TOBACCO AND THE MUSCULOSKELETAL SYSTEM

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I. GOAL OF MODULE: Provide students with knowledge and skills on tobacco in relation to the musculoskeletal system

II. TARGET AUDIENCE

a. Level of Student/Learner: *3^{rd} & 6^{th} semester students*
b. Suggested Course or Subject: *Dept. of Pharmacology and Dept. of Surgery/Orthopedics*

III. LEARNING OBJECTIVES

1. To understand the relationship between tobacco use and back pain and understand the mechanism by which this occurs.
2. To discuss the relationship between tobacco and osteoporosis.
3. To review the effects of smoking on bone mineral density and the risk of fractures.
4. To understand the benefits of cessation in relation to bone loss and risk of hip fracture.
5. To understand what nicotine is, how it acts, and how it is metabolized
6. To get an overview of the current data available regarding smoking and chronic pain and its limitations
7. To understand the various aspects physicians need to be aware of during smoking cessation

IV. CURRICULUM STANDARDS ADDRESSED:

The Orthopaedics Department, having a total of 30 hours have the broad goal of teaching undergraduate students the basics of fractures and dislocations commonly encountered and the essential treatments needed for emergency management. This slot can be utilized for this mini-lecture.

- The student will be able to understand the principles of recognized bone injuries and dislocations. They will be able to recognize metabolic bone diseases as seen in the country.

Skills:

- They will be able to detect sprains, deliver first aid measures for common fractures and sprains and manage uncomplicated fractures.

The pharmacology department has the broad goal of teaching undergraduate students to inculcate a rational and scientific basis of therapeutics.

- They will able to describe the pharmacokinetics and pharmacodynamics of essential and commonly used drugs.

- They will able to describe the pharmacokinetic basis, clinical presentations, diagnosis, and management of common poisonings.
- They will able to classify environmental and occupational pollutants and state the management issues.

Skills:

- They will be able to prescribe drugs for common ailments.
- They will able to recognize adverse reactions and interactions of commonly used drugs.

V. MINI-LECTURES

MINI LECTURE 1 ***[Tobacco and Musculoskeletal Pain (Back Pain & Osteoporosis)]***

a. MINI LECTURE 1: CORE GENERIC SLIDES

1. Tobacco & Back Pain
2. How Smoking Causes Back Pain? (1–2)
3. Tobacco & Osteoporosis
4. Smoking & Bone Mineral Density
5. Smoking & Fractures
6. Benefits of Smoking Cessation

b. MINI LECTURE 1: OPTIONAL SUPPLEMENTAL SLIDES

1. Other Musculoskeletal Conditions
2. Bone Mineral Density
3. Bone Density & Age
4. Risk of Hip Fracture & Age

MINI LECTURE 2 [*Nicotine's Effects on Pain]*

a. MINI LECTURE 2: CORE GENERIC SLIDES

1. Nicotine
2. Nicotine: How Does it Act?
3. How is Nicotine Metabolized?
4. Data on Smoking & Chronic Pain
5. Smoking & Pain: Area of Research
6. Smoking Cessation & Pain

b. MINI LECTURE 2: OPTIONAL SUPPLEMENTAL SLIDES

1. Metabolites of Nicotine
2. Analgesic Effect of Nicotine

VI. CASE DISCUSSION / CLINICAL SCENARIO AND SKILLS CHECKLIST

CASE SCENARIO – asking patient about tobacco use

Overview

In this module, students are asked to practice integrated communication during case discussion under supervision of instructors, in order to develop their smoking cessation skills. Students will be trained to routinely ask about patients' smoking status in every case. After obtaining patients' current smoking status, students will then practice how to assess patients' readiness to quit, advise and assist patients to quit smoking, and also arrange follow ups to monitor patients' smoking cessation progress. Therefore students will also learn how to deliver efficient encouragement and provide proper explanation about the harm of tobacco on health and to help patients on their smoking cessation attempts.

Introduction

Tobacco has direct and indirect association with various musculoskeletal conditions, particularly back pain and osteoporosis. Both tobacco use in general and nicotine in particular also have an impact on pain, its perception, threshold, and management, which should also be discussed as part of this case.

Learning Objectives

Upon the completion of this skills laboratory practice, students are expected to be able to:

- Routinely ask all the patients about their smoking status.
- Assess patients' readiness to quit.
- Advise patients with musculoskeletal problems to quit smoking.
- Assist the patients to quit.
- Arrange follow ups on patients' smoking cessation progress.
- Explain the harm of tobacco on the musculoskeletal system.

Asking the patients' smoking history

The health consequences of cigarette smoking are well known as is the fact that there is no part of the human body that is not affected by tobacco.

Research studies show that if doctors have a reminder to ask about smoking, e.g., smoking status is part of the vital signs, doctors are three times more likely to advise patients to quit. Simple advice from a physician has been shown to increase abstinence rates significantly (by 30%) compared to no advice.

