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Secundum Artem

Current & Practical Compounding Information for the Pharmacist.

COMPOUNDING FOR SPORTS INJURIES

GOALS AND OBJECTIVES

Goal: To provide information on sports pharmacy and how compounding pharmacists can serve an important role in treatment of athletic injuries.

Objectives: After reading and studying the article, the reader will be able to:

1. Describe the two primary types of sports injuries.
2. List at least five opportunities for pharmacists interested in sports pharmacy.
3. Describe the differences among mild, moderate and severe sports injuries.
4. List at least 10 active ingredients that are commonly used in topical preparations for treating sports injuries.

INTRODUCTION

The increasing popularity of recreation, sports and fitness during the past 25 years has been described as a lifestyle revolution. Sports participation involves both spectator sports and active involvement in sports and fitness activities. Sports provides enormous enjoyment and health benefits but there is also a significant downside that involves sports injuries.[1] Sports medicine contains many niches that a sports pharmacist and compounder can easily fit into at several different levels.

The University Interscholastic League says there are approximately 230,000 high school athletic teams in the United States; the National Collegiate Athletic Association (NCAA) has 1,185 members who are involved at different levels of participation, and sponsor about 7,800 men's and 7,700 women's sports teams. In addition, there are the numerous professional and Olympic teams worldwide. In summary, there is a wide market for sports pharmacy and sports medicine.[1,2]

Practically all athletes sustain an injury at some time. It has been estimated that 60 to 70% of runners, 40 to 50% of swimmers and 80 to 90% of serious triathletes are injured during some point in their activities.[1,2] An athletic injury is defined simply as one that is sustained during an athletic event.

There are basically two types of athletic or sports injuries. Acute injuries and cumulative/overuse/repetitive injuries. Acute injuries result from a fall, contact or twist, such as a sprain or fracture. Cumulative or repetitive trauma, or overuse injuries, are those that are related to the "quantity" of exercise.

These forms of injuries are related to the two primary types of sports; contact sports and repetitive sports. Contact sports include football, hockey, soccer, and basketball where acute injuries are common. Repetitive sports include baseball, golf and tennis where chronic injuries are common. There are also combinations; for example, a quarterback can have repetitive motions from throwing the ball but also will have significant contact.

Formerly, interest in sports injuries primarily centered on acute injuries; those seen most often in full and partial contact sports, with injuries such as sprains, strains, bruises and breaks. Recently, however, there has been significant interest in overuse or chronic injuries, those that are caused by recurrent stress to an area of the body and not just to a single trauma.

Frequently injuries result from "too much too soon". Injuries can occur when participants suddenly increase the frequency, duration or intensity of their activities. Examples of sports where cumulative injuries occur include those to the runner, swimmer, aerobic dancer, and racket sports player. Prior to the fitness boom, these injuries were seldom seen in the general population; today, however, they are commonplace.

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OPPORTUNITIES IN SPORTS PHARMACY

A number of opportunities exist for pharmacists interested in sports pharmacy. These include (1) counseling athletes about nutrition, drug use and injury treatment, (2) serving as an information resource on drugs banned for collegiate and Olympic athletes, (3) producing and distributing educational materials related to sports pharmacy, (4) speaking at local events on pharmacy and sports (drug use and abuse, nutrition, prevention and treatment of sports injuries and drug testing), and (5) working with local trainers in providing medications for their emergency medical supply cabinets and travel cases.[1] Another opportunity is to establish a sports pharmacy rotation at your facility to introduce pharmacy students to the practice of sports pharmacy.[3]

TYPES OF SPORTS INJURIES

Sports injuries primarily include the acute, chronic or overuse and skin injuries. Each of these will be discussed or described and a few examples involving specific body parts (shoulders, knees, back) commonly injured will be listed.

Acute

Common acute sports injuries include sprains, bruises/contusions, hemobursa, strains, fractures, dislocations/subluxations, lacerations, incisions, punctures, abrasions, acute compartment syndrome, excessive bleeding, internal bleeding and shock caused by bleeding. This can result from most contact sports. A few of the specific acute injuries related to the shoulders and knees are listed below.

Common acute shoulder and upper arm injuries include fractured collarbone (clavicle fracture), shoulder dislocation, shoulder subluxation, shoulder separation, rupture of the long head tendon of the biceps, biceps bruise, fractures of the upper and middle shaft of the upper arm, torn rotator cuff, biceps strain and strain of the chest muscle attachment to the upper arm.

