The Effects of Smoking on the Eye
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Disclosure Statement: Nothing to disclose. Tweet about this session using the official meeting hashtag #aaoptom14

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Learning Objectives
- Be able to describe the most common ocular effects of smoking
- Be able to discuss management options for the most common ocular conditions found in smokers
- Be able to provide a list of resources for patients interested in quitting
- Be able to discuss the most common smoking cessation strategies with patients

The Problem
- Tobacco smoke is known to have 4,000 active compounds, including 40 known chemical carcinogens
- Cigarette smoking is the primary preventable cause of disease, disability, and premature death in the United States
- Smokers die significantly earlier than non-smokers:
  - 13.2 years for men and 14.5 years for women
- According to the CDC, ~20% of Americans are smokers
- Nearly 70% of smokers report a desire to quit

How often are patient records updated regarding smoking status?

| % (n) |
|---|---|
| Always—every visit | 14.8 (26) |
| Never | 8.0 (6) |
| Only during their first visit | 10.0 (85) |
| Sometimes—if the visit is a full oculo-visual assessment but not during a partial oculo-visual assessment | 24.8 (211) |
| I ask about smoking status only if patients show signs of a health condition associated with smoking (such as COPD) | 26.8 (228) |
| I ask about smoking status if patients show signs of an ocular health condition associated with smoking (such as AMD) | 55.8 (475) |

Note: respondents could check more than one option.
Why are we not educating patients on the effects of smoking?

Reasons why optometrists might not incorporate information about smoking into their practice:

<table>
<thead>
<tr>
<th>Possible reason</th>
<th>Selected, % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient knowledge about cessation services</td>
<td>66.2 (563)</td>
</tr>
<tr>
<td>Insufficient time during patient visits</td>
<td>56.5 (480)</td>
</tr>
<tr>
<td>Lack of appropriate information/materials for patients</td>
<td>54.6 (464)</td>
</tr>
<tr>
<td>Concern about patient resistance</td>
<td>50.1 (424)</td>
</tr>
<tr>
<td>Lack of patient compliance</td>
<td>48.6 (413)</td>
</tr>
<tr>
<td>Lack of patient motivation or interest</td>
<td>48.2 (410)</td>
</tr>
<tr>
<td>Lack of sufficient training to address smoking</td>
<td>46.7 (397)</td>
</tr>
<tr>
<td>Outside scope of practice or better done by other health care providers</td>
<td>28.2 (240)</td>
</tr>
<tr>
<td>Insufficient reimbursement from insurance/ province/ territory</td>
<td>27.1 (230)</td>
</tr>
<tr>
<td>Concern about losing patients</td>
<td>14.6 (124)</td>
</tr>
<tr>
<td>Support staff resistance to additional work</td>
<td>10.0 (85)</td>
</tr>
<tr>
<td>Ineffective smoking cessation services</td>
<td>3.4 (29)</td>
</tr>
</tbody>
</table>

Why you are here!

- 90% were interested in a continuing education program about the impact of smoking on vision and eye health as well as strategies for discussing tobacco cessation and prevention.
- Study Conclusion: “Opportunities for continuing education around cessation—including training specifically for optometrists—need to continue to increase.”

Smoking and the Eye

- Toxic effects of smoking related to:
  - Cell damage from free radicals
  - Decrease blood flow to ocular vasculature
  - Increased formation of clots within ocular vasculature

The Doctor’s Report

- [http://www.youtube.com/watch?v=X0tWONdhyO0&feature=related](http://www.youtube.com/watch?v=X0tWONdhyO0&feature=related)

Cornea and Tear Film

- Very thin (~0.5mm) transparent front surface layer of the eye
- Responsible for ~2/3 of the eye’s refractive power
- No vasculature
  - Receives oxygen passively from environment
  - Receives nutrition/waste removal via aqueous humor
- One of the body’s most densely innervated tissues
- Tear film coats the most anterior layer of the cornea (epithelium) and maintains moisture
  - Lipid layer (prevent evaporation)
  - Aqueous layer (maintain moisture)
  - Mucin layer (adherence to the cornea)