There are several important factors that should be considered when we are asking the patients'smoking history, i.e. 1) asking the smoking status of all patients (including women and teenagers); 2) if a patient does not smoke, they should be asked if they have ever smoked (because even after quitting, a smoker can start again); 3) questions should be delivered in a non-

critical manner, 3) evaluate the patients' smoking history as to how many cigarettes they smoke daily, do they use any other forms of tobacco; and 4) make a note on the patients' smoking status in the medical record. Women and children should not be excluded and they should also be asked about passive smoking.

Case Scenario

A 54 year old manual laborer with history of bronchitis and severe coughing spells developed a sharp pain in the lower back radiating to the right leg after one particularly bad episode. The pain was sudden in onset. On examination, straight leg raising test was positive on the right side. On X-ray, there was no evidence of fracture.

He has been a smoker for the last 20 years and smokes between 5 and 7 cigarettes a day. He consumes alcohol only socially.

Vital Signs:
Blood Pressure: 120/84
Pulse: 72/min
Body Weight:72 kg
Temperature: 97 F
Smoking Status: Smoker Ex-Smokers Never Smoke (Circle one)
Smoking Status of spouse: Smoker Ex-Smokers Never Smoke (Circle one)

Checklist for Case Scenario

S.No.	Aspects	Please tick if student has covered this aspect
	Ask	
1.	• Ask patient whether he/she smokes or not	
2.	• If the patient doesn't smoke, ask whether he/she ever smoked before	
3.	• If the patient smokes, ask how many cigarettes he/she takes per day	
	Assess	
4.	• Assess patient's readiness to quit.	
	Advise	
5.	• Advise patient to quit smoking	
6.	• Personalize advice by using the tobacco user's health status/disease	
	Assist	
7.	• Assist the patient to quit by giving him/her pamphlets, brochures	
	Arrange for Follow-up	
8.	• Arrange to follow up on tobacco use	

Points for Discussion

- Even though the etiology of back pain is varied, medical practitioners should be aware of the fact that tobacco use is also one of the risk factors for back pain and osteoporosis. Since back pain and osteoporosis are not traditionally associated with cigarette smoking even by medical practitioners, this point should be emphasized right from history taking.
- Moreover, patients should be strongly encouraged to quit smoking, keeping in view the fact that most organ systems of the body including the musculoskeletal system are adversely affected by smoking. Smoking delays and impairs healing from musculoskeletal injuries.
- Research has shown that smokers tend to have more back pain than non-smokers. Smokers' cough increases intra-discal pressure and can cause disc herniation.

FACT SHEET

The fact sheets are to be used by the tutor to supplement the discussion about the scenario. This fact sheet will address background information on tobacco that could be relevant to the scenario.

Smoking and back pain:

1. Positive associations have been noted in both men and women between smokeless tobacco and low back pain,[1] current smoking and nonspecific back pain, sciatica and herniated discs, and also between past smoking and nonspecific back pain.[2]
2. Regular inhalation of tobacco smoke has been suggested as leading to reduced perfusion and malnutrition of intervertebral discs. Serious cases may involve disc pathology in the form of herniated discs or internal disc disruptions.[3]
3. Nicotine is a psychostimulant that affects both cortical and autonomic arousal leading to a pharmacological effect on pain perception.[4]
4. Tobacco smoking may cause tissue damage or a prolonged resetting of the threshold for pain tolerance, which is more probable than transient pharmacological effects alone.[4]
5. Smoking might also provoke disc herniation through coughing, or lead to pathological changes in the intervertebral disc through alterations in its nutrition, pH, or mineral content.[5]

Tobacco & osteoporosis:

1. Cigarette smoking[6] and smokeless tobacco use[7] are both recognized risk factors for low bone mineral density (BMD) and osteoporosis.
2. Early exposure to smoke may decrease peak bone mass.[6]
3. Replacement hormone therapy may be ineffective in preventing hip fractures in postmenopausal women who smoke.[7]
4. Direct toxic effects of smoking have some detrimental effect on bone metabolism.[8]
5. The effect of smoking on bone is mainly mediated by an adverse influence on sex-steroid metabolism, and in particular by an oestrogen-lowering effect.[8]
6. Serum 25-hydroxyvitamin D levels are lower in smokers than in nonsmokers.[8]
7. Smoking also seems to dampen the bone protective effects of nutritional calcium in postmenopausal women.[8]
8. Smoking is a major cause of hip fracture. Of all hip fractures, one in eight is attributable to smoking.[9]
9. Risk of hip fracture was lower in former smokers, and in current smokers there was a dose response relation with the number of cigarettes smoked.[10]
10. It has also been estimated that smoking increases the lifetime risk of developing a vertebral fracture by 13% in women and 32% in men.[9]
11. The effect of smoking on bone mineral density increases cumulatively with age.[10]
12. Smoking also appears to have an independent, dose-dependent effect on bone loss, which increases fracture risk, and may be partially reversed by smoking cessation[9] but the reversibility is slower in post-menopausal women smokers.[10,11]

