INTRODUCTION

Many women experience severe low back pain during labor. This pain is either continuous or intermittent occurring in concomitance with uterine contractions ***(Melzack and Schaffelberg, 1987)***. The relief of such pain besides being humanitarian, may improve the general course of labors as well ***(Calder, 1999)***.

Many analgesic options have been used to alleviate labor pain both pharmacologically as intramuscular administration of narcotics, nitrous oxide inhalation and epidural analgesia and nonpharmacologically as liberal mobilization, warm bathing and back massage .Yet all have various disadvantages ***(Martensson and Wallin, 1999)***.

The low back pain of labor is assumed to be referred pain. This assumption is based on the fact that the impulses coming from the uterine cervix and corpus and those coming from the skin area over the lower back converge to the dorsal horns of the same segments of the spinal cord (T10 – L1) ***(Bonica, 1979)***. Thus techniques entailing anesthesia or stimulation of this area has been attempted in order to inhibit pain transmission to the dorsal horns ***(Martensson and Wallin, 1999)***.

Among these techniques, intracutanuous injection of sterile water has shown promising results ***(Troll et al, 1991 and Lytzen et al, 1989)***. However some investigators have reported that this technique was accompanied by transient intense pain during administration of the injections ***(Labrecque et al, 1999).***

As this technique is cheap, nonpharmacologic and easy to perform, it is investigated further in the present work and the subcutaneous method of administration is tried and evaluated regarding efficiency and the intensity of pain accompanying its administration compared with the intracutaneous method.

Aim of the work

The aim of this study is to evaluate the effect of intracutaneous and subcutaneous injection of sterile water as methods for alleviating low back labor pain.

REVIEW OF LITERATURE

A- <u>Types and Causes of Labor Pain</u>

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage ***(Cailliet, 1993)***.

During the early first stage of labor, ***Melzack and Schaffelberg (1987)*** mentioned three different Labor pains namely, front contractions, back contractions and continuous back pain. The latter pain was encountered in about 33% of the women included in the study. This type of pain was described as intense, difficult to bear and exhausting. It was not produced directly by contractions because it persisted between contractions and contraction pain rode on it. ***Melzack and Schaffelberg (1987)*** added that continuous back pain was not caused by cervical dilatation because it occurred in only one third of the women, yet every vaginal birth obviously involves a dilated cervix. The same reasoning precluded distention of the vagina or perineum as the cause of continuous low back pain of labor. ***Melzack and Schaffelberg (1987)*** postulated that continuous low back pain is probably caused by the distention and pressure on adjacent visceral and neural structures in the peritoneum in contrast to the rhythmic pains that are clearly related to uterine contractions. In an earlier study, ***Melzack et al (1984)*** found that continuous low back pain was not only common but it was also the most severe aspect of labor pain in a substantial proportion of women.

More recently, ***Cunningham et al (1997)*** mentioned that although the cause of the labor pain is not known definitely the following have been suggested: (1) hypoxia of the contracted myometrium, (2) compression of nerve ganglia in the cervix and lower uterus by the tightly interlocking muscle bundles, (3) stretching of the cervix during dilatation, and (4) stretching of peritoneum overlying the fundus.

During the second stage of labour, a fourth kind of pain is encountered caused by stretching and tearing of tissues in the perineal area ***(Melzack and Schaffelberg 1987)***. For many women, episiotomy pain is a fifth kind of pain to be felt during labour ***(Reading et al 1982).***

B- Nerve Pathways And Labour Pain

The first step leading to the sensation of pain is the stimulation of receptors known as nociceptors. The exact mechanism that underlies the stimulation of nociceptors is poorly understood, however, bradykinins, H^+, K^+, prostaglandins, leukotrienes, histamine and serotonin sensitize these receptors. Receptor activation leads to action potentials that are transmitted along afferent nerve fibers to the spinal Cord ***(Baumann, 1997).***

Afferent fibers are classified as A, B or C. Large fast, myelinated A fibers are further divided into alpha, beta, gamma and delta subfibers. In comparison, C fibers are small, slaw and unmyelinated and are not subgrouped. Nociceptive transmission takes place in the A-delta or C fibers. Stimulation of A-delta fibers evokes bright, well-localized pain, whereas stimulation of C fibers produces dull, poorly localized, and persistent pain ***(Chapman, 1984).***

Knowledge of nerve pathways of the genital tract is required for proper understanding of transmission and relief of pain during labor.

Visceral sensory fibers from the uterus, cervix and upper vagina traverse through the Frankenhauser ganglion, which lies just lateral to the cervix, into the pelvic plexus, and then to the middle and superior internal iliac plexuses. The fibers then travel in the lumbar and lower thoracic sympathetic chains to enter the spinal cord through the white rami communicantes associated with the 10^{th}, 11^{th} and 12^{th} thoracic and first lumber nerves. Early in the first stage of labour, the pain of uterine contractions is transmitted predominantly through the 11^{th} and 12^{th} thoracic nerves ***(Cunningham et al, 1997).***

Visceral pain is referred to the areas (dermatomes) supplied by the same nerve roots, that is the lower abdomen. Uterine contractions are also felt in the lower back because pain inputs from uterus entering the spinal cord through the anterior primary rami of T10 – L1 are felt as referred pain over the area supplied by the posterior rami, the skin overlying the L2 – S2 vertebrae ***(porter, 1997).*** Some women experience continuous low back pain and some feel contraction pains primarily in the back ***(Melzack and Schaffelberg, 1987)***. Continuous low back pain in labor is often associated with an occipito-posterior position, stretching in particular the posterior part of the lower segment of the uterus, the cervix and other pain-sensitive structures in the pelvis ***(Porter, 1997).***

During the transitional stage and second stage of labor, additional pain is caused by distension of the vagina and perineum and from pressure on and stretching of adjacent structures. Some of these pain impulses are transmitted through visceral nerves but the main route is via somatic afferents of the sacral plexus entering the cord through the pudendal nerve. The peripheral branches of this nerve provide sensory innervation to the perineum, anus and the more medial and inferior parts of the vulva and clitoris. The sensory nerve fibers of the pudendal nerve are derived from the ventral branches of the 2^{nd}, 3^{rd}, and 4^{th} sacral nerves. ***(Cunningham et al, 1997; porter, 1997)***. Pain of the second stage of labor is both localized to the site of pain activation and referred, and is felt in the perineal, sacral and suprapubic areas ***(Porter, 1997).***

Uterine pain is carried by A delta and to a lesser and variable extent by C fibers ***(Russell and Reynolds, 1997).*** The cell bodies of these sensory fibers are in the posterior root ganglion and the central projections of all C fibers and the majority of A delta fibers synapse principally in the substantia gelatinisa, lamina II of the posterior horn. A small but variable proportion of A delta fibers bypass this system and travel directly up in the substantia gelatinosa can be inhibited presynaptically by a system of inhibitory neurons and opiate receptors which inhibit pain transmission pre-and post-synaptically, but principally by presynaptic inhibition of transmitter release ***(Russell and Reynolds, 1997).***

The motor pathways of the uterus leave the spinal cord at the level of the 7^{th} and 8^{th} thoracic vertebrae. Theoretically any method of sensory block that does not also block the motor pathways to the uterus can be used for analgesia during labor ***(Cunningham et al, 1997).***

