

## SYLLABUS

COURSE: DENF 2562 Local Anesthesia  
SEMESTER: Fall  
CREDIT HOURS: 1.0

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## GOAL

Local anesthesia is essential for the performance of a great majority of the clinical procedures you will use in treating your patients throughout your career. The goal of this course is for you to learn the pharmacology and toxicology of dental local anesthetic drugs and the proper techniques for their administration.

The mechanical manipulation of hard and soft tissue in the oral cavity represents a very important aspect of the overall treatment rendered to the dental patient. A great deal of time and effort will be expended by first year and second year dental students in learning the mechanical principles of cavity preparation, removal of teeth, periodontal surgery, and endodontic manipulations. In order to transfer to the patient the technical skills and knowledge that you will acquire in the classroom and laboratory, it will be necessary that you provide effective pain control measures for your proposed treatment. The production of local anesthesia of the hard and soft tissues of the oral cavity represents an important area of pain control and patient management.

This teaching course will present the complete pharmacology of local anesthetic agents, commonly-employed injection techniques of the maxilla and mandible, the nerves involved, important landmarks to utilize, and the anticipated distribution of local anesthesia.

Upon satisfying the instructor(s) of your didactic knowledge of local anesthesia, you will be given the opportunity to test your newly acquired skill of local anesthesia administration in a clinical situation. For this exercise, you and your classmates will jointly participate both as the "dentist" and the "patient." Successful completion of this laboratory is required for the use of local anesthesia in your clinical patients.

## OBJECTIVES

### I. INTRODUCTION TO LOCAL ANESTHESIA

1. Define "local anesthesia".
2. List the properties of the "ideal" local anesthetic.

### II. ION CHANNELS IN PAIN AND PAIN CONTROL

1. Describe the neuronal site of action of local anesthetics.
2. Describe the physiologic roles of voltage-gated ion channels in mammalian tissues
3. Classify voltage-gated sodium channels (IUPHAR classification), according to their tissue location and function.
4. Describe the role of the "resting", "open", "closed" and "inactivated" voltage-gated sodium channel in local anesthetic actions
5. Define "voltage dependence" as it applies to the interaction between dental local anesthetics and the voltage-gated neuronal sodium channel
6. Define "frequency dependence" as it applies to the interaction between dental local anesthetics and the voltage-gated neuronal sodium channel
7. Describe the influence of phenotypic variants of the native form of the voltage-gated neuronal sodium channel on clinical actions and failures of conventional dental local anesthetics.

### III. PHARMACOLOGY OF LOCAL ANESTHETICS

1. List and/or recognize ester and amide-type local anesthetics according to their chemical structure.
2. Describe the effect of chemical modifications on the duration of action and pharmacokinetics of local anesthetics.
3. Describe the process of uptake of local anesthetics, taking into account the effects of vasodilation and site of administration.
4. Describe the process of distribution of local anesthetics, including factors which increase and decrease their rate of distribution.
5. Describe the metabolism of local anesthetics.
  - 5.1 describe the site and mechanism of metabolism ester-type agents
  - 5.2 describe the site and mechanism of metabolism of amide-type agents
  - 5.3 describe the influence of the patient's medical status on local anesthetic metabolism and vice versa
6. Describe the excretion of local anesthetics.
7. Describe the systemic actions and toxicity of local anesthetics.

- 7.1 describe the central nervous system effects of local anesthetics
  - 7.2 describe the cardiovascular effects of local anesthetics
  - 7.3 describe the respiratory effects of local anesthetics
  - 7.4 describe the miscellaneous effects of local anesthetics
8. Describe the phenomenon of differential nerve block by local anesthetics.

IV. PHARMACOLOGY OF VASOCONSTRICTORS

- 1. List/and or recognize catecholamine and non-catecholamine vasoconstrictors according to their chemical structure.
- 2. List and/or recognize four results of the vasodilating properties of local anesthetics.
- 3. List and/or recognize five (5) reasons for adding a vasoconstrictor to a local anesthetic preparation.
- 4. Describe the mechanisms of action of vasoconstricting drugs, including types of receptors involved.
- 5. Describe the modes of action, the systemic actions, the termination of action and elimination, the side effects and overdose symptoms, the clinical application(s) and the availability in dentistry for the vasoconstrictors in dentistry:
  - 5.1 epinephrine
  - 5.2 felypressin
  - 5.3 phenylephrine
- 6. Recognize various dilutions of vasoconstrictors and be able to convert dilution values to milligram per milliliter values.
- 7. Recognize the proprietary names of the vasoconstrictors used in dentistry.
- 8. Describe the process of selection of a vasoconstrictor for clinical use:
  - 8.1 describe the influence of the duration of a dental procedure on the selection of a vasoconstrictor
  - 8.2 describe the influence of hemostatic requirement on the selection of a vasoconstrictor
  - 8.3 describe the influence of the patient's medical status on the selection of a vasoconstrictor
- 9. List maximum doses of vasoconstrictors for ASA I, II, III and IV patients.

