

Seven of eight athletes with a concussion had increased reaction times measured with the ruler-like device, which could be used on the athletic field, said Dr. James T. Eckner shown demonstrating the device.



COURTESY DR. JAMES T. ECKNER

## Simple Device May Help To Diagnose Concussions

BY ROBERT FINN

An extremely simple device that tests an athlete's reaction time is showing promise in diagnosing concussions, according to a study announced in advance of its scheduled presentation at the annual meeting of the American Academy of Neurology.

Seven of eight Division I athletes who had suffered a concussion showed significantly slowed reaction times with the device, Dr. James T. Eckner said in an interview.

"It's actually very similar to an experiment that's done commonly in physics classrooms in high schools," said Dr. Eckner, of the department of physical medicine and rehabilitation at the University of Michigan, Ann Arbor. In that experiment, reaction times are judged by the speed with which people can catch a ruler dropped between their fingers.

The device "is a fancier ruler, essentially," Dr. Eckner said. "It's basically a dowel rod that we've coated in friction tape, and we've marked it in centimeter increments. And then at the base of it

Table 1 (contd)

System Organ Class Preferred Term	Titration	Maintenance	
	EMBEDA (N=547) n (%)	EMBEDA (N=171) n (%)	Placebo (N=173) n (%)
Vomiting	46 (8.4%)	7 (4.1%)	2 (1.2%)
General disorders and administration site conditions	39 (7.1%)	9 (5.3%)	10 (5.8%)
Fatigue	16 (2.9%)	1 (0.6%)	2 (1.2%)
Nervous system disorders	135 (24.7%)	12 (7.0%)	11 (6.4%)
Dizziness	42 (7.7%)	2 (1.2%)	2 (1.2%)
Headache	22 (4.0%)	4 (2.3%)	2 (1.2%)
Somnolence	76 (13.9%)	2 (1.2%)	5 (2.9%)
Psychiatric disorders	34 (6.2%)	10 (5.8%)	9 (5.2%)
Insomnia	7 (1.3%)	5 (2.9%)	4 (2.3%)
Skin and subcutaneous tissue disorders	46 (8.4%)	7 (4.1%)	7 (4.0%)
Pruritus	34 (6.2%)	0	1 (0.6%)
Vascular disorders	4 (0.7%)	5 (2.9%)	2 (1.2%)
Flushing	0	4 (2.3%)	1 (0.6%)