C- Value Of Labor Pain Relief

The control of pain should form an integral part of the management of labor, yet pain relief in labor is a surprisingly controversial subject ***(Reynolds, 1997)***. Although the severity of pain varies greatly among women in labor, numerous studies demonstrate quite consistently that if women are asked during or very shortly after labor to score their pain most rate it as severe while few have little or no pain ***(Kangas-Saarela and Kangas-Karki, 1994).***

Effective pain relief during labor is recommended for a number of reasons. First, though pain may be quickly forgotten ***(Robinson et al, 1980, Morgan et al, 1982).*** This does not make it any more tolerable at the time, it is therefore only humane to attempt to relieve it ***(Reynolds, 1997).*** Secondly, though anxiety may exacerbate pain, relieving labor pain can quite dramatically reduce a mother's anxiety. Pain scores have been found to correlate positively with a number of factors including anxiety ***(Melzack et al, 1984)***. Thirdly, the pain of labor represents severe physiological stress, which may cause harmful adverse effect to both mother and fetus ***(Moore, 1993).***

The physiological and hormonal changes that make up the stress response are designated to maintain cerebral and myocardial perfusion, but in labor there is an unwanted reduction in visceral, including placental, blood flow and adverse biochemical changes ***(Moore, 1993).***

The stress response involves the hypothalamic/pituitary axis with release of ACTH and β- lipotropin which are cleaved from the parent molecule pro-opiomelanocortin ***(Russell, 1997).*** These in turn cause increases in cortisol and β- endorphin levels, though the latter unfortunately appears unable to attenuate labor pain in the majority of sufferers ***(Russell, 1997).*** Activation of the sympathoadrenal system also causes catecholamine release. The metabolic outcome of the increased cortisol and catecholamine levels is hyperglycemia with poor insulin response, lipolysis with release of free fatty acids and an increase in ketone and lactate levels ***(Reynolds, 1997, Russell; 1997).*** High catecholamine levels have potentially adverse effects on β-receptors, reducing uterine contractility which prolongs labour ***(Lederman et al, 1985)*** and on α-receptors reducing placental blood flaw ***(Falconer and Powles, 1982; Moore, 1993).***

Episodes of hypoxaemia have been reported during painful labour ***(Reed et al, 1989, Griffin and Reynalds, 1995)***. Earlier, ***Hush and coworkers (1977)*** outlined the mechanism whereby the pain of uterine contractions stimulates hyperventilation thus reducing Pco_2. This reduces ventilatory drive and subsequent hyperventilation or apnea between contractions may result in maternal oxygen desaturation ***(Deckardt et al, 1987)***. During pregnancy functional residual capacity is reduced and minute ventilation and oxygen consumption are increased so hypoventilation results in hypoxia and hypercarbia more readily. The increased oxygen consumption of painful labor exacerbates this further. These episodes are potentially harmful to the fetus, not only from maternal hypoxaemia but also because of reduced oxygen delivery to the fetus consequent on maternal alkalosis. The outcome of such effects may be dangerous to woman with cardiovascular disease and to a fetus with already reduced oxygen supply ***(Porter, 1997; Reynolds, 1997).***

Many studies have demonstrated that effective analgesia can attenuate the adverse effects of labor pain ***(Abboud et al, 1982; Shnider et al, 1983).***

D - Management of Pain in Labor

Like many other types of pain, labor pain can be managed by a number of methods including pharmacological and non pharmacological interventions, each of which has its advantages and disadvantages ***(Cailliet, 1993, Cunningham et al, 1997).*** For convenience of reviewing literature, the following classification will be adopted.

I-Pharmacological methods*:*

1- Inhalational analgesia.
2- Systemic opioid analgesia.
3- Spinal analgesia.
4- Epidural analgesia.
5- Combined spinal epidural analgesia.
6- Paracervical block.
7- Pudendal block.

II-Non pharmacological methods

1- Natural birth and psychoprophylaxis.
2- Transcutaneous electrical nerve stimulation.
3- Acupuncture.
4- Support during labor.
5- Massage.
6- Water baths.
7- Water blocks.

I-PHARACOLOGICAL METHODS

1- Inhalational Analgesia

Several gases and volatile agents have been used for pain relief in labor. These include ether, chloroform, cyclopropane, trichloroethylene, methoxyflurane, enflurane, isoflurane desflurane and nitrous oxide. The latter is currently widely used ***(Porter, 1997).***

In theory, subanaesthetic concentrations of many inhalational agents provide analgesia during labor without risking loss of consciousness, regurgitation or aspiration of stomach contents. All inhalational agents readily cross the placenta and the concentration in fetal blood soon approaches that of the mother ***(Porter, 1997).*** The uterine contractions have a periodic nature suitable for the intermittent administration of inhalational agents. During the initial period of uterine contraction, the mother feels tightening and inhales the agent in order to reach analgesic concentration just before pain follows ***(Porter, 1997).***

Nitrous oxide

In low concentrations, analgesia is the main feature of nitrous oxide while at high concentrations it is an anaesthetic in susceptible individuals. The analgesic activity is believed to involve the proenkephalin-derived family of endogenous opioid peptides ***(Finck et al, 1995)*** and acts as a partial opioid agonists ***(Gillman and Lichtigfeld, 1994).***

In 1961, ***Tunstall*** introduced a mixture of nitrous oxide and oxygen, which is commercially known as "Entonox". This is self-administered from a pressurized cylinder via a reducing valve and a demand valve assembly, through a facemask or mouthpiece. Parturients are taught to start inhaling when they first feel the contraction and to stop once the peak has passed. Inadequate pain relief can result from faulty equipment that may allow dilution of the gas through a leak in the tubing or valve or an ill-fitting facemask ***(Porter, 1997).***

Harrison et al (1987) demonstrated success with Entonox as a primary method of pain relief in 95% of woman compared with 20% for pethidine and transcutaneaus electrical nerve stimulation (TENS). More recently, ***Carstoniu et al (1994)*** compared Entonox with compressed air in a randomized, double blind, crossover, placebo-controlled study. They found that pain scores rated over five contractions were nearly identical and independent of whether the women were breathing Entonox or compressed air. Furthermore, ***Ranta et al (1994)*** studied pain management in the first stage of labor using various agents and found no reduction in pain scores following nitrous oxide or pethidine.

According to a review by ***Porter (1997),*** it was mentioned that the use of Entonox may encourage mothers to hyperventilate during contractions in an attempt to improve analgesia. This may lead to symptoms of hypocapnia namely dizziness, tingling and tetany and a reduction in uterine blood flow with potential reduction in fetal oxygenation.

2. Systemic Opiod Analgesia

An opiate is defined as a drug that is derived from opium and has agonist and / or antagonistic activity at an opioid receptor. There are at least three receptor subtypes whose activation causes inhibition of neural transmission ***(Scrutton, 1997).*** Drugs that bind to opioid receptors are grouped into three categories: agonists (e.g. morphine, fentanyl), partial agonists (e.g. buprenorphine, pentazocine) and antagonists (e.g. naloxone) according to profound analgesia, partial or no analgesia respectively ***(Scrutton, 1997).***

Many opioids have been investigated over the years to achieve analgesia in labor. These include morphine, diamorphine, pethidine, meptazinol, pentozocine, fetanyl, nalbuphine and tramadol. The majority of alternative opioids provide equally inadequate analgesia while their side-effect profiles differ very little. Pethidine is the most widely used opioid in labor ***(Scrutton, 1997)*** and hence its use in labor will be assessed.