V. CLINICALLY-USEFUL PREPARATIONS/BASIS FOR SELECTION

- 1. Recognize the proprietary names of lidocaine.
- 2. List three (3) formulations of lidocaine (by local anesthetic and vasoconstrictor concentration).
- 3. List the maximum dosage of lidocaine (in mg/kg) and be able to calculate the maximum allowable dose in mg and cartridges, when given the body weight of a sample patient.
- 4. List the duration of pulpal and soft tissue analgesia for the various preparations of lidocaine.
- 5. Recognize the proprietary names of mepivacaine.

6. List the formulation of mepivacaine (by local anesthetic and vasoconstrictor concentration).
7. List the maximum dosage of mepivacaine (in mg/kg) and be able to calculate the maximum allowable dose in mg and cartridges, when given the body weight of a sample patient.
8. List the duration of pulpal and soft tissue analgesia for the various preparations of mepivacaine.
9. List the proprietary names, maximum dosage and two (2) formulations of prilocaine (by local anesthetic and vasoconstrictor concentration).
10. Describe the distinguishing features of the metabolism of prilocaine in comparison with those of lidocaine.
11. Describe the clinical pharmacology (including maximum dosage) and preparation (trade name) of articaine and differences between articaine and other amide agents.
12. Recognize the official and proprietary names and maximum dosage of a long-acting local anesthetic.
13. Recognize the names of local anesthetics that are used as topically-applied agents, including combination/compound topical anesthetics.
14. Describe the basis for selection of a local anesthetic for clinical use, including the consideration of various medical conditions that may be relative or absolute contraindications for specific local anesthetic.

#### VI. LOCAL AND SYSTEMIC COMPLICATIONS

1. Recognize twelve potential local complications of dental local anesthetic injections.
  - 1.1 recognize the cause(s) of local complications of local anesthesia
  - 1.2 recognize the steps taken in the management of various local complications of local anesthetic injections, including the elements of informed consent
2. List five (5) causes of toxic blood levels of local anesthetics and describe the cause(s) and prevention of each.
3. List the signs and symptoms of minimal-to-moderate overdose levels of local anesthetics.
4. List the signs and symptoms of moderate-to-high overdose levels of local anesthetics.
5. List the steps to be taken in the management of local anesthetic overdose reactions:
  - 5.1 mild overdose reaction, rapid onset
  - 5.2 severe overdose reaction, rapid onset
6. List the clinical manifestations and the signs of epinephrine overdose.
7. List five (5) steps taken in the management of epinephrine overdose.
8. List four (4) types of signs and symptoms of generalized anaphylaxis.

9. List the steps taken in the management of delayed skin reactions, immediate skin reactions and bronchial constriction, and describe the drugs used in these conditions and their dosages.

## VII. DRUGS INTERACTING WITH LOCAL ANESTHETICS

1. Recognize potential adverse interactions between local anesthetics and other medications.
2. Describe the interactions which may occur between dental local anesthetics and:
  - 2.1 Cimetidine (Tagamet®)
  - 2.2 Propranolol (Inderal®)
  - 2.3 CNS depressants
  - 2.4 tricyclic antidepressants
  - 2.5 cardiovascular drugs

## VIII. SYRINGES, CARTRIDGES, NEEDLES AND ADDITIONAL ARMAMENTARIUM

1. Recognize the advantages and disadvantages of the metallic, breech-loading, cartridge-type syringe and its parts.
2. Compare the characteristics of the breech-loading, cartridge-type syringe with those of the:
  - 2.1 self-aspirating syringe
  - 2.2 pressure-type syringe
  - 2.3 jet injector syringe
  - 2.4 disposable syringe
3. Describe the proper care and handling of reusable local anesthetic syringes.
4. Describe five (5) potential problems with dental local anesthetic syringes.
5. Describe three (3) parts of the local anesthetic needle.
6. Describe the effect of length and needle gauge on needle deflection, aspiration and potential breakage during injections.
7. Describe the proper care and handling of dental local anesthetic needles.
8. Describe four (4) potential problems with dental local anesthetic needles.
9. Describe the parts of the dental local anesthetic cartridge.
10. Recognize the color-coding characteristics of dental local anesthetic cartridges.
11. List the contents of dental local anesthetic solutions and be able to convert their dilutions to mg/ml values and vice versa.
12. Describe the proper care and handling of dental local anesthetic cartridges.
13. Describe eight (8) potential problems to the dental local anesthetic armamentarium and describe the use of each.