during pregnancy if the need for strong opioid analgesia justifies the potential risk to the fetus. **Labor and Delivery:** EMBEDA is not recommended for use in women during and immediately prior to labor, where shorter acting analgesics or other analgesic techniques are more appropriate. Occasionally, opioid analgesics may prolong labor through actions which temporarily reduce the strength, duration, and frequency of uterine contractions. However, this effect is not consistent and may be offset by an increased rate of cervical dilatation which tends to shorten labor. Neonates whose mothers received opioid analgesics during labor should be observed closely for signs of respiratory depression. A specific opioid antagonist, such as naloxone or nalmefene, should be available for reversal of opioid-induced respiratory depression in the neonate. **Nursing Mothers:** Morphine is excreted in the maternal milk, and the milk to plasma morphine AUC ratio is about 2.5:1. The amount of morphine received by the infant depends on the maternal plasma concentration, amount of milk ingested by the infant, and the extent of first pass metabolism. Withdrawal symptoms can occur in breast-feeding infants when maternal administration of morphine sulfate is stopped. Because of the potential for adverse reactions in nursing infants from EMBEDA, a decision should be made whether to discontinue nursing or discontinue the drug, taking into account the importance of the drug to the mother. **Pediatric Use:** The safety and efficacy of EMBEDA in individuals less than 18 years of age have not been established. **Geriatric Use:** Clinical studies of EMBEDA did not include sufficient numbers of subjects aged 65 and over to determine whether they respond differently from younger subjects. The pharmacokinetics of EMBEDA have not been investigated in elderly patients (>65 years) although such patients were included in clinical studies. In a long-term open label safety study, the pre-dose plasma morphine concentrations after dose normalization were similar for subjects <65 years and those ≥65 years of age. Other reported clinical experience has not identified differences in responses between the elderly and younger patients. In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy. **Neonatal Withdrawal Syndrome:** Chronic maternal use of opiates or opioids during pregnancy coexposes the fetus. The newborn may experience subsequent neonatal withdrawal syndrome (NWS). Manifestations of NWS include irritability, hyperactivity, abnormal sleep pattern, high-pitched cry, tremor, vomiting, diarrhea, weight loss, and failure to gain weight. The onset, duration, and severity of the disorder differ based on such factors as the addictive drug used, time and amount of mother's last dose, and rate of elimination of the drug from the newborn. Approaches to the treatment of this syndrome have included supportive care and, when indicated, drugs such as paregoric or morphine. **Race:** Pharmacokinetic differences due to race may exist. Chinese subjects given intravenous morphine in one study had a higher clearance when compared to Caucasian subjects (1852 ± 116 mL/min versus 1495 ± 80 mL/min). **Hepatic Failure:** The pharmacokinetics of morphine was found to be significantly altered in individuals with alcoholic cirrhosis. The clearance was found to decrease with a corresponding increase in half-life. The morphine-3-glucuronide (M3G) and morphine-6-glucuronide (M6G) to morphine plasma AUC ratios also decreased in these patients indicating a decrease in metabolic activity. **Renal Insufficiency:** The pharmacokinetics of morphine is altered in renal failure patients. AUC is increased and clearance is decreased. The metabolites, M3G and M6G, accumulate several fold in renal failure patients compared with healthy subjects. Adequate studies of naltrexone in patients with severe hepatic or renal impairment have not been conducted. **Breakthrough Pain/Adverse Experiences:** Patients should be advised to report episodes of breakthrough pain and adverse experiences occurring during therapy. Individualization of dosage is essential to make optimal use of this medication. **Mental and/or Physical Ability:** Patients should be advised that EMBEDA may impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g., driving, operating machinery). Patients started on EMBEDA or whose dose has been changed should refrain from dangerous activity until it is established that they are not adversely affected. [See Warnings and Precautions]. **Avoidance of Alcohol or Other CNS Depressants:** Patients should be advised that EMBEDA should not be taken with alcohol, prescription or non-prescription medications containing alcohol, or other CNS depressants (sleeping medication, tranquilizers) except by the orders of the prescribing healthcare provider because dangerous additive effects may occur resulting in serious injury or death. [See Warnings and Precautions]. **Pregnancy:** Women of childbearing potential who become or are planning to become pregnant, should consult their prescribing healthcare provider prior to initiating or continuing therapy with EMBEDA. [See Use in Specific Populations]. **Cessation of Therapy:** Patients should be advised that if they have been receiving treatment with EMBEDA for more than a few weeks and cessation of therapy is indicated, it may be appropriate to taper the EMBEDA dose, rather than abruptly discontinue it, due to the risk of precipitating withdrawal symptoms. Their prescribing healthcare provider should provide a dose schedule to accomplish a gradual discontinuation of the medication. **Drug of Abuse:** Patients should be advised that EMBEDA is a potential drug of abuse. They should protect it from theft, and it should never be given to anyone other than the individual for whom it was prescribed. [See Warnings and Precautions]. **Constipation:** Patients should be advised that severe constipation could occur as a result of taking EMBEDA and appropriate laxatives, stool softeners and other appropriate treatments should be initiated from the beginning of opioid therapy. **Storage/Destruction of Unused EMBEDA:** Patients should be instructed to keep EMBEDA in a secure place out of the reach of children. When EMBEDA is no longer needed, the unused capsules should be destroyed by flushing down the toilet.

### FDA-Approved Patient Labeling

[See separate leaflet.]

Manufactured for: King Pharmaceuticals, Inc., 501 Fifth Street, Bristol, TN 37620  
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by: Actavis Elizabeth LLC, 200 Elmora Avenue, Elizabeth, NJ 07207 USA


EMBEDA is a trademark of Alpharma Pharmaceuticals LLC, a wholly owned subsidiary of King Pharmaceuticals, Inc.