Smoking and the Cornea/Tear Film

- Increases risk of dry eye syndrome
- Symptoms include:
  - Burning
  - Itching
  - Redness
  - Tearing
  - Foreign body sensation
  - Intermittent blurred vision
- Second hand smoke increases dry eyes in children
- Mechanism: free radicals and other pro-oxidants in smoke/tar cause lipid peroxidation (break down of lipid layer) and alteration of tear proteins
  - Results in a reduced tear break up time
SMOKING AND THE CORNEA/TEAR FILM

- Treatment:
  - Eliminate offending agent
  - Lubrication (artificial tears, ophthalmic ointments)
  - Restasis
  - Punctal occlusion
  - Omega-3s
    - Mechanism
      - Anti-inflammatory?
      - Enhancement of lipid layer of tear film?
      - How much?
      - No FDA recommendation (1g-6g/day)

EXTRAOCULAR MUSCLES

- Six muscles responsible for movement and alignment of the eyes

EXTRAOCULAR MUSCLES

- Cigarette smoking is a risk factor for Graves’ disease
  - Development
  - Progression
  - Severity (increased risk of diplopia and exophthalmos)
  - Poorer outcomes with immunosuppressive therapies in the active phase
  - Increases risk of progression following radiotherapy
  - The relationship between smoking and effect may be dose dependent

EXTRAOCULAR MUSCLES

- Graves’ Disease Signs/Symptoms
  - Ocular irritation, redness, tearing, photophobia
  - Diplopia
  - “Stare” due to lid retraction
  - Exophthalmos
  - EOM restriction
  - Dry eyes/exposure keratopathy
  - Lagophthalmos
  - Elevated IOP
  - Compressive optic neuropathy (~5%)

  - Management
    - Copious lubrication, nocturnal lid taping
    - Systemic steroids, radiotherapy, surgery

CONJUNCTIVA AND SCLERA

- Conjunctiva is the thin cellophane-like layer that lines the sclera and inner eyelids
  - Responsible for maintaining moisture of the ocular surface

- Sclera is the white/opaque, fibrous, layer of the eye located directly posterior to the conjunctiva
  - Primary role is protective in nature

- Smoking increases the risk of conjunctivitis
  - Allergic in nature

CONJUNCTIVA AND SCLERA

- Conjunctivitis symptoms:
  - “Pink eye” (cosmesis)
  - Burning
  - Itching
  - Redness
  - Tearing
  - Foreign body sensation
  - Swollen eyelids
  - Increased sensitivity to light
CONJUNCTIVA AND SCLERA
- Mechanism: toxins and irritants in smoke cause an allergic response that results in inflammation
  - Higher amount of squamous metaplasia in the conjunctival epithelium
  - Reduction or absence of conjunctival growth factors
- Treatment:
  - Eliminate offending agent
  - Lubrication

ANTERIOR CHAMBER
- Space between cornea and iris that houses aqueous
  - Plays a nutritional role with posterior cornea, trabecular meshwork, lens, and anterior vitreous
  - Maintains intraocular pressure
- Smoking doubles the risk for infectious and inflammatory uveitis
- Symptoms
  - Eye pain
  - Redness
  - Photophobia
  - Tearing

MECHANISM:
- Pro-inflammatory components of tobacco smoke cause vascular inflammation (via hydrogen peroxide and upregulation of cytokines), which promotes organism entry to intraocular tissue
  - Tobacco smoke may also enhance the response of inflammatory cells to the microorganism
- Treatment
  - Topical steroids
  - Topical cycloplegic
  - Systemic work up as indicated

