Pain Pathways

- Can be blocked by blocking depolarization, conduction, or synaptic transfer
- Head/neck region takes up ½ of the homunculus

- Types of Anesthesia
  - Topical
  - Transdermal – applied with intent of deeper penetration
  - Infiltration – placed near tissue, diffused in
  - Local – placed to affect specific nerve trunk
    - Ideal LA
      - Water soluble
      - Non-irritating to nerve
      - Low systemic toxicity
      - Short induction
      - Adequate duration
      - No side effects
      - Vasoconstriction
- Neuroanatomy
  - Type A – pressure/motor
  - Type B – myelinated, boderate in size
  - Type C – pain/temperature
- Calculations per Carpal – 1.8cc per carpal
  - 1% = 10mg/cc
  - 1:1000 = 1.0mg/mL 1:100,000 = 0.01mg/mL
- Carpal contents
  - Anesthetic agent
  - Vasoconstrictor – epi or levonordephrin
  - Vasoconstrictor preservative – sodium metabisulfite
  - Isotonic NaCl
    - Note – methylparaben present in multidose vials – anesthetic preservative (slightly allergenic)
- Types of LA – aromatic lipophilic group and hydrophobic tertiary amino sandwiching an intermediate chain
  - Amides – have an "i" before "_caine"
    - Metabolized in liver, use low dose to avoid toxicity
  - Esters – all others (exception – piperocaine is an ester LA)
    - Metabolized in plasma via pseudocholinesterase
    - PABA is major metabolite – known allergen
    - Patients with atypical pseudocholinesterase may have systemic toxicity from ester Las
- Nerve Conduction
  - RMP = -80mV
  - Nerve excitation → increased permeability → Na^+ influx → reaches firing threshold (-50mV) → action potential → peak (+40mV) → membrane becomes impermeable → K^+ efflux, return to -80mV
- LA Mechanism
  - Depress depolarization
  - Blocks reaching threshold potential
  - Blocks AP formation – blocks Na^+ channel influx (blocks action potential formation)
  - Blocks conduction

- Infected tissues have a lower pH
    - Non-ionized base crosses nerve membrane – less non-ionized base to cross membrane → less potent
        - pKa 9.1 – procaine
        - pKa 8.1 – bupivacaine
        - pKa 7.9 – lidocaine, prilocaine
        - pKa 7.7 – etidocaine
        - pKa 7.6 – mepivacaine
    - Lower pKa – more rapid onset
    - Increased lipid solubility – more potent
    - Increased protein binding – longer duration
- Vasoconstrictors
    - Attach and directly stimulate adrenergic receptors
    - Act indirectly provoking release of endogenous catecholamines from intraneuronal storage sites
    - Both
- Toxicity
    - Systemic
        - Inadvertent IV injection
        - Large quantities
        - Altered metabolism
    - Local response
    - Idiosyncratic reactions
    - Allergies
        - Agent (xylocaine)
        - PABA
        - Sodium metabisulfite (vasoconstrictor preservative)
        - Methyl paraben (agent preservative)
- Side Effects
    - Convulsions – self limiting
        - Treat with diazepam, barbiturate, succinylcholine
    - Respiratory depression
    - CV collapse

- No drug exerts only 1 effect
- No drug is without some toxicity
- Danger lies in hands of the user

Acute and Chronic Pain

- Acute pain – transient pain from noxious stimulus – protects from injury, promotes healing
- Chronic pain – spontaneous pain/hypersensitivity in association with damage/lesion to nervous system
- Anxiety – vague unpleasant emotional state, objectless
- Fear – anxiety with an object
- Phobia – intense, unreasonable fear

- Neurons
  - A-delta fibers – low threshold mechanoreceptors (crude touch, pressure, pain, temperature)
  - C-fibers – nociceptive specific (pain, temperature, touch, pressure)
  - A-beta fibers – wide dynamic range (touch, kinesthesia)
- Types of Pain
  - Central – emanates from CNS structures
  - Referred – felt in area innervated by **different** nerve than mediates primary pain
  - Projected – felt in peripheral distribution of **same** nerve that mediates primary nociceptive input
- Conceptual models – biomedical vs biopsychosocial
  - Biological
  - Behavioural
  - Emotional
  - Social
  - Cognitive
  - Environmental