Common acute knee injuries include medial collateral ligament (MCL) sprain, and anterior cruciate ligament (ACL) sprain.

Common acute injuries to the back include back muscle strain, back ligament sprain and back contusion.

Chronic or Overuse

Common overuse injuries of the shoulder and upper arm include impingement syndromes, rotator cuff tendinitis, shoulder bursitis, inflammation of the long tendon of the biceps, and inflammation of the pectoral muscle insertion and frozen shoulder (adhesive capsulitis).

Common overuse knee injuries include sprains, medial collateral ligament (MCL) sprains, anterior cruciate ligament (ACL) sprains, iliotibial band friction syndrome, meniscus injuries, bursitis, knee plica, Osgood-Schlatter syndrome (inflammation or partial separation of the tibial tubercle), osteochondritis dissecans (loose bodies in the joint), patellofemoral pain syndrome (PFPS), patellar tendinitis (jumpers knee), quadriceps tendinitis.

Chronic /overuse injuries to the back can involve intervertebral disc disease (slipped disc, herniated disc, ruptured disc), spondylolysis and spondylolisthesis (stress fracture of the vertebra and stress fracture with slippage of a portion of the vertebra).

Joggers and walkers experience knee pain and inflammation. Muscle soreness, tendinitis, bursitis, and inflammatory responses are also common repetitive injuries. Joint-related inflammation and abrasions are common with activites such as skateboarding and rollerblading.

Skin Injuries

Skin problems in the athletic population include abrasions (turf burns, "strawberries"), cuts (lacerations), sunburn (actinic dermatitis), frostbite/frostnip, prickly heat (miliaria), jogger's nipples, skin chafing (intertrigo), allergic contact dermatitis, insect bites, and jock itch (tinea cruris). Skin injuries can also be due to mechanical means, including corns, calluses, taonoir (calcaneal petechiae), tennis toe, jogger's nipples, and piezogenic pedal papules.

Examples of skin injuries include swimmer's ear and fungal problems in swimmers, outdoor sports involving sun exposure, resulting in herpes, dry skin and dry/chapped lips. Also, fungal infections of the skin and nails can result from sharing showers with affected individuals.

Mild, Moderate and Severe Injuries

Injuries are generally classified into mild, moderate and severe. Mild injuries are defined as those in which performance is not affected, pain occurs only after exercise, the area is not tender to the touch, there is no or minimal swelling and there is no discoloration. Moderate injuries are those where performance is mildly affected, there is pain before and after activity, the area is mildly tender to the touch, there is mild swelling and some discoloration. Severe injuries consist of pain before, during and after exercise. Performance, daily activities and normal movement are affected by pain. Severe pain occurs when finger pressure is applied, there is swelling and/or discoloration of the affected areas.

Emergency Injuries

Emergency situations, although rare, requiring immediate medical attention include; obvious deformity in any bone, localized tenderness or pain (especially in a joint), alteration in consciousness, drowsiness, disorientation, persistent vomiting, pupils of unequal size, leakage of clear fluid from nose or ears, eye injuries involving altered vision, seizure, pains in the neck after impact, deep wound with bleeding, breathing difficulties after blows to the head, neck or chest and any injury accompanied by severe pain.

TREATMENTS USED IN SPORTS INJURIES

The typical cornerstone of acute sports injuries (strains, sprain and bruises) self-treatment is contained in the acronym RICE; Rest, Ice, Compression and Elevation. Beyond that, are the additional treatments involving cryotherapy (cold), thermotherapy (heat), whirlpools/immersion baths, hydrocollators, laser treatments, electrical stimulation, ultrasound and phonophoresis, extracorporeal shock wave therapy, transcutaneous electrical nerve stimulation (TENS), microwave and short-wave diathermy, spinal traction, iontophoresis, and pharmacotherapeutics.

Healing times for high school, college and professional athletes are reasonably short because they are usually younger in age and in most cases are in better physical and medical condition. Recreational athletes, however, vary in age and condition so their recovery rates are less predictable.