LENS
- Crystalline lens is a transparent refractive medium that provides ~1/3 of the eye’s power
- In young patients (<45), changes shape to change focus (accommodation)
- Cloudiness of the lens is called a cataract
- Cataract symptoms
  - Blurred vision (distance and near)
  - Difficulty night driving (pupil dilates)
    - Glare/halos around lights
    - Poor glare recovery (oncoming headlights)
- Mechanism:
  - Systemic absorptions of smoke constituents produce oxidative stress
    - Reduction in levels of vitamin C in the lens and blood
  - Accumulation of metals such as Cd and Fe
- Treatment:
  - Eliminate offending agent
  - Cataract surgery
  - Vitamins/Supplements are inconclusive
**Optic Nerve**

- Responsible for conduction of sensory signal from the retina to the visual cortex
- Cranial nerve II
- “Blind spot”

**Symptoms of optic neuritis/neuropathy**
- Blurred vision (minor → profound)
- Visual field defect
- Pupillary abnormality
- Color deficiency
- Pain (in acute inflammatory phase)

**Treatment of optic neuritis/neuropathy**
- Remove offending agent
- IV/Oral steroids in acute inflammatory phase
  - Speeds resolution but does not improve outcome
- Low vision rehabilitation

**Optic Nerve**

- Smoking has been associated with increased risk of
  - Optic neuritis
    - Poor recovery than non-smokers (more R/G color defects)
    - May speed progression and/or increase relapses
  - Ischemic optic neuropathy
  - Toxic optic neuropathy

**Glaucoma**

- A bilateral, progressive death of the optic nerve
- 2nd leading causes of blindness worldwide
- Affects 2-3 million in the US; ~10% of blindness in the US
- Exact pathogenesis is unclear
- Treatment involves controlling the disease there is no cure

- Smoking increases the risk and progression of glaucoma and worsens surgical outcomes

**Optic Nerve**

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**Retina**

- Sensory portion of the eye
- Contains rod and cone photoreceptors
- Transmits visual sensory information to the brain via optic nerve
Smoking is associated with increased risk of:
- Diabetic retinopathy (DR) and Diabetic Macular Edema (DME)
- Age related macular degeneration (ARMD/AMD)

**Diabetic Retinopathy and Diabetic Macular Edema**
- Leading cause of blindness in people <65
- 10% of world will be diabetic by 2035; 11% of US
- DME is the most frequent cause of severe vision impairment in diabetic patients
- Vision loss is secondary to the accumulation fluid within the macula (most sensitive part of vision)

**Treatment**
- Glycemic control
- Laser Photocoagulation
- Anti-VegF injection

**Age related macular degeneration**
- Affects ~10 million in US
- Accounts for 50% of severe and irreversible vision loss in the US, particularly those >65
- Expected to rise to nearly ~20 million by 2050
- Population attributable risk percent for smoking and AMD is 13.8%

**Dry AMD**
- No treatment

**Intermediate/Late Dry AMD**
- AREDS formula vitamins
  - 500mg Vitamin C
  - 400mg Vitamin E
  - 15mg Beta carotene*
  - 80mg Zinc
  - 2mg Copper
- Reduces risk of progression to advanced (exudative/wet) by 25% in patients with intermediate/late dry AMD
- AREDS 2: removed beta carotene, added lutein/zeaxanthin
- Wet AMD: Anti-VegF (Lucentis/Avastin) injections

**Mechanism**
- Oxidative damage to retinal pigment epithelial cells
- Depression of serum antioxidant levels
- Alterations of choroidal blood flow and of retinal pigment epithelium drug detoxification pathways
- Decrease luteal pigments to increase, increasing damage to the macula by light and oxidative damage

**Treatment**
- Early Dry AMD-No treatment
- Intermediate/Late Dry AMD-AREDS formula vitamins
- Reduction of progression to advanced (exudative/wet) by 25%

**Refractive Considerations**
- Smoking does not appear to influence refractive error of smokers, but can second hand smoke influence children’s refractive error?
- Study of ~4000 children age 1-6 years (STARS)
- Inverse relationship between child myopia and
  - H/o maternal smoking
  - Smoking during child’s life
  - Smoking during pregnancy
  - H/o paternal smoking
- Previous study of older children (mean 8.7) in the US found similar inverse relationship
- Mechanism: nicotinic acetylcholine receptors?
MARIJUANA
- 23 States and DC have legalized medical use of marijuana
- 2 States have legal recreational marijuana
- THC is the primary compound marijuana’s neurogenic and psychotropic effects
  - Stimulate specific dopamine receptors in the central nervous system, resulting in an induced state of euphoria or relaxation