<u>Pethidine (meperidine)</u>

Despite a number of retrospective trials suggesting that pethidine provides satisfactory analgesia, the overwhelming majority of prospective trials continue to report that pethidine is, at best, a poor analgesic in labor ***(Scutton, 1997).***

A fundamental problem with many studies that describe good analgesic results from pethidine is the manner in which pain assessment was made. Independent observers commonly report good analgesic effect based on the fact that the parturient appears calmer and quieter following injection of pethidine though with little or no improvement of pain ***(Olofsson et al, 1996).*** Thus sedation, which is potentially harmful for the mother and may detract from her experience of birth, has become confused with analgesia ***(Morgan et al, 1984).***

Olofsson et al (1996) compared the effect of pethidine and morphine on pain scores during labor and showed no significant change in pain over time or between groups. ***Fairlie et al (1999)*** compared the pain relief and side effects of pethidine with diamorphine in labor. They reported more women allocated to pethidine than to diamorphine having slight or no pain relief at 60 minutes after injection of these drugs.

The addition of anti-emetics has been suggested to improve pethidine analgesia, though the evidence is inconsistent ***(Vella et al, 1985; Harrison et al, 1987, Rosenblatt et al, 1991)***. A combination of pethidine and promazine has been shown to provide inferior analgesia to TENS ***(Harrison et al, 1987).***

Systemic pethidine has been compared with epidural analgesia in a few randomized trials which showed clinically inferior analgesia ***(Thorp et al, 1993; Ranta et al, 1994; Ramin et al, 1995).***

Although nausea and vomiting are common in labour, the administration of pethidine has been shown to increase the incidence of these complications ***(Vella et al, 1985)***. ***Griffin and Reynolds (1995)*** reported that pethidine provides minimal reduction of labor pain and hyperventilation during contraction, and yet causes a degree of sedation between contractions that exacerbates the periods of underventilation and apnea.

Neonatal respiratory depression caused by maternal administration of pethidine is documented particularly after repeated maternal doses ***(Koch and Wendel, 1968)***. Also there are many studies of neurobehavioral changes following delivery in babies exposed to pethidine in utero. These babies are reported to be sleepy, less able to develop suckling skills and take longer time to establish breast feeding ***(Nissen et al; 1995, 1997, Matheson and Nylander, 1999).***

3. Spinal Analgesia

Introduction of a local anaesthetic into the subarachnoid space produces spinal block. This has a more rapid onset of action than does epidural block ***(Collis et al, 1995).*** Subarachnoid injection of bupivacaine and fentanyl has been shown to produce analgesia within 5 minutes whilst labor pain may still be felt 20 minutes after epidual injection. Despite this rapid onset of action, the place of spinal analgesia in obstetrics has been limited because it has usually been performed as a single-shot technique and analgesia does not usually last for the entirety of labor ***(Russell, 1997).*** It is therefore, inappropriate for use in early labour but it may be useful in advanced labor or for operative delivery ***(Cunningham et al, 1997; Russell, 1997).***

Low spinal block is a popular form of analgesia for vaginal delivery where the level of analgesia extends to the 10th thoracic dermatome relieving pain of uterine contractions. For cesarean delivery, a higher level of spinal sensory blockade is essential to at least the level of 8th thoracic dermatome ***(Cunningham et al, 1997).***

Nearly all local anaesthetic agents have been used for spinal analgesia, but for many years tetracaine and lidocaine have proved quite satisfactory. Neither agent is administered for vaginal delivery until the cervix is fully dilated ***(Cunningham et al, 1997)***. In spinal analgesia the dose required of local anaesthetic is one tenth that in the epidural space, which means there is much less risk of systemic toxicity, even from accidental intravenous injection ***(Russell, 1997).***

A number of complications may follow induction of spinal analgesia, which includes hypotension. This may develop very soon after injection of the analgesic agent. Hypotension is the consequence of vasodilatation from sympathetic blockade compounded by obstructed venous return caused by uterine compression of the vena cava and adjacent large veins ***(Cunningham et al, 1997)***. Hypotension and apnea resulting from respiratory paralysis may promptly develop to cardiac arrest if not immediately treated ***(Cunningham et al, 1997).***

Until the introduction of atraumatic spinal needles, unacceptably high rate of backache and headache due to CSF leakage from the site of puncture of dura, limited the use of spinals in obstetric analgesia ***(Cunningham et al, 1997; Russell, 1997).*** Instances of nerve irritation, nerve damage and arachnoiditis resulting as post-dural puncture cephalgia have been reported associated with convulsions and in rare cases blindness ***(Russell, 1997).*** There have also been reports of both infections and aseptic meningitis following dural puncture in labor ***(Harding et al, 1994, Stallard and Barry, 1995).***

With spinal analgesia bladder emptying may be impaired for the first few hours after delivery leading to bladder distension. Failure to relieve this distension promptly by catheterization may result in bladder dysfunction and possibly urinary tract infection ***(Russell, 1997).***

As mentioned by ***Cunningham et al (1997)*** spinal block is contraindicated in a number of conditions especially severe preeclampsia, coagulation and other defective hemostasis and certain neurological disorders.

4. Epidural Analgesia

Relief from the pain of uterine contractions and delivery can be accomplished by injecting a suitable local anaesthetic agent into the epidural or peridural space ***(Cunningham et al, 1997).*** The portal of entry into the epidural space for obstetrical analgesia is through either a lumbar intervertebral space (lumbar epidural analgesia) or through the sacral hiatus and sacral canal (caudal epidural analgesia). Although one injection may be used, much more often these are repeated through an indwelling plastic catheter, or they are given by continuous infusion using a volumetric pump ***(Cunningham et al, 1997).***

In continuous lumbar epidural block, complete analgesia for pain of labor and delivery necessitates a block from the 10^{th} thoracic to 5^{th} sacral dermatomes. The spread of epidurally injected anaesthetic agent depends upon the location of the catheter tip as well as the dose, concentration and volume of anaesthetic agent used ***(Cunningham et al, 1997).*** Before any injection of the local anaesthetic agent, a test dose is given and the woman observed for features of toxicity from intravascular injection and signs of spinal blockade from subarachnoid injection. If there is no evidence for these, then a full dose is given carefully ***(Russell, 1997).***

In caudal epidural analgesia, because the dose required to reach T11 / 12 is so great, the quantity of analgesia, especially in the first stage, is often poor and the potential for side effects is greater than with lumbar epidural analgesia ***(Russell, 1997)***. As the disadvantages far outweigh any potential benefit caudal analgesia is only recommended for use in labor when the lumber approach is impossible or if the sacral analgesia is the main objective ***(Russell, 1997).***

A wide variety of epidural loading doses have been used to achieve analgesia. Most contain the local anaesthetic bupivacaine alone or in combination with other agents most commonly opioids such as fentanyl ***(Breen et al 1993),*** sufentantanil ***(Russell et al, 1993),*** diamorphine ***(Mc Grady et al, 1989)*** or clonidine ***(Brichant et al, 1994).***

The addition of opioids such as fentanyl to epidural solutions permits a reduction in the dose of the local anaesthetic required to produce analgesia. Fentanyl 25-50 ug combined with 0.1 - 0.125% bupivacaine produces effective pain relief in early labour ***(Russell, 1997)***. Alpha agonists such as adrenaline and clonidine may be used to permit a reduction in bupivacine requirements. The addition of adrenaline, however, increases the incidence of maternal motor block ***(Yarnell et al, 1990)*** while hypotension and sedation have been observed with clonidine.