IX. BASIC INJECTION TECHNIQUE

1. List the steps required for proper, a traumatic injection of dental local anesthetics, and describe the rationale for each step.
2. Recognize two steps in the atraumatic injection technique which are optional in increasing the difficulty of obtaining mandibular anesthesia.

X. SPECIAL CONSIDERATIONS: PEDIATRICS, GERIATRICS, AND MEDICALLY COMPROMISED PATIENTS

1. List factors which must be considered in geriatric patients in connection with administration of local anesthetics and other drugs.
2. Describe the basis for exaggerated drug effects and pharmacokinetic changes that occur in the elderly patient.
3. Describe methods for avoiding adverse drug reactions in the elderly.
4. Describe and recognize the implications for dental treatment of a positive response to each of the 18 health-history questions described in the textbook.
5. Recognize four levels of blood pressures in patients and the precautions to be taken during dental care for each blood pressure category.
6. Recognize the six categories of patient physical status classification (American Society of Anesthesiologists, Table 10-3) and the dental therapy modifications required by each category.
7. Recognize the mechanism, clinical signs and symptoms and etiologic factors for malignant hyperthermia.
8. Describe the dental management of the malignant hyperthermia patient.
9. Describe the significance of atypical plasma cholinesterase in dentistry.
10. Describe the proper dental management of methemoglobinemia, including recognition of its signs and symptoms.
11. Recognize local anesthetic considerations in medically compromised patients.
12. Describe the toxicity of local anesthetics in pediatric patients, when used alone and in combination with other CNS depressants.
13. Describe the management of soft tissue injury associated with local anesthesia in children.
14. Describe the modifications in local anesthetic injection techniques required in pediatric patients.
15. Recognize the eight components of the stress-reduction protocol for ASA II-IV patients.

XI. ANATOMY OF LOCAL ANESTHESIA

1. Describe the distribution of all branches of the three divisions of the trigeminal nerve.
2. Describe the importance of bifid inferior alveolar nerves and mandibular canals and the mylohyoid nerve in increasing the difficulty of obtaining mandibular anesthesia.

3. Recognize the osteological features of the maxilla and the mandible and the influence of these features on local anesthesia.
4. Describe anatomic considerations in obtaining maxillary and mandibular local anesthesia and anatomic complications of local anesthesia (from printed media resource #3).

## XII. TECHNIQUES OF MAXILLARY ANESTHESIA

1. For each of the following injections, describe nerves anesthetized, the areas anesthetized, the technique and the procedure:
  - 1.1 supraperiosteal (infiltration)
  - 1.2 posterior superior alveolar nerve block
  - 1.3 middle superior alveolar nerve block
  - 1.4 infraorbital nerve block
  - 1.5 greater palatine nerve block
  - 1.6 nasopalatine nerve block
  - 1.7 maxillary division block

## XIII. TECHNIQUES OF MANDIBULAR ANESTHESIA

1. For each of the following injections, describe nerves anesthetized, the areas anesthetized, the technique and the procedure:
  - 1.1 inferior alveolar nerve block
  - 1.2 buccal nerve block
  - 1.3 mental nerve block
  - 1.4 incisive nerve block
  - 1.5 mandibular nerve block/Gow-Gates technique
  - 1.6 periodontal ligament injection

## XIV. PDL AND INTRAOSSEOUS INJECTIONS

1. Describe the differences between conventional and intraosseous injections.
2. List the advantages of intraosseous injections over conventional injections.
3. List the indications for PDL and intraosseous injections.
4. List the contraindications for PDL and intraosseous injections.
5. Describe potential complications associated with the use of the PDL and intraosseous injections.
6. Describe the clinical technique for intraosseous injections using the Stabident and X-tip systems.

## RESOURCES

### I. Media Resources

#### A. Printed media

1. Required textbook

Malamed, Stanley F.  
*Handbook of Local Anesthesia*, 5<sup>th</sup> ed.  
Mosby Year Book, 2004.