<table>
<thead>
<tr>
<th>Proposed Medical Applications of Marijuana</th>
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<tbody>
<tr>
<td>Cancer</td>
<td>Anti-virus, appetite stimulation</td>
</tr>
<tr>
<td>AIDS</td>
<td></td>
</tr>
<tr>
<td>Alzheimer’s disease</td>
<td>Management of nausea, vomiting, and anorexia</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td></td>
</tr>
<tr>
<td>Tauristic syndrome</td>
<td>Management of spasticity, tone, tremors, and dystonia</td>
</tr>
<tr>
<td>Hepatitis cholestasis</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>Management of pain</td>
</tr>
</tbody>
</table>

MARIJUANA
- Initial studies in the 1970s (Hepler and Frank) showed IOP lowering effect peaking at 60-90 minutes and lasting only 3-4 hours
  - Prostaglandin analog may have IOP lowering effect 80+ hours
- Side effects
  - Conjunctival hyperemia
  - Diminished tear production (leading to dry eye)
  - Pupillary mydriasis
  - Cardiac arrhythmias
  - Psychogenic effects: disruption of short-term memory, cognitive impairment, a sense of time distortion, reduced motor coordination and sleepiness

MARIJUANA
- Marinol-synthetic version of THC available by Rx in 2.5mg, 5mg or 10mg capsules
- Topical routes are challenging due to the hydrophobic/lipophilic nature of cannabinoids, which make them insoluble in water.
  - Canasol-topical glaucoma medication marketed in Jamaica

MARIJUANA
- Position from American Academy of Ophthalmology:
  “Based on analysis by the National Eye Institute and the Institute of Medicine, the Academy finds no scientific evidence that marijuana is an effective long-term treatment for glaucoma, particularly when compared to the wide variety of prescription medication and surgical treatments available.”

SMOKING CESSATION

FACTORS CONTRIBUTING TO ADDICTION
- Biological
  - Nicotine affects brain centers associated with feelings of reward and arousal
  - Changes induced by tobacco persist long after cessation
  - Withdrawal symptoms appear within hours and may persist for months or even years
- Psychological
  - Coping mechanism for stress
  - “Self-medication” for anxiety, depression, etc
- Cultural
  - Identification with a group
  - May be part of daily rituals
**SMOKING CESSATION BENEFITS**

- 20 minutes: blood pressure drops to normal
- 12 hours: carbon monoxide level in the blood drops to normal
- 2 weeks: circulation improves and lung function increases.
- 1 month: coughing, sinus congestion, fatigue, and shortness of breath decrease as cilia regrow in the lungs.
- 5 years: Risk of cancer of the mouth, throat, esophagus, and bladder are cut in half.
- 10 years: lung cancer risk cut in half; reduced risk of laryngeal and pancreatic cancer.
- 1 year: risk of coronary heart disease cut in half.
- 1 month: coughing, sinus congestion, fatigue, and shortness of breath decrease decreases as cilia regrow in the lungs.
- 1 year: risk of coronary heart disease cut in half.
- 5 years: Risk of cancer of the mouth, throat, esophagus, and bladder are cut in half. Cervical cancer risk falls to that of a non-smoker. Stroke risk reduced to non-smoker level.
- 10 years: lung cancer risk cut in half; reduced risk of laryngeal and pancreatic cancer.
- 15 years: risk of coronary heart disease reduced to non-smoker levels.

**SMOKING CESSATION BENEFITS**

- Economic-What is the average cost of a pack of cigarettes?