DRUGS AND DOSAGE FORMS

Drugs commonly used to treat both acute and repetitive/chronic sports injuries include analgesics, nonsteroidal anti-inflammatory agents, anti-inflammatory agents (corticosteroids), rubefacients, counterirritants, anesthetics, muscle relaxants, emollients, sunblockers, anti-infectives (antibiotics, antifungals) and others. Sample active ingredients and their commonly used concentrations are listed in Table 1.

Virtually all dosage forms can be used in sports medicine but two that are probably used more in sports medicine than in the general population include phonophoresis and iontophoresis. Phonophoresis is best accomplished by incorporating the active drug into gels and iontophoresis uses simple aqueous solutions. These are included in the sample formulations in the following section.

For topical application, gels and creams are most commonly used, followed by ointments and oils. Sprays are convenient and can be formulated with penetration enhancers for greater delivery of the active ingredients.

Due to the extremely large list of drugs and dosage forms that can be used in sports pharmacy, those presented here will primarily include topical preparations.

SAMPLE FORMULATIONS

Rx Lidocaine hydrochloride 4% and Epinephrine hydrochloride 0.1% Topical Gel

Lidocaine hydrochloride		4 g
Epinephrine hydrochloride		100 mg
Purified water		qs
Methylcellulose 3% Gel	qs	100 g

Dissolve the lidocaine hydrochloride and the epinephrine hydrochloride in a small quantity of purified water. Incorporate the solution into the methylcellulose gel. Package and label.

Rx Sports Rub Cream

Methyl salicylate		15 mL
Menthol		10 g
Eucalyptus oil		1 g
Hydrophilic ointment	qs	100 g

Mix the menthol and eucalyptus oil with the methyl salicylate. Slowly, incorporate this solution in the hydrophilic ointment and mix well. Package and label.

Rx Triamcinolone and Lidocaine Oral Puffing Powder

Triamcinolone acetonide		100 mg
Lidocaine hydrochloride		2 g
Polyox	qs	100 g

Ensure that the powder particles are in the same particle size range. Blend the powders together until uniform. Package in a "puffer" type administration device. Label.

Rx Lidocaine 2% Popsicle

Lidocaine		2 g
Aspartame		200 mg
Xanthan gum		3 g
Sucrose		20 g
Citric acid		200 mg
Flavor		qs
Purified water	qs	100 mL

Mix the lidocaine with the aspartame, xanthan gum, sucrose and citric acid. Add this mixture to approximately 60 mL of purified water and mix well. Add the flavor and sufficient purified water to volume and mix well. Allow to stand for 1-2 hours for the xanthan gum to fully hydrate. Package in plastic sleeves or pour into ice cube trays and place in a freezer. Package in zip lock bags and label.

Rx Acyclovir with Lidocaine hydrochloride 1% and PABA 0.5% Medication Sticks

Acyclovir	1.2 g
Lidocaine hydrochloride	200 mg
p-Aminobenzoic acid	100 mg
Polyethylene glycol 3300	8 g
Polyethylene glycol 300	14 mL

Melt the polyethylene glycol 3300 and polyethylene glycol 300 together at a temperature of about 55° C. Incorporate the acyclovir, lidocaine hydrochloride and the PABA powders and mix well. Cool slightly, then pour into medication stick tubes. Package and label.

Rx Dexamethasone (base) 4 mg/mL and Lidocaine Hydrochloride 40 mg/mL Solution for Iontophoresis

Dexamethasone sodium phosphate		520 mg
Lidocaine hydrochloride		4 g
Sterile water for injection	qs	100 mL

Dissolve the dexamethasone sodium phosphate and the lidocaine hydrochloride powders in sufficient sterile water for injection to volume. Filter, package and label appropriately.

Rx Ketoprofen 10% and Ibuprofen 2.5% in Pluronic Lecithin Organogel

Ketoprofen		10 g
Ibuprofen		2.5 g
Lecithin:Isopropyl palmitate 1:1 Solution		22 mL
Pluronic F127 20% Gel	qs	100 mL

Mix the ketoprofen and ibuprofen powders with propylene glycol to form a smooth paste. Incorporate the lecithin:isopropyl palmitate solution and mix well. Add sufficient Pluronic F127 gel to volume and mix using high shearing action until uniform. Package and label.