To report SUSPECTED ADVERSE REACTIONS, contact King Pharmaceuticals, Inc. at 1-800-546-4905 or DSP@kingpharm.com or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch

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<sup>1</sup>Adverse reactions are classified by System Organ Class and Preferred Term as defined by the Medical Dictionary of Regulatory Affairs (MedDRA) v9.1. If a subject had more than one AE that codes to the same Preferred Term, the subject was counted only once for that Preferred Term. **Long-Term Open-Label Safety Study:** In the long-term open-label safety study, 465 patients with chronic non-malignant pain were enrolled and 124 patients were treated for up to 1 year. The distributions of adverse events were similar to that of the randomized, controlled studies, and were consistent with the most common opioid related adverse events. Adverse reactions, defined as treatment-related adverse events assessed by the investigators, reported by ≥ 2.0% of subjects are presented immediately below. **Adverse Reactions Reported by ≥2.0% of Subjects in Long-Term Safety Study – Safety Population (N=465):** Any Related AE 288 (61.9%); Gastrointestinal disorders 219 (47.1%); Constipation 145 (31.2%); Diarrhoea 10 (2.2%); Dry mouth 17 (3.7%); Nausea 103 (22.2%); Vomiting 37 (8.0%); General disorders and administration site conditions 51 (11.0%); Fatigue 19 (4.1%); Nervous system disorders 99 (21.3%); Dizziness 19 (4.1%); Headache 32 (6.9%); Somnolence 34 (7.3%); Psychiatric disorders 42 (9.0%); Anxiety 10 (2.2%); Insomnia 13 (2.8%); Skin and subcutaneous tissue disorders 52 (11.2%); Hyperhidrosis 16 (3.4%); Pruritus 26 (5.6%). Adverse reactions are classified by System Organ Class and Preferred Term as defined by the Medical Dictionary of Regulatory Affairs (MedDRA) v9.1. If a subject had more than one AE that codes to the same Preferred Term, the subject was counted only once for that Preferred Term. **Adverse Reactions Observed in the Phase 2/3 Studies: Most common (≥10%):** constipation, nausea, somnolence. **Common (≥1% to <10%):** vomiting, headache, dizziness, pruritus, dry mouth, diarrhea, fatigue, insomnia, hyperhidrosis, anxiety, chills, abdominal pain, lethargy, edema peripheral, dyspepsia, anorexia, muscle spasms, depression, flatulence, restlessness, decreased appetite, irritability, stomach discomfort, tremor, arthralgia, hot flush, sedation. **Adverse Reactions Observed in the Phase 2/3 Studies: Most common (≥10%):** Gastrointestinal disorders: constipation, nausea; Nervous system disorders: somnolence. **Common (≥1% to <10%):** Gastrointestinal disorders: abdominal pain, diarrhea, dry mouth, dyspepsia, flatulence, stomach discomfort, vomiting; General disorders and administration site conditions: chills, edema peripheral, fatigue, irritability; Metabolism and nutrition disorders: anorexia, decreased appetite; Musculoskeletal and connective tissue disorders: arthralgia, muscle spasms; Nervous system disorders: dizziness, headache, lethargy, sedation, tremor; Psychiatric disorders: anxiety, depression, insomnia, restlessness; Skin and subcutaneous tissue disorders: hyperhidrosis, pruritus; Vascular disorders: hot flush. **Less Common (<1%):** Eye disorders: vision blurred, orthostatic hypotension; Gastrointestinal disorders: abdominal distension, pancreatitis, abdominal discomfort, fecaloma, abdominal pain lower, abdominal tenderness; General disorders and administration site conditions: malaise, asthenia, feeling jittery, drug withdrawal syndrome; Hepatobiliary disorders: cholecystitis; Investigations: alanine aminotransferase increased, aspartate aminotransferase increased; Musculoskeletal and connective tissue disorders: myalgia, muscular weakness; Nervous system disorders: depressed level of consciousness, mental impairment, memory impairment, disturbance in attention, stupor, paraesthesia, coordination abnormal; Psychiatric disorders: disorientation, thinking abnormal, mental status changes, confusional state, euphoric mood, hallucination, abnormal dreams, mood swings, nervousness; Renal and urinary disorders: urinary retention, dysuria; Reproductive system and breast disorders: erectile dysfunction; Respiratory, thoracic and mediastinal disorders: dyspnea, rhinorrhoea; Skin and subcutaneous tissue disorders: rash, piloerection, cold sweat, night sweats; Vascular disorders: hypotension, flushing. **USE IN SPECIFIC POPULATIONS: Pregnancy: Teratogenic Effects:** Pregnancy Category C: Teratogenic effects of morphine have been reported in the animal literature. High parental doses during the second trimester were teratogenic in neurological, soft and skeletal tissue. The abnormalities included encephalopathy and axial skeletal fusions. These doses were often maternally toxic and were 0.3 to 3-fold the maximum recommended human dose (MRHD) on a mg/m<sup>2</sup> basis. The relative contribution of morphine-induced maternal hypoxia and malnutrition, each of which can be teratogenic, has not been clearly defined. Treatment of male rats with approximately 3-fold the MRHD for 10 days prior to mating decreased litter size and viability. **Nonteratogenic Effects:** Morphine given subcutaneously, at non-maternally toxic doses, to rats during the third trimester with approximately 0.15-fold the MRHD caused reversible reductions in brain and spinal cord volume, and testes size and body weight in the offspring, and decreased fertility in female offspring. The offspring of rats and hamsters treated orally or intraperitoneally throughout pregnancy with 0.04- to 0.3-fold the MRHD of morphine have demonstrated delayed growth, motor and sexual maturation, and decreased male fertility. Chronic morphine exposure of fetal animals resulted in mild withdrawal, altered reflex and motor skill development, and altered responsiveness to morphine that persisted into adulthood. There are no well-controlled studies of chronic *in utero* exposure to morphine sulfate in human subjects. However, uncontrolled retrospective studies of human neonates chronically exposed to other opioids *in utero*, demonstrated reduced brain volume which normalized over the first month of life. Infants born to opioid-abusing mothers are more often small for gestational age, have a decreased ventilatory response to CO<sub>2</sub>, and increased risk of sudden infant death syndrome. There are no adequate and well-controlled studies of naltrexone in pregnant women. EMBEDA should only be used