Local Anesthesia Administration

- Armamentarium = syringe, needle, cartridge
    - Syringe
        - Non-disposable
            - Breech loading, metallic, cartridge type, aspirating
            - Breech loading, plastic, cartridge type, aspirating
            - Breech loading, plastic, cartridge type, self-aspirating
            - Pressure syringe, PDL injection
        - Disposable syringe
        - Safety syringe
        - Computer controlled systems
        - Needle adapter
        - Piston with harpoon
        - Syringe barrel
        - Finger grip
        - Thumb ring
    - Needle – larger gauge = smaller internal diameter
        - 25G – red cap
        - 27G – yellow cap
        - 30G – blue cap
        - Long needle = 32mm
        - Short needle = 20mm
    - Cartridge (carpal)
        - 1.7/1.8mL (North America)
        - 2.2mL (UK, Australia)
        - Stored at room temp
        - NOT autoclavable, NOT soaked in ^OH, NOT exposed to sunlight
- Remove syringe → attach needle → retract piston and load carpal → engage harpoon → remove cap → landmark → insert → aspirate, rotate 90°, aspirate again → inject → remove → recap needle
    - Recap using scoop technique
    - Do not bend needles
    - Never insert needle to need hub depth
    - Place needles and carpal in sharps, do NOT remove needle adaptor
- Other armamentarium
    - Topical anesthetics – ointments, gels, pastes, sprays (metered and unmetered)
        - Best applied on dry tissue
        - Hurricaine spray
        - Dentipatch – lidocaine transoral delivery
            - Pre-injection – 10-15min before injection
            - Scale/root planning – 5-10min before procedure
    - Applicator sticks
    - Cotton gauze
    - Hemostat

Complications of LA

- Local pain
    - pH < 5.0
    - Cold temp
    - Rapid injection
    - ^OH contamination
    - Touching periosteum
  - Treat via careful administration
- Difficult anesthesia
  - Discuss with patient
  - Lots of LA
  - Block anesthesia
  - PDL, intrapulpal Las
  - Consider adjuncts (N_2O, IV sedation)
  - Consider local anatomy, systemic physiology
- Local Complications
  - Needle breakage
    - Unexpected patient movement
    - Needle size (25G – 30G)
    - Needle manipulation (bending)
    - Visible – remove
    - Invisible – refer to OMFS
  - Trismus
    - IAN, Akinosi, Gowgates, IM injection (M. pterygoid, temporalis)
    - Hemorrhage
    - Barbed needle
    - ^OH contamination
    - Moist towel 20min/hr
    - Physiotherapy, analgesia, R/O infection
  - Hematoma
    - Arterial/venous disruption
    - Less common in palate
    - Good anatomy knowledge
    - Apply pressure to site
    - Analgesics
    - Heat application (>6h post injection – vasodilatory)
  - Facial nerve paralysis
    - Deposition in parotid gland
    - Transient paralysis – protect cornea
    - Reassure patient, saline eye drops, eye patch
  - Self inflicted
  - Children and MR at high risk
  - Use short-acting LA (prilocaine)
  - Give good instructions
  - Closely observe

- Post-anesthetic lesions
    - Resemble HSV outbreak
    - Local trauma/hypoxia/necrosis
    - Activation of HSV
  - Reassure patient
  - Self limiting lesions – 10-14 day course
  - Provide analgesia
- Epithelial dequamation
    - Prolonged topical
    - High [] vasoconstrictors
    - Usually palatal mucosa
  - Resolution 7-10 days
  - Provide analgesics, saline rinses
- Persistent paresthesia/anesthesia
    - Nerve sheath trauma
    - Hemorrhave around neural sheath
    - Usually lingual nerve following IAN block
  - Explain pathophysiology
  - Explain normal nerve recovery signs – tingling, intermittent burning/sharp pain
  - Re-evaluate in 2 weeks, refer to OMFS if persistent
  - Document degree and extent if >2 months, refer to OMFS within 3months of consultation
- Nerve Injury – compression, retraction, partial/complete severance
  - Type I (neuropraxia) – mild temporary conduction failure, no damage to nerve, no degeneration, recovery in 4 weeks, no intervention needed
    - Sunderland I
  - Type II (axonotemesis) – wallerian degeneration of axons, but nerve intact. Recover within 1-3 months, but never complete, surgery required.
    - Sunderland II – IV
  - Type III (neurotemesis) – complete nerve severance, degeneration, lose fasicicular pattern, scar tissue formation, no recovery, surgery required
    - Sunderland V, VI
  - Neuroma – disorganized collagen mass with randomly organized fascicles
    - Trigger point via Tinels test – tap nerve area and see if distal areas tingle – signifies regeneration
    - Spontaneous ectopic generation of impulses
- Evaluating nerve injuries
    - History/ physical
    - Etiology
    - Onset and time course
    - Quantitative sensory examination, directional strokes, 2 point discrimination, pinprick sensation, thermal discrimination
  - Articaine = 2.5x more likely to cause paresthesia than prilocaine