Campbell and colleagues (1997) conducted a study to determine whether the addition of epinephrine to the combination of sufentanil and bupivacaine would prolong intrathecal analgesia for labour. They detected significantly prolonged labor analgesia without adverse effect to the mother or the fetus. ***Gautier et al (1998)*** determined the efficiency of low doses of intrathecal clonidine (15 or 30 μg) combined with sufentanil and found that the larger dose significantly increased the duration of analgesia during the first stage of labor without adverse maternal or fetal effects.

In epidural analgesia, block of pain fibers in the lower thoracic and upper lumbar nerve roots prevents the lower abdominal pain of uterine contractions while perineal pain is relieved by blocking the sacral nerve roots ***(Russell and Reynolds, 1996)***. Motor block during regional anesthesia is dependent on cumulative dose of local anaesthetic and thus motor block becomes progressively more severe with duration of epidural analgesia ***(Russell and Reynolds, 1996).*** Maternal satisfaction with regional analgesia is reduced as motor block increases. Allowing a reduction in dose of local anaesthetic by adding opioids to the epidural solution, therefore, increases maternal satisfaction. Local anesthetics readily block conduction in preganglionic autonomic β fibers in low dose. This produces vasodilatation and decreased sweating ***(Russell, 1997).*** Dorsal column function is progressively impaired by increasing doses of epidural and spinal local anesthetics. In ***1994, Buggy and colleagues*** demonstrated that following 30-mg epidural bupivacaine, 66% of women developed abnormal distal proprioception.

As the dose required for epidural analgesia is ten-fold greater than that for spinal use, unrecognized injection into the CSF of an epidural dose of local anaesthetic results in accidental total spinal anesthesia. The block rapidly extends in a cephalad direction causing severe hypotension, respiratory failure, unconsciousness and death if treatment is not started immediately ***(Russell, 1997).*** Puncture of the dura whether deliberate or unintentional, may lead to a CSF leak and a low-pressure headache.

Local tenderness at the site of needle insertion is common in the first few days after delivery. It follows epidural analgesia in approximately 35 – 45% of women ***(Russell and Reynolds, 1996).*** Long-term backache was found to be associated with epidural analgesia in labor in two large retrospective studies ***(MacArthur et al, 1990; Russell et al, 1993).*** However, in prospective studies with more accurate documentation of antenatal backache, long term backache has been no more common after epidural analgesia than after other forms of pain relief ***(Breen et al, 1994;Russell et al, 1996).***

Difficulty in passing urine is not uncommon during labor. Regional analgesia with both local anaesthetic and opioids increases the incidence of urinary ***retention (Russell and Reynolds, 1995),*** if laboring women are unable to pass urine, the bladder should be emptied with a catheter to prevent distension which may lead to postnatal urinary dysfunction.

Epidural analgesia in labor has been reported to be associated with a rise in maternal temperature ***(Fusi et al, 1989, Camann et al, 1991)*** though without apparent effect on either mother or baby. In ***1997, Lieberman and coworkers*** carried out a study to evaluate the impact of epidural analgesia during labor on the rate of intrapartum fever and the performance of neonatal sepsis evaluation and treatment with antibiotics. They found that intrapartum fever occurred in 14.5% of women receiving an epidural compared to 1% of control women. Neonates whose mothers received epidural were more often evaluated for sepsis (34.0% Vs 9.8%) and treated with antibiotics (15.4% Vs 3.8%). Furthermore, ***Dashe and coworkers (1999)*** reported that epidural analgesia is associated with intrapartum fever but only in the presence of placental inflammation. These workers suggested that the reported fever is due to infection rather than the analgesia itself. ***Schwarz et al (2000)*** carried out a retrospective cohort analysis of nulliparous women to determine if labor epidural analgesia is associated with intrapartum hyperthermia. They concluded that the use of labor epidural analgesia is associated with a clinically significant increase in the incidence of intrapartum hyperthermia.

Scull and workers (1998) found that the metabolic stress response to the pain of labor was attenuated by epidural analgesia. In contrast, plasma oxytocin concentration and frequency of uterine contractions were unaffected by the attenuation of metabolic stress response.

There are still many debates about the effects of regional analgesia on the progress and outcome of labor. A number of studies reported that an increase in the numbers receiving epidural analgesia was associated with no increase in the need for cesarean section ***(Gribble and Meier, 1991, Robson et al, 1993, Newman et al, 1995).***

Halpern et al (1998) found that epidural labor analgesia is not associated with increased rates of instrumental vaginal delivery for dystocia or cesarean delivery. Patients receiving epidural analgesia have longer labor. However, ***Rojansky et al (1997)*** revealed that epidural analgesia significantly prolongs labor time in induced patients and was associated with an increase in instrumental delivery rate. A significant reduction in intrapartum complication rate was observed while cesarean section rate and Apgar scores were not found to be influenced by epidural analgesia. In contrast, ***Yancey and calleagues (1999)*** retrospectively compared large population of woman for operative vaginal and abdominal delivery rates with and without labor epidural analgesia and found no statistically significant differences.

Recently, ***Zhang and collaborators (2000)*** concluded that epidural analgesia prolongs the second stage of labor but it does not prolong the first stage of labor nor does it increase risk of operative deliveries. On the other hand, ***Zimmer et al (2000)*** mentioned that prolongation of labor and increase in non-spontaneous deliveries should be expected when using epidural analgesia in labor.

Randomized studies comparing epidural with systemic analgesia have produced conflicting results ***(Russell, 1997). Ramin and co-workers (1995)*** compared bupivacine / fentanyl epidural infusions with intravenous pethidine / promethazine. They showed that the need for operative delivery for dystocia was 9% in the epidural group and 5% in those receiving pethidine. ***Newton and colleagues (1995)*** compared myometrial activty in women receiving bupivacaine/ fentanyl epidural infusions with a control group receiving pethidine. The workers reported no difference in the myometrial contractility, although the need for oxytocin was greater and the rate of cervical dilatation slower in the epidural group. In a study by ***Halpern et al (1998),*** patient satisfaction and neonatal outcome were found to be better after epidural than parenteral opioid analgesia.

5. Combined Spinal Epidural Analgesia

Combined spinal epidural (CSE) analgesia has become popular for labour because it combines the rapid onset of spinal block, particularly valuable in the labour in multipara, and the flexibility of epidural technique ***(Russell, 1997).***

Using an intrathecal loading dose of 2.5 mg bupivacaine with 25μg fentanyl followed by epidural top-ups of 0.1% bupivacoine with 2μg / ml fentanyl, many mother are able to ambulate during labor whilst pain-free ***(Collis et al, 1994).*** As the initial dose in CSE is given intrathecally, the onset of analgesia is far more rapid than with epidural analgesia alone with increased maternal satisfaction ***(Collis et al, 1995).*** Furthermore, ***Tsen and coworkers (1999)*** found that in healthy nulliparaus parturient in early labor CSE analgesia is associated with more rapid cervical dilation compared with epidural analgesia. ***Van de Velde et al (1999)*** concluded that CSE analgesia resulted in excellent pain relief during labor with immediate gratification as compared to epidural analgesia using a mixture of bupiracaine 0.125% epinephrine

1.25ug/ml and sufentanil 0.75μg/ml. In ***1999, Kee et al***, mentioned that CSE analgesia is useful technique for providing analgesia and maintaining haemadynamic stability in parturients with mitral stenosis.