Rx Ketoprofen 5% and Capsaicin 0.075% Topical Gel

Ketoprofen		5 g
Capsaicin		75 mg
Hydroxypropyl cellulose 1500 cps		1.5 g
Isopropyl alcohol 70%	qs	100 mL

Dissolve the ketoprofen and capsaicin in about 95 mL of the isopropyl alcohol. With moderate stirring, slowly sprinkle the hydroxypropyl cellulose into the mixture. Add sufficient isopropyl alcohol to volume and mix well. Allow to set for about one hour to fully hydrate. Package and label.

Rx Ketamine 4%, Ketoprofen 10% and Cyclobenzaprine 0.5% in Pluronic Lecithin Organogel

Ketamine hydrochloride		4.6 g
Ketoprofen		10 g
Cyclobenzaprine hydrochloride		500 mg
Propylene glycol		10 mL
Lecithin:Isopropyl palmitate 1:1 Solution		22 mL
Pluronic F127 20% Gel	qs	100 mL

Mix the ketamine hydrochloride, ketoprofen and cyclobenzaprine hydrochloride powders with propylene glycol to form a smooth paste. Incorporate the lecithin:isopropyl palmitate solution and mix well. Add sufficient Pluronic F127 gel to volume and mix using high shearing action until uniform. Package and label.

Rx Wintergreen Compound Emollient Rub

Methyl salicylate		30 g
Menthol		7.5 g
Lanolin		2.5 g
White wax		15 g
White petrolatum		45 g

Heat the white wax using low heat. When melted, incorporate the lanolin and the white petrolatum and mix well. Remove from heat and begin cooling the preparation. Dissolve the menthol in the methyl salicylate. Incorporate the solution into the soft base and mix well. Package and label.

Rx Eastern Analgesic Oils

Methyl salicylate		60 mL
Menthol		15 g
Camphor		10 g
Lavender oil	qs	100 mL

Dissolve the menthol and the camphor in the methyl salicylate. Add sufficient lavender oil to volume and mix well. Package and label.

Rx Analgesic Sports Rubbing Oil

Methyl salicylate		30 mL
Menthol		7 g
Camphor		7 g
Eucalyptus oil		3 mL
Mineral oil, Light	qs	100 mL

Dissolve the menthol and camphor in the methyl salicylate and add the eucalyptus oil. Add sufficient light mineral oil to volume and shake well to uniformly disperse. Package and label.

Rx Dexamethasone 1% and Piroxicam 0.1% Gel

Dexamethasone		1 g
Piroxicam		100 mg
Propylene glycol		5 mL
Alcohol		70 mL
Hydroxypropyl cellulose		2 g
Purified water	qs	100 mL

Mix the dexamethasone, piroxicam and hydroxypropyl cellulose with the propylene glycol to form a smooth paste. Mix the alcohol with approximately 20 mL of purified water and place on a magnetic stirring apparatus. With moderate stirring speed, slowly incorporate the drug-hydroxypropyl cellulose mixture into the liquid. Add sufficient purified water to volume and mix well. Cover and allow to set for about 1 hour. Package and label.

Rx Dexamethasone (base) 1% and Lidocaine Hydrochloride 4% Ultrasound Gel

Dexamethasone sodium phosphate		1.32 g
Lidocaine hydrochloride		4 g
Propylene glycol		5 mL
Ultrasound gel	qs	100 mL

Mix the dexamethasone sodium phosphate and the lidocaine hydrochloride with the propylene glycol. Incorporate the ultrasound gel and mix well. Package and label.

Rx Ketoprofen 10% Ultrasound Gel

Ketoprofen		10 g
Sodium hydroxide 10% solution		qs
Hydroxy ethylcellulose 5000 cps		3 g
Methylparaben		50 mg
Propylparaben		20 mg
Purified water	qs	100 mL

Heat approximately 80 mL of the purified water almost to boiling. Add the methylparaben and propylparaben and stir until dissolved. Cool and add the ketoprofen powder. Adjust the pH to the range of 7.0 (+/- 0.3) and stir until the ketoprofen is dissolved. Stir the solution at moderate speed and add the hydroxy ethylcellulose and mix until uniform. Allow to set for an hour. Package and label. Note: Be careful not to incorporate air into this product.

Rx Ketoprofen 5% Topical Spray

Ketoprofen		5 g
Isopropyl myristate		10 mL
Ethyl alcohol 95%		45 mL
Isopropyl alcohol 99%	qs	100 mL

Mix the ketoprofen with the isopropyl myristate and alcohol. Add sufficient isopropyl alcohol to volume and mix well. Package and label.