- LA Overdose
    - Too large a dose
    - IV injection
    - Altered metabolism/excretion
        - Hepatic insufficiency
        - Renal dysfunction
        - Pseudocholinesterase for ester Las
- Dosing

Name	pKa	Inset	Duration	Max Dose
Procaine	9.1	Slow	45-90min	8-10mg/kg
Lidocaine	7.9	Fast	120-240min	4.5-7mg/kg
Bupivacaine	8.1	Slow	240-480min	2.5-3mg/kg
Prilocaine	7.9	Mid	90-360min	5-7.5mg/kg
Articaine	7.8	Fast	140-270min	4-7mg/kg

- Articaine – same pKa and toxicity as lidocaine, $t^{1/2}$ = ¼ lidocaine
- Systemic complications
    - Allergens
        - PABA in esters
        - Metabisulfite – vasoconstrictor preservative
        - Sulfa – articaine
        - Latex
        - Obtain accurate history
        - 1% diphenhydramine
    - Signs (low dose)
        - Lightheadedness, dizziness
        - Visual/auditory, disorientation, drowsiness
        - Tachycardia
    - Signs (high dose)
        - CNS excitation → rapid CNS depression
        - Bradycardia
        - Convulsions/seizures
        - Syncope, coma, RS depression, CVS depression, collapse
    - Management
        - ABCs, supplemental O_2, activate EMS
        - Treat symptoms – 5mg diazepam/1mg midazolam IV (anxiety/convulsions)
        - Monitor vitals, cardiopulmonary resuscitation
    - Epi overdose signs
        - Fear, anxiety, headaches, restlessness, heart palpitations, tremors, seizures
        - Levonordefrin = 5x stronger than epi
- Methemoglobinemia
    - Fe^{2+} → Fe^{3+} = Hb cannot release O_2
        - Respiratory depression, syncope, cyanosis, chocolate brown arterial blood
    - Drugs that can cause methemoglobinemia – prilocaine, lidocaine, large dose nenzocaine
    - Treat with 1% methylene blue (1.5mg/kg)
        - Congenital methemoglobinemia – relative contraindication

Mandibular Injections

- Block – anesthetic near main nerve trunk, anesthetizes entire nerve distally
- Infiltration – anesthetic near distal fibers, only area that anesthesia is beside

- IAN block – Most often used, 10-15% aspiration, 15-20% failure
  - Landmarks
    - Coronoid notch/anterior ramus
    - Pterygomandibular raphe
    - Occlusal plane (6-10mm superior)
    - Medial aspect of Mn, near Mn foramen
  - Inject cross arch, by contralateral canine – 20-25mm deep, lingual N block on way out
  - Failure
    - Anatomic – too low, too anterior (needle hits ramus prematurely)
    - Hematoma, trismus, transient facial paralysis (injection in parotid gland)
- Gow-Gates – Mn nerve block
  - Landmarks
    - Lateral side of condylar neck – mouth must be wide open – bring condylar neck inferior
    - Distal to Mx 2^{nd}/3^{rd} molars
    - High of Mx 2^{nd} molar ML cusp
  - Inject – cross arch, 25mm deep, as if trying to hit the ear
- Akinosi – Mn nerve block
  - Landmarks
    - High of mucogingival junction adjacent to Mx 3^{rd} molar
    - Closed mouth, no bony landmarks
  - Inject 25mm deep
- Long Buccal – Mn posterior vestibule
  - Landmarks
    - Distobuccal of 3^{rd} molar
    - Mucobuccal fold along ascending ramus/external oblique ridge
  - Inject 1-2mm deep
- Mental Block – LEAST frequently used, premolars forward, soft tissue anesthesia
- Incisive Block – premolars forward, pulpal anesthesia
  - Landmarks
    - Between apices of 2 premolars
    - Mucobuccal fold/just anterior to foramen
  - Inject with 25-27G short needle, 5-6mm deep
    - Inject deep for incisive block, shallow for mental block