Recently, ***Hepner et al (2000)*** compared the CSE technique with epidural method regarding time to initiate and manage motor block, onset of analgesia and satisfaction during labor. They reported that although epidural analgesia with low concentration of local anaesthetic and opioid mixture takes longer to produce complete analgesia, it is a satisfactory alternative to CSE technique.

The disadvantages of CSE analgesia are essentially those of spinal analgesia including headache, infection ***(Stallard and Barry, 1995, Bouhemad et al, 1998)***, concerns over catheter position ***(Abouliesh et al, 1991)*** and failure rate ***(Collis et al, 1994).***

The use of plain local anaesthetic to provide CSE (***Stacey et al, 1993)*** has been superseded by low dose bupivacine/opioid regimens ***(Collis et al, 1994),*** as the reduction in motor block enables women to ambulate whilst pain-free.

Loading with sufentanil is popular either alone ***(Cohen et al, 1993)*** or in combination with bupivacaine ***(Campbell et al, 1995)***. In ***1998, Levin et al*** compared a standard dose of intrathecal bupivacine with sufentanil for CES analgesia with two does of ropivacaine, a new local anaesthetic. They found that both bupivacaine and ropivacaine provided similar analgesia during labor and equivalent side effect profiles in the doses studied.

Intrathecal pethidine 10mg has been reported to produce labor analgesia ***(Boreen et al, 1992),*** although it was associated with fetal heart rate abnormalities in 40% of cases. Diamorphine also provides excellent analgesia in doses of 0.2-0.5mg but side effects of nausea, vomiting and pruritus have been reported in 75% of mothers ***(Kestin et al, 1992).***

D'Angelo and colleagues (1999) studied the effects of spinal clonidine administration with spinal sufentanil and bupivacaine on labor analgesia using a combined spinal-epidural technique and concluded that spinal clonidine significantly prolongs labor analgesia from spinal sufentanil and bupivacaine without producing serious adverse effects.

6. Paracervical Block

Pain transmission from the uterus may be blocked at the base of the broad ligament lateral to the cervix ***(Cunningham et al 1994; Russell, 1997).*** Local anesthetics injected at this site relieve the pain of the first stage of labor. A guarded needle is introduced into the lateral vaginal fornix and advanced 2-3 mm through the vaginal mucosa. After aspiration, up to 10ml of dilute local anaesthetic such as lidocaine, is injected and the procedure repeated on the opposite side ***(Cunningham et al 1994; Russell, 1997).***

Although now rarely used because of the adverse effects, the technique has the advantage that it may be performed by the obstetrician, and for this reason it remains popular where anesthetists are not routinely available ***(Kanges-Saarela and Kanges-Karki, 1994)***

The major adverse effect associated with paracervical block is the development of fetal bradycardia within 10 minutes of injection. Several theories for bradycardia have been suggested, including direct local anaesthetic toxicity in the fetus, reflex bradycardia from manipulation of fetal head and local anaesthetic produces uterine artery vasoconstriction with reduction of uteroplacental perfusion ***(Beazley et al, 1972, Carlsson et al, 1987)***. There is a possible danger of misplaced injection with a paracervical block. Injection into the uterine artery may produce local anaesthetic toxicity whilst injection into the fetus will have similar effects and may result in possible fetal death ***(Russell, 1997).***

A paracervical block only relieves uterine contraction pain and lasts 90-210 minutes depending on which local anaesthetic is used. For outlet analgesia, pundendal nerve block is required in addition. The total dosage of local anaesthetic if the blocks are combined carries a significant risk of toxicity ***(Russell, 1997).***

7. Pudendal Block

The pudendal nerve carries sensation from the lower vagina, vulva, and perineum and the motor supply to the perineal muscles and the external anal sphincter ***(Russell, 1997).*** Pudendal nerve block has no effect on the pain of uterine contraction but it may be used for simple instrumental delivery where spinal or epidural blockade are unavailable or contraindicated ***(Cunningham et al, 1997; Russell, 1997).***

Pudendal nerve block is almost always performed by an obstetrician using either the transvaginal or transperineal approach. Using local anaesthetic solution such as lidocaine ***(Russell, 1997).***

Pudendal nerve block has a high failure rate. Studies have reported successful bilateral block in only 50% of cases with transvaginal approach and just 25% with transperineal ***(Russell, 1997).***

Complications of pudendal block are intravenous injection into the adjacent pudendal vessels. Vaginal and ischiorectal haematoma ***(Russell, 1997)***. Rarely, severe infection may originate at the injection site. The infection may spread to the region posterior to the hip joint, into the gluteal musculature or into retropsoal space ***(Svancarek et al, 1977; Russell, 1997).***

II- NON PHARMACOLOGICAL METHODS

1. Natural Childbith & Psychoprophylaxis

Methods of psychological analgesia can be divided into three main categories: natural childbirth (Read method), psychoprophylaxis (Lamaze technique) and hypnosis ***(Porter, 1997).***

Proponents of each technique claim the elimination of pain in a high percentage of women without harmful effects to the mother, the baby or the progress of labor, and without the need for chemical analgesia. All require considerable antenatal preparation ***(Porter, 1997).***

In its broadest sense, psychological preparation for labor describes a form of antenatal preparation that includes education, distraction and relaxation, designed to reduce pain and to cope with pain in labor ***(Cunningham et al, 1997; Porter, 1997)***.

a) **Natural childbirth** pioneered by Read in 1933 involves a regime of antenatal education concerning anatomy and physiology of pregnancy and labor. It also includes a program of physical exercises and techniques of muscle relaxation and breathing control for use during labor. This is aimed at creating a state of mind that would prevent the so-called " fear-tension-pain syndrome" ***(Porter, 1997).***

b) **Psychoprophylaxis** was developed in 1958 by Lamaze who believed that women experienced pain in labor purely because they were conditioned to believe they would. Pregnant women could be deconditioned and then reconditioned using positive conditioned reflexes such as breathing exercises and relaxation techniques to avoid the perception of pain. Thus a uterine contraction could be the signal for the initiation of a new repetitive acquired respiratory reflex ***(Porter, 1997).***

Since pain has been described as a complex perceptual experience, it may be influenced by psychological variables such as fear, attention and suggestion ***(Melzack et al, 1981).*** Consequently, clinical pain should theoretically be less when anxiety, tension and fear are reduced. However, the hypothesis that knowledge diminishes fear and so increase resistance to pain is clearly not the whole story, since midwives and female doctors are not immune to painful labor. Breathing exercises such as the panting taught by Lamaze have an analgesic effect through distraction, similar to the analgesia experienced by a soldier in battle ***(Porter, 1997).***

The mechanism by which antenatal preparation may result in physical advantages may be related to stress hormones. Catecholamines have been shown to reduce uterine contractility and women who were anxious about labor were reported to have increased concentration of plasma catecholamines, longer labor and more birth complication ***(Zuspan et al, 1962;Lederman et al, 1978, 1985).***

Efficiency of the psychological antenatal preparation is inconclusively reported. In some studies, women receiving special antenatal training for childbirth have had analgesic requirements similar to those of control women but in most their need for pharmacological analgesia are less ***(Scott and Rose, 1976; Hughey et al, 1978). Melzack et al (1981,1984)*** demonstrated a reduction in pain scores after training but the difference was not dramatic and pain scores were still very high even though these women were a self-selected sample with positive attitude. Similarly, ***Bundsen et al (1982)*** reported little or on effect on pain intensity but found that antenatal training produced a more satisfactory reaction pattern to pain.