2. Supplemental reading

Katzung, Bertram  
*Basic and Clinical Pharmacology*, 9<sup>th</sup> ed.  
Lange Series, 2003

3. Journal article (distributed in class)

Robert S. Roda and Patricia L. Blanton  
*The Anatomy of Local Anesthesia*  
Quintessence International, Volume 25, number 1, 1994

#### B. Non-printed media

1. CD Rom

*Mandibular Anesthesia- A Study of Reliable Techniques*

Maxillary Anesthesia  
(Dentsply Pharmaceuticals)

Mandibular Anesthesia  
(Dentsply Pharmaceuticals)

### II. Human Resources

Arthur Jeske, Ph.D., D.M.D.  
Phone: 713-500-4506; Room 493  
Email: Arthur.H.Jeske@uth.tmc.edu

## STUDY PLAN AND REQUIREMENTS

The study of this course consists primarily of a lecture series, required textbook assignments and videotapes.

The videotapes review the anatomy and technique of various local anesthetic injections. While this same material will be described in the required reading of the textbook and in the course lectures, viewing of the tapes is considered essential to understanding the injections and their associated anatomy.

Students are required to attend scheduled lectures/seminars, read the required textbook assignments and view the videotapes, and demonstrate their skill in the administration of local anesthesia.

This course must be successfully completed prior to performing a local anesthetic injection on any clinic patient, either in the dental Branch or in any of its extramural clinical facilities.

### DENF 2562 LOCAL ANESTHESIA 2009 Fall Semester Schedule

Mondays, 8-8:50 am  
See schedule for exceptions.

DATE	SESSION TOPICS
Mon, Aug 17	Introduction to Local Anesthesia in Dentistry
<b>Thu, Aug 20</b> <b>3-3:50 pm</b>	Ion Channels in Pain and Pain Control
Mon, Aug 24	Pharmacology of Local Anesthetics
Mon, Aug 31	Pharmacology of Vasoconstrictors
Mon, Sep 7	<i>Labor Day Holiday</i>
Mon, Sep 14	Clinically-Useful Preparations/Basis for Selection
Mon, Sep 21	Systemic and Local Complications
Mon, Sep 28	<b>EXAM</b> <span style="float: right;"><b>Room 207</b></span> <i>(Material from August 17 through September 14)</i>
Mon, Oct 5	Syringes, Cartridges, Needles and Additional Armamentarium
Mon, Oct 12	Basic Injection Technique
Mon, Oct 19	Special Considerations: Pediatrics, Geriatrics, and Medically Compromised Patients
Mon, Oct 26	Anatomy of Local Anesthesia
Mon, Nov 2	Techniques of Maxillary Anesthesia

DATE	SESSION TOPICS
Mon, Nov 9	<b>EXAM</b> <span style="float: right;"><b>Room 207</b></span> <i>(Material from September 21 through October 26)</i>
Mon, Nov 16	Techniques of Mandibular Anesthesia
Mon, Nov 23	PDL and Intraosseous Injections <b>Course Evaluation</b>
Mon, Nov 30	Special Considerations: Injections <i>Simulation Center</i> <span style="float: right;"><b>Room 1.084</b></span>
Dec 10 <b>8-9:50 am</b>	<b>COMPREHENSIVE FINAL EXAM</b> <span style="float: right;"><b>Room 207</b></span>

## EVALUATION METHODS

Students will be evaluated on the basis of two, one-hour examinations and one, two-hour comprehensive final examination, including both objective-type and essay questions. The first two exams will cover the material preceding it in the course outline. The last exam in the course will be comprehensive in nature and will include material from all preceding sections, but will focus primarily on material in the final one-third of the course. The first and second exams will each comprise 30% of the course grade, and the final exam will be 40% of the course grade.

The injection laboratory will be evaluated by clinical faculty on the basis of your knowledge of injection techniques and must be completed successfully in order to receive your course grade. All materials required for the lab will be provided by the school.

Attendance will be considered as a factor in your final course grade. Attendance will be taken in each lecture session by means of a sign-in roster that will be circulated during class time. Three (3) points will be deducted from your final course grade for each unexcused absence. Tardiness, leaving class early and any other deviations from our standards of professional conduct will also be used in determination of final grades, at the discretion of the course director (the course director can deduct up to five (5) points from your final course grade for each incident). Refer to the *2009-2010 Student Guide to Academic Studies* for the details about all of these standards.