- PDL injection – special syringe to force anesthesia into small space
- Intraosseous – requires access into bone (drilling) at apex of tooth
- Intrapulpal – for acute pulpitis (hot tooth)

- Charting
  - Drug name, dosage, location of injection
  - Concentrations, LA agent, vasoconstrictor

Maxillary Injections

- Infiltration – most Mx "blocks" are infiltrations
  - Individual teeth – 1-2 teeth for pulpal anesthesia
  - Landmarks
    - Root apex
    - Mucobuccal fold
  - Inject syringe parallel to long axis of tooth, insert roughly 45^{o} to Mx
- Posterior-superior alveolar – 3.1% aspiration (vessel plexus), molars
  - Landmarks
    - Superior to 2nd molar
    - Mucobuccal fold, no bony landmarks
  - Inject posteriorly, superiorly, medially, 15-20mm
  - Failure
    - Hematoma
    - Sometimes does not get mesial half of first molar
- Infraorbital block – canine to central incisor
    - 72% get anesthesia of premolars and mesiobuccal root of 1st molar
  - Landmarks
    - Over first premolar, lateral to canine (avoid zygoma)
    - Infraorbital foramen
  - Inject 25mm, 0.9-1.2mL
- Nasopalatine – painful (apply pressure on injection, topicals, etc), canine to canine
  - Palatal approach
    - Get incisive papilla, then palatal aspect of premaxilla
  - Labial approach
    - Get labial frenum, then interdental papilla, then incisive papilla
  - Inject with ¼ carpal
- Greater Palatine – secondary hemipalate
  - Landmarks – distal to 2nd molar
  - Inject until tissue blanches
- Maxillary nerve block - hemimaxilla
  - Higher tuberosity approach – pterygopalatine fossa
  - Greater palatine approach – through greater palatine foramen

Treatment Plan Development

- pKa of LA usually means ½ exists as non-ionized form at physiologic pH 7.4
    - Remember – solubility determines onset (potency)
- Infection lowers tissue pH
- Maximum dosage is usually 2 carpals for CV complicated patients, 11 for normal patients
        - Healthy patient – 0.2mg
        - Cardiac patient – 0.04mg
    - 0.018mg epi in 1.8mL carpal, [1:100,000]
        - 0.01mg/mL ratio
- Diabetes
    - Type I – use 50% in morning, short acting
    - Type II – stop oral insulin prior day
    - Post-operative – insulin sliding scale (titrate insulin, don't give too much)
    - Glucose check day of therapy
- N_2O contraindicated for pregnant women
    - Blocks B_{12} absorption, needed for folate metabolism → thymidine, DNA base acid
- N_2O fine for asthma, COPD
- Seizures – hypoxia warning, precipitated by stress
    - N_2O is okay
    - O_2 is good

Nitrous Oxide

- Anxiety most frequent factor for office medical emergency
    - Combined with labile patient, can produce medical crisis
    - Use anesthesia, analgesia, anxiolysis agents
- Anesthesia – loss of sensation
- Analgesia – loss of pain sensation, pain relief without loss of consciousness
- Anxiolysis – reducing anxiety
- Sedation
    - Conscious sedation – depressed level of consciousness from pharmacologic agent, patient still independently continuously maintains airway and communication
    - General anesthesia – controlled state of depressed consciousness produced by pharmacologic agent, complete loss of reflexes and unable to responds purposefully to physical/verbal stimuli
- Psychological factors

Increased pain	Decreased Pain
Sadness, depression	Happiness
Fatigue, insomnia	Rest, sleep
Anger, discomfort	Diversion, symptom relief
Anxiety, fear	Sympathy, understanding