The physical benefits of antenatal preparation are equally variable (Porter, 1997). Labors have been claimed to be shorter or unchanged in length ***(Scott and Rose, 1976; Hughey et al, 1978).*** More spontaneous deliveries with fewer forceps deliveries, and a reduced or equal incidence of operative delivery have all been reported ***(Scott and Rose, 1976; Hughey et al, 1978).*** Reported benefits to the baby include a reduction in fetal distress, less neonatal depression, better or equal Apgar scores and lower rates of perinatal morbidity and mortality ***(Scott and Rose, 1976; Hughey et al 1978).***

Despite the many positive benefits claimed for psychological preparation, these studies should be interpreted with caution since many suffer from methodological shortcomings. A review by ***Beck and Hall***

(1978), criticizes many of the studies for having small numbers, poor control populations or no controls at all. Many are unblinded and unrandomized and frequently statistical analysis is either inappropriate or omitted.

There may be several reasons for the variable efficacy of psychological preparation on pain intensity. One explanation may be the severity of labor pain itself. In some reports 60-80 % of parturient described labor pain as severe or intolerable ***(Bundsen et al, 1982; kangas-Saarela and kangas karki, 1994; Raula et al, 1995).*** However, women report a huge variation in pain intensity, ranging from extremely severe to almost none, irrespective of childbirth preparation ***(Melzack, 1984).*** Pain scores have been found to correlate positively with frequency of contractions, use of oxytotics, cervical dilatation, women’s weight, size of the baby, occipito-posterior position, and menstrual pain, as well as anxiety.

Maternal age, education, socio-economic status, and emotional support correlate negatively with pain intensity ***(Melzack et al, 1981, 1984).***

Although antenatal-training techniques may help women to cope with pain, most women still experience severe labor pain ***(Bundsen et al, 1982; Melzack et al, 1984).***

Techniques relying heavily on breathing exercises may lead to hyperventilation with subsequent maternal alkalosis, which impairs placental oxygen transfer, and lead to vasoconstriction and a reduction in cerebral and uterine blood flow ***(Levinson et al, 1974).*** Similarly, excessive panting may lead to periods of maternal hypoventilation with the possibility of fetal acidosis.

c) **Hypnosis** is the oldest form of psychological analgesia dating back for thousands of years ***(Porter, 1997).***

Suggestion forms the basis of hypnotherapy. A hypnotized subject appears to be asleep often with eyes closed and very relaxed. In reality the patient is awake but in a trance, a state of deep concentration in which the subject is very receptive to suggestion of the hypnotist. Pleasurable sensations are suggested and distressing inputs such as abdominal pain are transformed to more tolerable thoughts such as "tingling" or "waves rolling on from the sea" ***(Brann and Guzvica, 1987).***

Success with this method as a means of pain relief in labor requires a great deal of antenatal training. The woman has to attend several conditioning or training classes, run by a skilled hypnotist, in order to reach the degree of concentration required for labor ***(Porter, 1997).***

Hypnosis has been claimed to reduce pain and the requirement for pharmacological analgesia and to shorten labor ***(Porter, 1997).*** In the only randomized controlled trial of hypnosis in labor, ***Freeman et al (1986),*** found no difference in epidural use between the two groups, but good or moderate hypnotic subjects were less likely to require epidural analgesia than poor hypnotic subjects. Scores for pain relief were similar between the two groups and between good and poor hypnotic subjects.

Hypnosis thus involves much antenatal training, which is time consuming and may be expensive. Through amnesia, the woman may feel deprived of the sense of active participation in the birth ***(Porter, 1997).*** Suggestions to the mother to breathe deeply may result in hyperventilation tetany ***(Moya and James, 1960).*** It has also been suggested that hypnosis may lead to psychological problems later on ***(Wahl, 1962).***

2. **Transcutaneous Electrical Nerve Stimulation (TENS).**

TENS has been used for the relief of chronic pain since the 1970s and was introduced for use in childbirth in the early 1980s. Two pairs of electrodes are adhered to the back on each side of the vertebral column, over the posterior primary rami of T10-L1 and S2-4. Wires connect them to a small battery powered pulse generator which produces electrical pulses of 0.1-0.5ms duration, at a frequency of 40-150Hz ***(Porter, 1997).***

TENS is thought to relieve labor pain in two ways. High frequency TENS most commonly used in labor may act by stimulating the myelinated Aβ fibers in the posterior primary rami of the spinal nerve roots T10-L1 and S2-4, the collaterals of which synapse in the substantia gelatinosa, activating neurons that inhibit transmitter release along pain pathways. Cortical impulses from higher centers can also act via the descending inhibitory neurons, hence the value of mental distraction on the pain threshold ***(Porter, 1997)***. Continuous use of low frequency stimulation at 2Hz acts through neuronal release of endorphins into CSF which may result in a feeling of well-being as well as analgesia ***(Sjolund et al, 1977; Walkins and Mayer, 1982).***

TENS appears to work best for low level pain and is therefore most effective earlier on in labor ***(Stewart, 1979).*** It is most efficacious for back pain but has little effect on abdominal, suprapubic pain or perineal pain or during the second stage of labour ***(Robson, 1979; Miller Jones, 1980; Bundsen et al, 1981, 1982; Thomas et al, 1988).***

The effect of TENS on the pain of labor and delivery is equivocal. In a controlled but unrandomized study, Miller Jones, (1980) reported that 72% of women obtained satisfactory pain relief and primiparae in the TENS group required significantly less pethidine than controls. However, in subsequent randomized controlled and blinded trials comparing TENS with dummy TENS, results were far less positive, showing no benefit with TENS in terms of pain relief and the need for other forms of analgesia ***(Nesheim, 1981; Harrison et al, 1986)***. In these trials, 12 – 14 % of the women were reported to have good pain relief or completed labor without additional analgesia. In a large, prospective, randomized, double blind, placebo-controlled trial by ***Thomas et al (1988),*** results were similar. There was no difference in pain intensity between women using TENS and those using dummy TENS, nor was there any difference between the two groups in change of pain experienced when the machine was switched off for two contractions each hour. Further more the need for supplementary analgesia was similar in the two groups.

Randomized controlled trials by ***Carroll et al, (1997)*** provided no compelling evidence for TENS having any analgesic effect during labor. Weak positive effects in secondary (analgesic sparing) and tertiary (choosing TENS for future labors) outcomes may be due to inadequate blinding causing overestimation of treatment effects.

Kaplan et al (1998) examined the TENS for pain relief during labor and delivery. They revealed that TENS is an effective non-pharmacological, non-invasive adjuvant pain relief modality for use in labor and delivery. TENS application reduced the duration of the first stage of labor and the amount of analgesic drug administered. There were no adverse effects on the mothers or newborns. Recently, ***Tsen et al (2000)*** reported that in healthy laboring parturients, the application of a TENS unit did not alter the quality or duration of labor analgesia provided by the spinal portion of combined spinal epidural analgesia. In conclusion, although some women undoubtedly do achieve pain relief with TENS in early labor even then it is rarely complete and a large number of women experienced no benefit at all, particularly in late labor.

