CHAPTER 1

INTRODUCTION

1.1 Rationale

In the field of physical therapeutic modality, therapeutic ultrasound is commonly used and well accepted throughout the world for increased soft tissue extensibility[1], modulated inflammation[2-4], improved healing process[5-8], alterated nerve conduction velocity[9-11] and stimulated cutaneous thermal receptors. Alterations of these conditions mainly help to reduce pain. Although therapeutic ultrasound has been well accepted to manage different types of problems for decades, it has insufficient evidence to confirm benefits especially the neuro-physiological effects on pain modulation via neural functions.

The effects of ultrasound on pain modulation via neural function have been studied using various measurement tools. Most studies measured the nerve conduction velocities (NCV) which represent function of large myelinated nerve fiber (Aβ fiber) [9, 11-15] after ultrasound application. Aβ fiber mediates the sensations of joint position, vibration, touch and mild pressure. The majority of studies found that NCV of the large afferent increased with the application of the active ultrasound and this increase was related to the raise of temperature and vice versa. Alteration of NCV as a result of ultrasound application is directly related to intensity and duration, a fact attributed to the thermal or mechanical effects of the ultrasound[10, 11, 15, 16]. Conventional electro-diagnostic methods such as NCV can demonstrate the loss of Aβ afferent fibers but it is insensitive to selective loss of Aδ and C fibers[17, 18]. Moreover, NCV directly

explore only function of nerve but it may not represent the overall aspects of pain that accumulated from combination of physical, psychological and social perspective.

To explore the effect of ultrasound on function of small nerve fiber, several measures were used. Williams [19] studied the effect of continuous ultrasound at an intensity of 0.43 W/cm^2 at 1.1 MHz and found that threshold to pain produced by electrical current was decreased. Mardiman et al [20] investigated the effect of continuous ultrasound (intensity 1.0 W/cm^2 at 1.1 MHz for five minutes) on pressure pain threshold and found an increasing pressure pain threshold only in the area treated by ultrasound but not by sham modality in healthy subjects. Also, Srbely [21] studied the effect of therapeutic ultrasound on the pain sensitivity of myofascial trigger points induced by hand-held force gauge dynamometer and found a decrease in short-term trigger point sensitivity after ultrasound application. All of the above studies provided evidence that ultrasound can increase pain threshold induced by electrical and mechanical stimuli. Despite this, there remains a lack of physiological effect of ultrasound on thermal stimuli.

Perception of change in temperature is vital for human survival. Evidence suggested that alteration of thermal perception such as cold or warmth indicate impairment or dysfunction of small nerve fiber[22, 23] and may influence pain perception[24]. Neuropathic pain such as carpal tunnel syndrome, diabetes mellitus[22, 23], non neuropathic pain [25] such as migraine, tension-type headache, and rediculopathy pain [26-29] are examples of patients that perceived alteration of thermal perception threshold. The effect of ultrasound on thermal perception threshold will

help to answer critical questions about the clinical effectiveness of ultrasound physiotherapy in deciding proper treatment for these patients. To eliminate the confounding factors of hypoalgesic response from clinical condition and pain medication, asymptomatic subjects will be tested in this study.

1.2 Purpose of the study and hypothesis

Purpose:

To investigate the effect of three modes of therapeutic ultrasound, which were placebo ultrasound (0 W/cm^2), 20% pulse ultrasound (1 W/cm^2) and continuous ultrasound (1 W/cm^2), on cold detection thresholds and warm detection thresholds.

Hypothesis:

Cold detection threshold and warm detection threshold would be altered after application of placebo ultrasound (0 W/cm^2), 20%pulse ultrasound (1 W/cm^2) and continuous ultrasound (1 W/cm^2).

1.3 Advantage of the study

The results of this study may demonstrate the potential physiological effect of ultrasound on thermal perception threshold and may help physiotherapists to decide appropriate treatment for their patients.