- Inhalation anesthesia
    - N_2O
        - Advantages
            - Fast onset – similar to IV, faster than IM, oral, or rectal
            - Titration possible
            - Rapid complete recovery – 3-5min, escort not needed post-op
            - No injection needed, few side effects, analgesic properties (highly variable)
        - Disadvantages
            - Initial cost of tech, equipment maintenance (gas cylinders)
            - Variable potency, patients must breathe through nose, chronic exposure issues
- Must understand anatomy and physiology – CV, pulmonary, and CNS
    - Mechanics of respiration
        - Ventilation
            - Healthy individuals driven by CO_2 levels
                - CO_2 ↑ causes person to take a breath, CO_2 ↓ decrease ventilation rate
        - Muscles expand and contract chest cavity
            - Diaphragm, intercostals, SCM, abdominals, muscles of the spine
    - Principles of gas exchange – N_2O coefficient = 0.47 (very low)
            - High blood:gas coefficient – slow onset and recovery
            - Low blood:gas coefficient – insoluble in blood, so fast onset/recovery
        - Higher [N_2O] allows for rapid induction
            - Second gas effect
                - High potent but low concentration gas has slow onset
                - Giving gas that's less potent but high concentration causes first gas to have more rapid effect
                    - Giving N_2O with a more fast acting gas (halothane) speeds N_2O onset

- MAC – minimal alveolar concentration
  - Minimum [agent] prevents movement in 50% of individuals from surgical incision
  - N_2O MAC > 100 – not possible to produce surgical anesthesia alone in 50% of people
- Preparation
  - Heating ammonium nitrate crystals – decomposes to N_2O and H_2O
  - Compressed and stored – 30% of N_2O is liquid
  - Purity of gas usually approaches 99.5%
- N_2O properties
  - Not flammable or explosive
  - Support combustion (even w/o O_2)
    - Needs to be heated to 450°C → N_2 and O_2
  - N_2O is inhaled
    - Rapid diffusion into blood → ↑tension of gas → ↑[N_2] in brain → fast onset
      - Rapidly replaces N_2 in blood
      - Enters closed air space (middle ear, intestine) 35x faster than N_2
        - Increases cavity pressure/volume
  - Recovery
    - Rapid diffusion back into alveoli from blood (brain → blood → alveoli)
      - Causes diffusion hypoxia → dilution of O_2 and CO_2, decreasing respiratory drive
        - N_2O largely released from alveoli for first 5-10min post-op
      - Treat with 5-10min post-op 100% O_2
    - Diffusion hypoxia – nausea, headache, lethargy, hangover effect
  - Side Effects
    - Cutaneous vasodilation (flushing, perspiration)
    - Depression of myocardial contraction (at high [N_2O])
    - Does not affect HR, CO, BP in healthy patients
    - Anxiety reduction from deeper slow breathing
      - Deeper sedation may produce rapid shallow breathing
    - CNS depression, variable analgesia
    - Hypoxia – nausea and vomiting
    - B_{12} metabolism causing bone marrow suppression and neuropathies (chronic exposure)
- Procedure
  - 6L flow
  - 100% O_2 3-5min
  - Titrate 20% N_2O, increase 10%/min as needed
  - Treatment
  - 100% O_2 3-5min recovery

Patient Evaluation

- Delivery of N_2O/O_2
  - Central gas supply system
    - Cost savings, convenience, space
    - Manifold
    - Alarm system (<45psi, >60psi)
    - Pressure reducing value (regulator) 50psi
  - Portable delivery
    - For not frequent use
    - Moved easily
    - Holds 2-4 tanks
    - Pin index safety system
- Equipment involved:
  - Tanks
    - N_2O tank (blue)
      - Gas in liquid form, 750psi
      - Gauge will not indicate gas use until almost empty (20%)
      - Use 1 tank for every 3-4 O_2 tanks
    - O_2 tank (white/green)
      - 2000 psi, gas only, gauge measures gas accurately
    - N_2O cylinders
      - 95% liquid, 5% gas, 750 psi at 70^oF
      - Decreasing pressure (liquid/gas) – 20% contained
    - O_2 cylinder
      - 2000 psi, pressure gauge indicates accurately
      - O_2 tank is empty → no N_2O flow
  - Reducing valves (gauges)
    - High pressure to low pressure, 50psi
  - Hoses/pipes/manifold
  - On/flush switches
  - Flow meter
    - Gas flows through the meter, read to center of the sphere/cynlinder
    - Note – columns are NOT equal
    - Can flush, has a percent dial
  - Reservoir bag
    - 2-3L, gases mixed, most likely source of leak
    - Source of additional gas if needed (Positive O_2)
    - Monitor breathing (respiration here)
  - Conducting tubes
    - Non-collapsible
  - Nasal hood
    - Double mask system, should fit well to minimize gas leak
  - Gas scavenger
    - Standard of care