**Economic benefits**

- Average cost of a pack of cigarettes
  - Louisiana: $4.48 (lowest)
  - Oregon: $5.20
  - California: $5.48
  - Washington: $7.87
  - New York: $10.11 (highest)
- Indirect costs to healthcare system: ~$300 billion
  - $135.2 billion for direct medical care of adults
  - $151 billion for lost productivity due to premature deaths
  - $5.6 billion for lost productivity due to exposure to secondhand smoke
- Put a different way, the average retail price of a pack of cigarettes in The United States is $5.51. But the real price of a pack of cigarettes to society and to the state’s economy is $18.05 per pack.

**SMOKING CESSATION**

- Nearly 70% of smokers report a desire to quit, but many lack access to resources to help.
- Physician involvement greatly increases success rates, but physicians are not being as effective as they could be in helping patients quit.
  - Long term abstinence alone: 7%
  - Long term abstinence with help of physician: 30%
- Less than 3 minutes of counseling by health care providers has been shown to increase quit rates by 30% (US DHS)
- Ophthalmologists are more likely to counsel on smoking cessation than Optometrists (Lawrenson, 2013)

**SMOKING CESSATION BY EYE CARE PROVIDERS**

- Caban-Martinez et al
  - Cessation counseling for patients with AMD
  - Most patients who smoke reported never being advised to quit smoking
  - Most eye care providers reported that they had advised smokers to quit.
  - Two-thirds of providers expressed a desire for additional training and resources to support patient quit attempts, indicating the need for the integration of smoking cessation opportunities in the clinic setting.

**SMOKING CESSATION BY PCPs (AAMC)**

- All physicians surveyed believe it is their role to help patients quit smoking.
  - 86% ask patients who smoke about their smoking status and advise them to stop.
  - 13% usually refer smokers to others for appropriate treatment.
  - 17% arrange for follow-up visits to address smoking.
- Five factors cited most often by physicians as significant barriers to successful intervention:
  - (1) lack of patient motivation (63%)
  - (2) limited coverage for interventions (54%)
  - (3) limited reimbursement for a physician’s time (52%)
  - (4) time with patients is limited (41%)
  - (5) too few available cessation programs (39%)
SMOKING CESSATION OPTIONS

- According to PCPs, “highly effective” interventions include:
  - Bupropion with nicotine replacement (29%)
  - Nicotine replacement with counseling (21%)
  - Family support (19%)

- Evidence-based studies have suggested these interventions have success rates (long-term abstinence) up to 38%

NICOTINE REPLACEMENT

- Designed to wean the body off cigarettes
  - Supply nicotine in controlled amounts without chemicals found in cigarettes

- OTC nicotine replacement products include:
  - Skin patches: transdermal nicotine patches
    - Brand names Habitrol and Nicoderm
  - Chewing gum
    - Brand name Nicorette
  - Lozenges
    - Brand name Commit
  - Rx only product
    - Nasal spray or inhaler
  - E-cigarettes: controversial

REPLACEMENT THERAPY

Basal Nicotine Transdermal Dose (need basal and prn dosages)

1. 1-5 cigarettes per day (cpd) = 7 mg per day
2. 5-10 cpd = 14 mg per day
3. 10-15 cpd = 21 mg per day
4. 15-20 cpd = 28 mg per day
5. 20-30 cpd = 35 mg per day
6. 30-40 cpd = 42 mg per day

The patch takes 8-12 hours to reach its steady state, patch is replaced every 16-24 hours

Courtesy of Anya Hill Certified Tobacco Treatment Specialist

REPLACEMENT THERAPY

PRN Oral Dosage

- Standard dose: 4 mg if patient needs to smoke within 30 minutes of waking
- Low dose: 2 mg if patient does NOT need to smoke within 30 minutes of waking

- Instruct patient NOT to suck, chew or swallow the lozenge or gum whole. The nicotine must be absorbed through the buccal mucosa to work. Nicotine loses its efficacy in gastric acid.