### VITALS

**Major Finding:** Seven of eight athletes who had a concussion had significantly increased length of reaction times with the device.

**Data Source:** Screening of 209 Division I athletes.

**Disclosures:** A provisional patent application has been filed on an updated version of the device. The study was supported by the Foundation for Physical Medicine and Rehabilitation and the University of Michigan.

there's a little rubber disc, which is actually a hockey puck that it's embedded in."

The device is so simple that it has the potential of being used on the sidelines of a football game. The person being tested sits with his or her forearm resting on a table. The person administering the test holds the device so that the subject's hand is encircling, but not touching, the hockey puck. At a random moment the investigator drops the device, and the subject catches it as soon as he or she can.

"We measure then how many centimeters it fell before they caught it, and then we use a simple physics equation for a body falling under the influence of gravity to convert that into how many milliseconds it fell for," Dr. Eckner said.

Dr. Eckner and his colleagues recruited 209 members of Division I football, wrestling, and soccer teams. Before the start of the season the investigators measured each athlete's normal baseline reaction time. During the course of the season, eight of the athletes suffered concussions diagnosed by a physician. The investigators tested those eight athletes within 72 hours of their injury.

Seven of the eight athletes showed significant slowing of reaction.

"I think that our results are still a little bit preliminary," Dr. Eckner said. "They're all very encouraging, but the study we've got so far is fairly small. We've done some preliminary reliability data showing the inter-tester reliability and the test-retest reliability. But we do want to do that in a bigger sample to firm up the numbers that we have so far. ■