Other Musculoskeletal conditions:

1. Other musculoskeletal conditions associated with smoking are osteonecrosis of the femoral head, rheumatoid arthritis, Dupuytren's contracture and reflex sympathetic dystrophy.[12]
2. Smoking also delays and adversely affects bone healing and arthrodesis.[12]

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2. Goldberg MS, Scott SC, Mayo NE. A review of the association between cigarette smoking and the development of nonspecific back pain and related outcomes. Spine. 2000; 25:995–1014.
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5. Ernst E. Smoking, a cause of back trouble? Br J Rheumatol. 1993; 32:239-42.
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12. Conrad SE. The musculoskeletal effects of smoking. Available at: http://www.orthosmoke .org/orthoSmoke.pdf (accessed: June 2, 2009).

1. **REFERENCE LIST FOR MODULE**

MINI LECTURE 1 [Tobacco and Musculoskeletal Pain]

1. Mattila VM, Sahi T, Jormanainen V, Pihlajamaki H. Low back pain and its risk indicators: a survey of 7,040 Finnish male conscripts. Eur Spine J. 2008; 17:64–9.
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3. Scott SC, Goldberg MS, Mayo NE, Stock SR, Poitras B. The association between cigarette smoking and back pain in adults. Spine. 1999; 24:1090–8.
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MINI LECTURE 2 [Nicotine's Effects on Pain]

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2. National Institute on Drug Abuse. Brain Power! Challenge: Grades 6-9; *Module 2*: Legal Doesn't Mean Harmless. Available at: http://www.drugabuse.gov/JSP4/MOD2/page3.html (accessed: June 5, 2009)

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2. INSTRUCTOR KEY RESOURCES/REFERENCES

1. Conrad SE. The musculoskeletal effects of smoking. Available at: http://www.orthosmoke.org/orthoSmoke.pdf (accessed: June 2, 2009).
2. Benowitz NL. Cotinine as a biomarker of environmental tobacco smoke exposure. Epidemiol Rev. 1996; 18:188–204.

3. SUPPORT KEY REFERNCES

1. Conrad SE. The musculoskeletal effects of smoking. Available at: http://www.orthosmoke.org/orthoSmoke.pdf (accessed: June 2, 2009).
2. Benowitz NL. Cotinine as a biomarker of environmental tobacco smoke exposure. Epidemiol Rev. 1996; 18:188–204.

4. INSTRUCTOR WEB-SITE RESOURCES

1. http://www.orthosmoke.org/orthoSmoke.pdf
2. http://www.surgeongeneral.gov/topics/bonehealth/workshop_report/workshop_rpt.htm
3. http://www.drugabuse.gov/JSP4/MOD2/page3.html
4. http://www.drugabuse.gov/NIDA_Notes/NNVol17N6/Nicotine.html

5. http://www.pharmgkb.org/do/serve?objId=PA2011&objCls=Pathway

5. SAMPLE EXAMINATION QUESTIONS

Short Answers

1. Describe the mechanisms by which smoking causes back pain.
2. What are various pathways by which smoking leads to osteoporosis?
3. How does nicotine act to create craving?

Multiple Choice Questions (Answers in blue font)

1. Which one of the following is **not** a mechanism by which smoking causes back pain?

    a. Smoker's cough
    b. Malnutrition of disc
    c. Carboxy-methaemoglobin formation
    d. Decreases bone mineral density

2. Which of the following is **not true** of hormone replacement therapy?

    a. Effective in preventing hip fractures in postmenopausal women
    b. Ineffective in preventing hip fractures in postmenopausal women smokers
    c. Effective in preventing hip fractures in postmenopausal women smokers
    d. None of the above

3. Which of the following is **not** a mechanism by which smoking causes osteoporosis?

    a. Estrogen lowering effect
    b. Increased serum 25-hydroxyvitamin D levels
    c. Decreased calcium absorption from the gut
    d. Calcitonin resistance

4. Smoking has a _____ effect on bone loss, increasing fracture risk.

    a. Dose-independent
    b. Cumulative
    c. Dose-dependent
    d. Multiplicative

5. Nicotine is shaped like the neurotransmitter _____.

    a. Acetylcholine
    b. Dopamine
    c. Gamma-aminobutyric acid (GABA)
    d. Glutamate

6. 80% of nicotine is metabolized to _____ by the _____.

    a. Cotinine, Lungs
    b. Norcotinine, Kidneys
    c. Cotinine, Liver
    d. Norcotinine, Liver