- Safety Features
  - Color Codes
    - Blue – N_2O
    - Green – O_2 (USA)
    - White – O_2 (international)
  - O_2 failsafe mechanism
    - Standard of care before 1976
    - Minimum 30% O_2 (ambient air is 21% O_2)
  - Index safety system
    - Pin index system – can't get into the wrong socket
    - Diameter index system – can't get into the wrong socket
  - Scavenger
    - Connection to suction, vent away from breathing area
- Major industries
  - Health settings – 85-90%
    - Hospitals – 80-85%
    - Dentists – 10%
  - Chemical industry – 5%
  - Food industry – 5-8%

Indications	Contraindications
- Anxiety, gagging, pain relief - Procedures where more than LA is needed - Lengthy procedures for medically compromised patients	- Compulsive personality - Claustrophobic persons - Unable to breathe through nose - Pregnancy - Severe behavior problems - URI, COPD

Advantages	Disadvantages
Rapid onset No biotransformation, no injection Variable analgesia Titratable (incremental dosing = standard of care)	Equipment cost Not potent Requires cooperative patient Chronic exposure problems Need person in room at all times (preferably same gender)

- Common signs/symptoms
  - Light headedness/dizziness
    - Transient feeling, [N_2O] inadequate for treatment
  - Tingling sensation of oral cavity, extremities
    - Good [N_2O] for starting IV, scaling, LA
  - Feeling of warmth, floating/heaviness
    - Near ideal [N_2O] for treatment
  - Note – patient variability is high – patient should feel relaxed and comfortable
- Elimination of N_2O
  - Stop leaks, use ventilation and scavenging nasal hoods
  - Minimize talking to the patient (N_2O can be exhaled orally)
  - Air monitoring – caution above 50ppm

- Monitoring
  - Questionable usefulness as decrease in respiratory drive should be minimal
  - NOT standard of care (oximetry and capnography)
  - Usually very few changes in vital signs present
- Primary indications
  - Fear and anxiety management
    - Anxiolysis
    - Analgesia (variable)
    - Reduction of pain threshold – useful prior to injection
  - Medically compromised patient
    - Anxiolysis
    - Minimal risk of hypoxia (if used properly)
    - Used in patients with angina, heart failure, dysrhythmia, MI
    - Fine for asthma patients – non-irritating to mucosa, no increase in bronchospasm
    - Good for epilepsy – if used properly, prevents hypoxia (hypoxia increases seizure risk)
      - Used in post-CVA patients (prevents hypoxia, same as epilepsy)
  - Gagging, gingival retraction cord
    - Provides analgesia, anxiolysis, decreased gag reflex
  - Incision and Drainage
    - Infection → ccidic pH – decreased LA effect
    - N_2O provides analgesia and anxiolysis
  - Dry socket dressing changes, suture removal
    - Short procedure, but can be discomforting
    - N_2O provides analgesia and anxiolysis
  - Initial dental/perio exam, insertion of wedges/matrix bands, rubber dam retainers
    - Axiety reduction, analgesia for sensitive tissues/pain/pressure
  - Removal of provisional crowns
    - Avoids use of LA because of analgesia/anxiolytic effects
  - Scaling/root planning/curettage
    - Painful procedure require debridement of necrotic tissue (ANUG) and from ultrasonics
    - N_2O provides analgesia and anxiolysis
- N_2O Recovery (after 100% O_2)
  - Check for normal feeling, common sense
  - Does not require patient escort if recovery is proper
- Pediatric patients
  - Nasal hood can be challenging
  - Can increase [N_2O] for “induction”
  - Use “tell-show-do” technique
  - Observation of sedation level should be apparent
  - Teenage patients may be aware of N_2O and request it
    - “the substance”
    - “nitrous”
    - “laughing gas”
    - “hippy crack”
    - “N_2O”

