nm



O_2 Saturation	PaO_2 (mmHg)	O_2 Saturation	PaO_2 (mmHg)
100%	100+	90%	60
97%	90	75%	40
95%	80	50%	27

Figure 1.5

Clinical Considerations

- *Factors affecting oxygen–hemoglobin affinity covered on page 47*
  - Falsely Low Reading
    - Nail polish
      - Debatable [1, 2]
    - Shivering
    - Poor circulation
    - Hypotension
    - Vasoconstrictors
    - Methemoglobinemia
      - *Methemoglobinemia covered on page 285*
    - Sulfhemoglobinemia from sulfonamides [3]
- Falsely High Reading
  - Carbon monoxide poisoning
    - SpO_2 will read 95+% regardless of true PaO_2
    - Venous blood will appear cherry pink
    - Carbon monoxide binds with 200× greater affinity to hemoglobin than oxygen forming carboxyhemoglobin
    - Carboxyhemoglobin has a similar absorption wavelength to oxyhemoglobin
    - Common clinical/exam scenario for this occurring is the first case on a Monday after the anesthesia machine has been left on over the weekend, desiccating the absorbent, which in turn will react with volatile agents to produce carbon monoxide

1.4 Electrocardiography

Function

- Measures electrical cardiac activity (Figure 1.6)
- *Dysrhythmia management covered in Section VI*

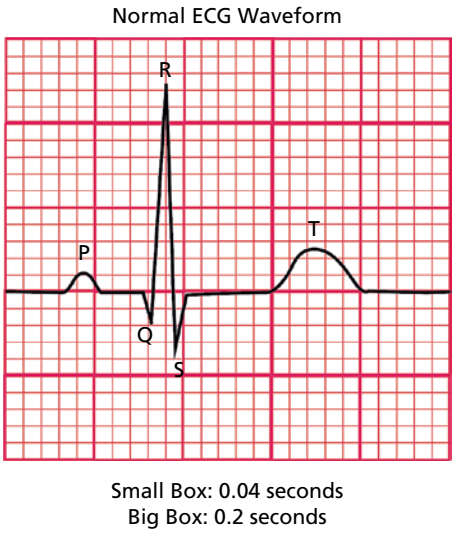


Figure 1.6

Clinical Considerations

- Dysrhythmia Detection
  - Lead II is considered best for routine monitoring
- Ischemia Detection [4]
  - Lead II and V_5, 80% sensitivity
  - Lead II, V_4, and V_5, 90% sensitivity
- P-Wave
  - Atrial depolarization
    - Typically upright and originates from the SA node
  - Normal
    - Upright
  - Inverted or absent P-wave
    - Likely due to rhythm propagation occurring inferior to the SA node or junctional rhythm
- P–R Interval
  - Conduction delay at the AV node
  - Normal
    - ~120–200 ms
  - Prolonged
    - First-degree heart block
- QRS Complex
  - Ventricular depolarization
  - Normal/narrow
    - ~80–100 ms
  - Delayed
    - 100–120 ms
    - Incomplete right or left bundle branch block
    - Nonspecific intraventricular conduction delay
  - Wide
    - >120 ms
    - Bundle branch block
    - Severe vagal stimulation
    - Second- or third-degree heart block
      - Can sometimes still be narrow depending on location of ectopic pacemaker
    - Premature ventricular contractions
    - Ventricular dysrhythmias
- T-Wave
  - Ventricular repolarization
  - Peaked T-wave
    - Sign of hyperkalemia
  - Inverted T-wave
    - Sign of ischemia

- QT Interval
  - Time from ventricular depolarization to repolarization
  - Normal
    - ~350–440 ms
  - Prolonged
    - Drug-induced
    - Prolonged QT syndrome
- R–R Interval
  - Time between QRS complexes
  - Dependent on heart rate
  - Normal
    - 0.6–1.0 seconds
      - 60 beats/min: RR is 1.0 seconds
      - 100 beats/min: RR is 0.6 seconds

1.5 Blood Pressure Monitors

Noninvasive Blood Pressure Cuff

- Function
  - Measures blood pressure by an inflatable cuff
  - Automated cuffs most commonly use oscillometry (Figure 1.7)
- Clinical Considerations
  - The extremity should be measured at the level of the heart
  - Bladder length should cover 80% of the upper arm circumference [5]
  - Bladder width should be >40% of upper arm circumference [5]
  - A cuff that is too small will give an artificially high reading
  - A cuff that is too big will give an artificially low reading
  - Morbidly obese patients may require a wrist cuff for accurate measurements
  - Cuff unable to read
    - Patient movement
    - Leak/disconnect in the cuff
    - Significant hypotension
    - Surgeon leaning on cuff
    - Kink in tubing
  - During head and neck procedures, consider placing cuff on a lower extremity or wrist to avoid surgeon interference and easier access

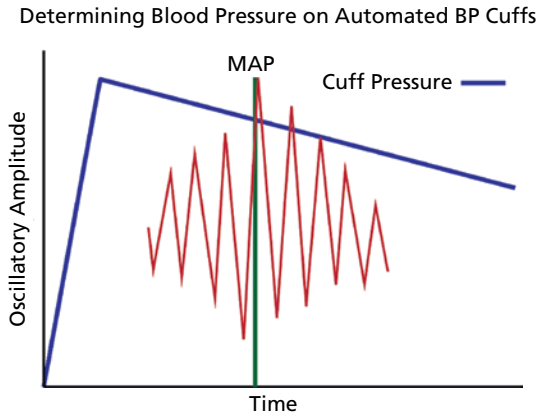


Figure 1.7

Arterial Line

- Function
  - Measures beat-to-beat arterial blood pressure by a transducer (Figure 1.8)
  - Access for ABG/blood samples
    - *Lab testing covered in Section III*

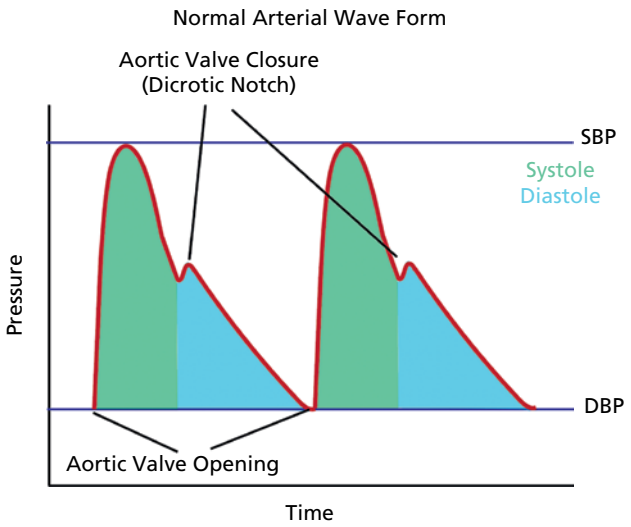


Figure 1.8