3. Acupuncture.

Acupuncture is an ancient form of Chinese medicine, first mentioned in the literature in 581BC. and still widely practiced in China to – day ***(Porter, 1997).*** The traditional teaching of acupuncture is based on the belief that life energy flows from organ to organ in the body through a network of invisible flow lines or meridians. These connect all tissues or organs of the body, regulate normal functions and reflect all pathological conditions. A block in a meridian is said to cause specific symptoms of illness and by inserting needles into specific acupuncture points on the skin, of which there are approximately 350, the flow of energy is restored and healing can occur ***(Porter, 1997).***

Acupuncture has mainly been used for cesarean section although it is also used with the aim of inducing labor, and augmenting and promoting regular, uterine contractions ***(Diamond, 1971; Tsuei and lai, 1974).*** It has been used for pain relief in labour only over the past 25 years and mainly in the western world ***(Porter; 1997)***

The acupuncture needles are inserted in certain points in the body to a depth of 2.5 – 3 cm. and are manipulated either manually by rotating between finger and thumb and rocking to – and – fro or more commonly, electrically by connecting them to a low voltage electrical source at a frequency of about 2 - 3 Hz. The needles are left undisturbed for 10 – 30 minutes at a time. Both manual and electrical stimulation have been employed during labor. Analgesia usually develops 10 – 30 minutes after the start of acupuncture ***(Wang, 1974; Abouleish and Depp, 1975).***

Studies by ***Chapman et al (1975)*** have confirmed that acupuncture raises the pain threshold. Although the mechanism remains uncertain, both neural and hormonal systems have been suggested as likely mediators. Two pain-relieving mechanisms seem to be involved ***(Cheng and Pomeranz, 1979; Clement-Jones et al, 1980; Watkins and Mayer, 1982).*** One is being endorphin system, which is reversed by naloxone and the other being a non-endorphin system probably involving serotonin and met-enkephalin. Acupuncture of the periaqueductal gray matter and so stimulate endogenous pain control pathways in a manner similar to TENS.

Neural and hormonal mechanisms probably interact. Neural conduction is obviously necessary on the afferent side since some effects of acupuncture are blocked by prior infiltration of local anaesthetic around the acupuncture point ***(Dimond, 1971; Dundee and Ghaly, 1991).***

A few uncontrolled or poorly controlled trials of acupuncture during labor and delivery have been reported. Overall they do not demonstrate a significant reduction in pain scores or in the need for conventional methods of analgesia ***(Porter, 1997). Wallis et al (1974)*** reported that neither manual nor electro- acupuncture provided adequate analgesia in 90% of women and 76% resorted to other forms of analgesia. ***Abouleish and Depp (1975)*** examined electroacupuncture in 12 women during childbirth and concluded that analgesia was inconsistent, unpredictable and incomplete. In a further uncontrolled study, ***Umeh (1986)*** found that 63% of women had adequate analgesia whilst 37% obtained no pain relief at all.

Recently, ***Ternov et al (1998)*** studied the analgesic effect of acupuncture during childbirth in 90 women by assessing their need for other pain treatment against 90 women as control. They revealed that 58% of women in the acupuncture group and 14% in the control group managed their deliveries without further pain treatment. They also mentioned that acupuncture treatment was found to have no major side effects and 94% of women in the group reported that they would consider acupuncture in future deliveries. Consequently, the workers concluded that acupuncture reduces the need for other methods of analgesia in childbirth.

4. Support During Labour.

A friendly atmosphere in the labor ward is a first priority to help a women cope with pain, and homely surrounding help to allay anxiety and may reduce the need for pharmacological analgesia ***(Chapman et al, 1986).*** Support in labor is an essential part of care and is provided by the attending midwife and in some cases, a partner or a supportive companion previously unknown to the mother, a “doula”.

The midwife plays an important role in providing psychological support and encouragement to the parturient. ***Morgan et al (1984)*** found that 61% of mothers felt that having a sympathetic midwife to help them through labor was more important than all clinical treatment for pain relief. Further more, explanation and participation in decision-making are extremely important factors contributing to maternal relaxation and satisfaction.

It has long been believed that the presence of the baby's father, or a friend or relative throughout labor to support and encourage the women, helps her to relax and to feel in control and confidant. Active participation by the partner is encouraged to provide psychological support and distraction as well as practical support such as back rubbing ***(Porter, 1997).***

The term doula has been used to describe any one who provides continuous labor support, preferably through to delivery, to soothe, touch, encourage and explain procedures. A doula is often a lay person, unknown to the parturient before labor ***(Porter, 1997).***

There is mounting evidence that continuous intrapartum support, social or professional, in addition to usual hospital care, benefits outcome for both mother and baby. A number of randomized controlled studies assessed the effects of continuous intrapartum support on mother and baby compared with the usual hospital care ***(Hofmeyr et al, 1991; Kennell et al, 1991; Wolman et al, 1993).*** These studies were extremely diverse including large differences in study design but the outcomes were remarkably similar. Whether or not a familiar companion was also allowed, the continuous presence of a trained support person who was unknown to the women before labor improved both physiological and psychological aspects of labor, delivery, and the postpartum period. There was a reduction in duration of labor, oxytocin use, and operative vaginal delivery rate. The analgesic requirements were also reduced. The need for cesarean section was also reduced. Neonatal outcome was also improved.

Recently, ***Madi et al (1999)*** used a randomized controlled trial of primigravidas to determine the effectiveness of the presence of a female relative as a labor companion on labor outcomes; significantly more mothers in the experimental group had a spontaneous vaginal delivery (91% vs 71%), less intrapartum analgesia (53% vs. 73%) less oxytocin (13% vs. 54%), fewer vacuum extractions (4% vs. 16%) and fewer cesarean sections (6% vs. 13%) than in the control group.

Since many of the positive results attributed to the presence of a doula occurred whether or not a partner, friend or a relative was present, it appears that the support of a chosen person is no substitute for the support provided by a specially trained caregiver ***(Porter, 1997).*** A doula may have an important role in reducing anxiety and therefore catecholamine concentration and in so doing, facilitate uterine contractility and utero-placental blood flow. Pain perception is influenced by psychological variables including anxiety ***(Melzack et al, 1981)*** and this may explain why the presence of a doula resulted in a reduction in analgesic requirements in some studies ***(Porter, 1997).***

5. Massage

In a review by ***Porter (1997),*** two studies on the use of massage for pain relief in labor was mentioned. The first was carried out in an osteopathic obstetric and gynecology unit in Michigan, USA in 1981. Five hundred mothers in labor received either osteopathic lumbar or massage of less appropriate areas of the back as control. Eighty one per cent of women in the study group obtained relief and women in the control group received 30% more pethidine. The second was a survey on pain and its relief in childbirth conducted by the National Birthday Trust, Edinburgh, Scotland, in 1993. It revealed that massage technique was used by about 20% of women in labor and about 90% of these women said it was either good or very good. The study indicated that pain may or may not have been actually reduced but massage was often found to be very soothing and relaxing ***(Poter, 1997).***

Massage is thought to work in several ways ***(Porter, 1997).*** It has an effect similar to that of TENS in blocking the transmission of pain impulses. It helps to relax taut muscles and probably has a psychological component too, reducing stress and anxiety and so reducing the associated muscle tension. Much of its effect comes from the soothing and comforting nature of repetition and from the distraction ***(Porter, 1997).***

6. Water Baths

Although bathing in warm water during labor dates back many centuries, it is only during the past 15 years that there has been renewed interest in the use of water as a therapeutic agent for labor and delivery ***(Porter, 1997).***

The mechanism by which pain relief is obtained from water may be similar to that of TENS. Sensations of warmth and pressure from the water all over the body may inhibit transmission of pain. The pleasurable sensation from warm water may also enhance the secretion of endorphins ***(Porter, 1997)***. It is claimed that warm water is very calming and soothing to many mothers and encourages relaxation both physically and mentally, so reducing pain, and helping the mother to cope with pain ***(Porter, 1997)***. Earlier, ***Odent (1983)*** stated that these effects may also reduce the secretion of endogenous catecholamines and so accelerates labor, though he reported no data.