Nitrous Oxide and Abuse

  - Addiction – repeated, compulsive use despite negative psychosocial consequences
  - Physical dependence – absence of substance leads to signs/symptoms of withdrawal
  - Withdrawal syndrome – overactivity of physiologic functions that were suppressed by drug
- Uses of N_2O
  - Medical/dental anesthesia
  - Engine injection for boosting horsepower in automobile racing
  - Oxidant for semiconductor industry and analytical chemistry
  - Raw material in production of chemicals used to inflate airbags
  - Propellant in food industry (whip cream)
- Abuse Effects
  - Myeloneuropathy, equilibrium and coordination problems
  - Muscle weakness
  - Headache, memory/mood alteration
  - Multiple-sclerosis like symptoms
  - Depletion of B_{12} – peripheral nerve numbing (fingers/toes), bone marrow depletion
- Delegation of responsibilities (if authorized and when dentist is present in office)
  - RDAs – monitor N_2O patients
  - Hygienist – administer N_2O to patients
- Requirements for Certification
  - Must graduate from N_2O administration course at accredited university
    - 16h lectures, supervised clinical experience using fail-safe equipment with positive pressure
  - Must be trained biannually in CPR/BLS
  - Equipment must be fail safe and capable of positive-pressure ventilation

Review and Case Discussions

- 6-14% of Americans avoid dental care because of fear
- More invasive procedures can be done in outpatient clinics
- Anxiolysis – reduction of anxiety. Cognitive function and coordination may be impaired, but CV and Resp are not
- Moderate sedation – minimally depressed level of consciousness, patient retains ability to independently continuously maintain their own airway and response to physical/verbal stimuli
- Deep sedation – drug induced controlled state of depressed consciousness with partial loss of protective reflexes. Unable to maintain airway independently continuously and/or respond to purposeful verbal command
- General Anesthesia – elimination of all sensation, loss of consciousness. Not arousable by painful stimuli, may require mechanical ventilation and CV support

- Other inhalation anesthesia agents besides N_2O – usually used in OR or surgery, not usually dental office
    - Sevoflurane
    - Halothane
    - Desflurane
    - Isoflurane
- Oral Sedation
    - Advantages – no IV, good patient acceptance, minimal armamentarium
    - Disadvantages – not titratable, may not achieve desired effects, not predictable, multiple dosing not desirable, late onset (20-45min), monitoring needed, additional training needed, pre-op fasting required
        - Triazolam/halcion
        - Diazepam/valium
        - Lorazepam/Ativan
        - Midazolam/versed
        - Chloral hydrate
- IM
    - Advantages – no IV access needed, faster than oral onset, more reliable absorption than oral
    - Disadvantages – not titratable, overdose potential, lag time before seen effects, needle needed, potential 2-4h duration, monitoring needed, additional training required, pre-op fasting required
- IV
    - Advantages – titratable, more predictable, rapid onset, rapid reversal if needed, emergency drug admin if needed, replace fluid deficit from fasting
    - Disadvantages – monitoring needed, IV access needed, additional training needed, pre-op fasting required
        - Midazolam/versed
        - Fentanyl
        - Ketamine
        - Propofol
        - Brevital/methohexital

- Common side effects of sedatives
    - CNS depression, amnesia
    - Respiratory depression/arrest
    - Nausea
    - Disphoria/dreaming
    - CV effects
    - Drug interactions
- Monitoring
    - Moderate sedation
        - BP – before, during, after
        - Pulse oximetry
        - Respiration – chest rise, precordial stethoscope, capnography
    - Deep sedation/general anesthesia
        - BP – intermittent throughout procedure (every 5min)
        - Continuous pulse oximetry
        - Respiration
        - ECG
        - May also need airway support
- Patient evaluation for sedation
    - ASA PS level (prefer I and II)
        - ASA I – no known systemic disease
        - ASA II – mild/well controlled systemic disease
        - ASA III – multiple/moderately controlled systemic diseases
        - ASA IV – poorly controlled systemic diseases
        - ASA V – moribund patients
        - ASA VI – brain dead patients
    - Airway evaluation – most serious and common office emergencies involve airways/resp complications
        - Anatomy
        - Range of motion
        - Mallampati classification
            - Class I – tongue doesn't block vision of uvula
            - Class II – tongue blocks lower vision of uvula, can still see oropharynx
            - Class III – can barely see oropharynx
            - Class IV – tongue blocks vision of oropharynx
        - BMI/neck circumference
    - Considerations for specific organ systems
- Preoperative considerations of anesthesia
    - NPA for >6h (no food for 6h)
    - Patient escort present/accounted for
    - Check daily medication regimen – prescription drugs, OTC meds, herbals
    - Comfortable clothing and shoes
- Systemic evaluation – CV, pulmonary, renal, hepatic, endocrine
    - Diabetes – HbA1c <6 for healthy, <7 for diabetic controlled