Courtesy of Anya Hill Certified Tobacco Treatment Specialist

NON-NICOTINE MEDICAL THERAPY

Chantix (varenicline tartrate)

- Acts at sites in the brain affected by nicotine. It provides some nicotine effects to ease withdrawal symptoms and blocks the effects of nicotine from cigarettes if users resume smoking.
- Side effects include:
  - Nausea
  - Constipation
  - Gas
  - Vomiting
  - Trouble sleeping
  - Vivid, unusual, or strange dreams.
  - Changes in behavior, depressed mood, hostility, and suicidal thoughts

Zyban (buproprion)

- Aids in cessation; precise mechanism unknown
- Same active ingredient as the antidepressant Wellbutrin
- Side effects include:
  - Insomnia
  - Dry mouth
  - Changes in behavior, depressed mood, hostility, and suicidal thoughts

Better Quit With...
COUNSELING & FAMILY SUPPORT

- Mentoring programs, smoking counselors
- Support groups
- Helplines
- SmokeFree Text
  - Encouragement, tips, and advice via text
- Apps
  - QuitSTART-free-tracks cravings and moods, monitors milestones and rewards with "badges," identifies smoking triggers, personalized "pick me ups" for challenging times, QuitPal-integrates calendar to set date goals, tracks monetary savings and financial goals, personalized messages from loved ones, social networking
  - QuitGuide-designed to help prepare quitting and provides support in the days and weeks after quitting via information and social networking

ONLINE RESOURCES

- Government Resources
  - National Quit line: 1-800-QUITNOW
  - SmokeFree.gov
  - National Cancer Institute
    - http://www.cancer.gov/aboutcancer/treatment/tobacco/index#tabid=42
    - Telephone Hotline: 1-877-448-7848
  - National Institutes of Health Smoking Cessation
  - Health Resources and Services Administration
    - http://www.hrsa.gov/stopsmoking/
    - 1-800-QUITNOW
  - Centers for Disease Control and Prevention
  - Agency for Healthcare Research and Quality
  - Womenshealth.gov
    - http://www.womenshealth.gov/quit-smoking/
  - Healthfinder
    - Tobacco Resources Page
  - MedlinePlus Tobacco/Smoking

BILLING AND CODING

- Diagnosis codes:
  - 305.1 Tobacco use disorder (Tobacco dependence)
  - V64.42 Counseling on substance use and abuse
- CPT codes (reimbursed by most insurance plans):
  - 99406 (smoking and tobacco cessation counseling visit; intermediate, greater than 3 minutes up to 10 minutes)
  - 99407 (smoking and tobacco cessation counseling visit; intensive, greater than 10 minutes)
- Must document total time spent, what was discussed, including cessation techniques, resources and follow-up
- Counseling lasting less than 3 minutes is considered part of an evaluation and management (E/M) service and is not paid separately.
- Services must be provided face-to-face

ONLINE RESOURCES

- Outside Organizations
  - American Lung Association
    - http://www.lungusa.org/site/c.dvLUK900I2H/d.22931/k.8500/Smoking_Cessation_Support.htm
  - Telephone Hotline: 800-LUNG-USA (586-4872)
  - American Cancer Society
    - http://www.cancer.org/learn/aboutcancer/smoking/ How_to_quit_smoking
d  - Telephone Hotline: 800-ACS-2345 (228-2345)
  - American Heart Association
    - http://www.americanheart.org/presenter.jhtml?identifier=3048036
  - Become an Ex (project of the National Alliance for Tobacco Cessation)
    - http://www.becomeanex.org/
  - American Legacy Foundation
    - Telephone Hotline: 866-66START (667-8278) [for pregnant smokers]
  - Campaign for Tobacco Free Kids
  - American Association for Respiratory Care

CONCLUSIONS AND THE GOOD NEWS!

- Smoking increases the risk for a variety of ocular and systemic health conditions
  - These ocular conditions range from nuisances to sight and life threatening
  - BUT, studies suggest there is a dose dependent relationship between tobacco use and it’s health side effects
  - THEREFORE: risk of tobacco use–related disease will likely decrease substantially after smoking cessation
  - We play a valuable role in providing resources to assist patients in quitting
REFERENCES