References

1. Micheli LJ. The Sports Medicine Bible. New York. HarperCollins Publishers Inc. 1995.
2. Price KO, Huff PS, Isetts BJ, Goldwire MA. University-based sports pharmacy program Am J Health-Syst Pharm 1995;52:302-9.
3. Sato SJ, Weingart DL, Brier KL. Sports pharmacy clerkship. ASHP 1993;50:2522.

TABLE 1:
ACTIVE INGREDIENTS COMMONLY USED IN TOPICAL SPORTS MEDICINE PREPARATIONS

Ingredient	Common % Used
Analgesics, Topical	
Camphor	3-11%
Capsaicin	0.025-0.25%
Eucalyptus oil	0.5-3.0%
Histamine dihydrochloride	0.025-0.10%
Menthol	1.25-16%
Methyl nicotinate	0.25-1.0%
Methyl salicylate	Up to 60%
Trolamine salicylate	10%
Turpentine oil	6-50%
Anesthetics	
Ketamine hydrochloride	5-10%
Lidocaine hydrochloride	5-10%
Anti-Inflammatory agents, Corticosteorids	
Dexamethasone	0.4-1.5%
Hydrocortisone	25%
Triamcinolone	0.025-0.5%
Anti-Inflammatory Agents, Nonsteroidal	
Ibuprofen	2-20%
Ketoprofen	2-10%
Piroxicam	0.5-1%
Muscle Relaxants	
Baclofen	2-5%
Cyclobenzaprine	0.5-1%

Extemporaneous Formulations and Stability Studies Available For:

- Acetazolamide
- Allopurinol
- Alprazolam
- Azathioprine
- Baclofen
- Bethanechol
- Captopril
- Chloroquine Phosphate
- Cisapride
- Clonazepam
- Diltiazem HCl
- Dipyridamole
- Enalapril Maleate
- Flecainide Acetate
- Flucytosine
- Hydralazine HCl
- Ketoconazole
- Labetalol
- Metolazone
- Metoprolol Tartrate
- Metronidazole
- Procainamide
- Pyrazinamide
- Quinidine Sulfate
- Rifampin
- Spironolactone
- Spironolactone/HCTZ
- Tetracycline HCl
- Verapamil HCl

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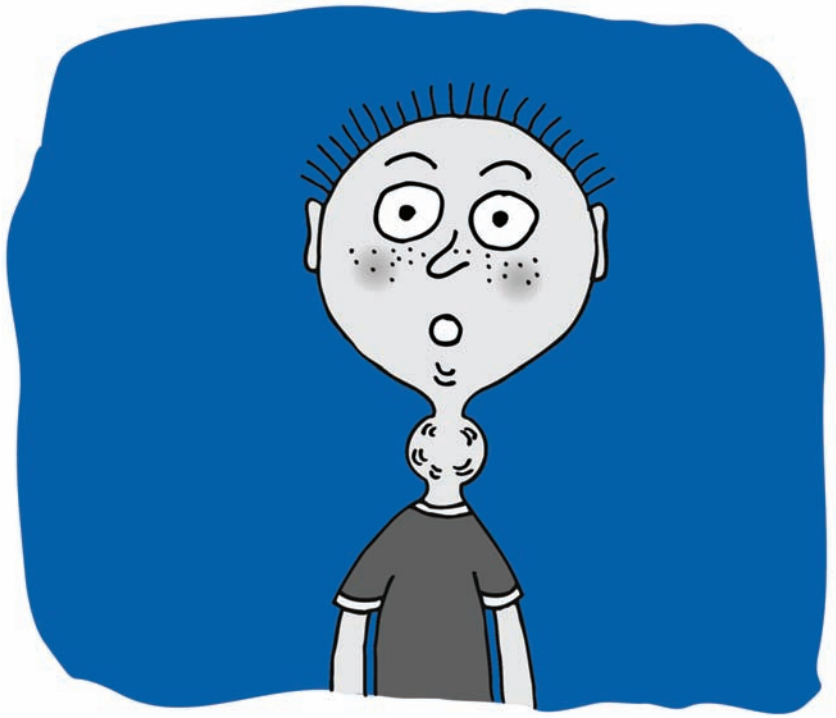

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