Controlled studies on the effect of warm water for pain relief in labor provide conflicting results. ***Lenstrup et al(1987)*** demonstrated a reduction in pain score in women immersed in water. However, mean pain scores were higher before immersion than in a control group. ***Waldenstrom and Nilsson (1992)*** reported a reduction in the use of pharmacological analgesia. However, randomized controlled trials reported by ***McCandlish and Renfrew (1993)*** and

Cammu et al (1994) suggest no reduction in pain score or in use of alternative analgesia.

In addition to pain relief, other benefits have been claimed for warm water in labor: faster cervical dilatation and shorter labor, avoidance of medical intervention, physical and mental relaxation and a better emotional experience with many women having high satisfaction ***(Odent, 1983; Lenstrup et al, 1987; Cammu et al, 1994).***

Neither TENS, electro-acupuncture, nor epidural analgesia can be used in the water bath. Use of the water bath should be restricted to uncomplicated pregnancies. Cephalo-pelvic disproportion, diabetes, cardiac disease, placenta praevia and sedative drugs are often considered to be contraindications ***(Porter, 1997).***

The use of warm water in labor has also resulted in conflicting effects on the baby. ***Odent (1983)*** mentioned that the fetal condition was improved by a warm bath in labor. On the contrary, others have advocated potential risks for the baby, including risk of infection and increased admission to the special care baby unit as well as hyperthermia ***(Waldenstrom and Nilsson,1992; Aderdice et al, 1995).*** Other randomized and non-randomized controlled studies have failed to demonstrate any benefit in terms of Apgar score, neonatal stress hormones or umbilical acid-base balance but equally they did not detect any harmful effects ***(Lenstrup et al, 1987, McCandlish and Renfrew, 1993; Cammu et al, 1994).***

7. Water Blocks

Intracutaneous injections of small volumes of sterile water, called sterile water blocks, in the skin over the sacrum have been reported to relieve labour pain in open trials ***(Trolle et al, 1986; Lytzen et al, 1989)*** and in controlled prospective studies ***(Ader et al, 1990; Trolle et al, 1991; Labrecque et al, 1999; Marensson and Wallin 1999).*** The mechanism of action has been suggested to be similar to that TENS. The local irritation caused by hypotonic sterile water injected intradermally is designed to act as a strong sensory stimulus to the surrounding skin, thought to prevent or reduce transmission of pain impulses at spinal level ***(Porter, 1997).***

The water blocks method has also been used to treat acute attacks of urolithiasis ***(Bengtsson et al, 1981),*** neck and shoulder pain ***(Byrn et al, 1991, 1993)*** and the chronic myofacial pain syndrome ***(Wreje and Brorsson, 1995).*** However, intracutaneous sterile water was shown to be ineffective in cervicogenic headache pain ***(Sand et al, 1992).*** Similarly, ***Ranta et al, (1994)*** reported no reduction in labor pain scores following water blocks, nitrous oxide or pethidine using visual analogue pain score. Furthermore, a transient intense pain accompanying the administration of the sterile water injections has been revealed as a disadvantage of the water blocks method ***(Martensson and Wallin, 1999).*** Because of this disadvantage, despite good pain relief during labor, ***Martensson et al (1995)*** expected that a considerable number of women would reject this treatment as an analgesic procedure in future deliveries.

As early as 1981, ***Bengtsson et al*** reported the use of water papules for treating pain due to painful urolithiasis. In their clinically controlled double – blind study, the workers injected four papules of sterile water over the cutaneous area where projected pain from the kidney and upper urinary tract was felt by the patients. Papules of isotonic saline solution were used as placebo. The workers demonstrated a significantly better effect using the sterile water than with the isotonic saline solution where no pain was felt at the site of injection. Analgesia was felt in 89% of the sterile water group compared to 36% in the placebo group.

In a study by ***Byrn and colleagues (1991)***, ten whiplash syndrome patients were treated with intracutaneous trigger point injections with sterile water for pain relief and followed for 2 months. Pain intensity was assessed with the visual analogue scale. Eight patients become free from pain and the other two improved immediately after treatment. In 1993, the workers expanded their study using 40 patients again with whiplash syndrome. They gave the patients subcutaneous injections of 0.3 – 0.5-ml sterile water or saline over tender and trigger points in the neck and shoulder. Neck mobility and pain intensity were evaluated before treatment and after 1,3 and 8 months. After 3 months, 19 of 20 patients in sterile water group had improved conditions with maximum pain level had fallen from 8.1 to 3.3 using visual analogue scale compared to only 6 patients out of 20 in the saline group and fall in pain level from 8.3 to 7.5.

A double blind cross – over trial has been conducted in 1992 by ***Sand et al*** in 10 women with cervicogenic headache in order to investigate whether sterile water injections were effective in this disorder. The investigators did not observe any beneficial effect for either saline or water injections neither on pain duration nor on neck mobility.

In ***1995, Wreje and Brorsson*** reported that 6 general practitioners located at 6 different clinics treated 117 patients with myofacial pain syndrome for at least 3 months in one or both of the upper quadrants of the body. Patients were randomized to receive either sterile water or saline, which was administered sub and intracutaneously on 1 occasion. The patients received a mean number of 10 injections of 0.5 ml of either substance. Pain intensity was measured 10 minutes and 14 days after using the visual analogue scale. No statistically or clinically significant differences in pain level reduction were observed between the two groups. The report also shows that injections of sterile water were substantially more painful than similar injections of saline with no better clinical outcome as method to treat patients with chronic myofacial pain syndrome.

In a study conducted by ***Lytzen et al (1989),*** a group of 83 women experiencing low back pain in the first stage of labor were injected intracutaneously with sterile water papules over sacrum. The workers reported instant and complete relief of the low back pain in 77 of the women lasting in many cases for up to 3 hours. The intensity of the pain was assessed by the visual analogue scale. A reduction in the total pain – score from 6.05 to 2.92 was seen after 1 hour with no further analgesia given. Moreover, half the women required no further analgesia during the first stage. The workers stated further that the sterile water papules were well tolerated and 67 of the 83 women indicated that they would like to have the method for their next delivery.

Ader et al (1990) randomized 45 pregnant women, in the first stage of labor complaining of lower back pain, into two groups. One group was given intracutaneous injections of sterile water in the lumbosacral region while the other group received subcutaneous injections of isotonic saline as placebo treatment. The pain intensity was measured by visual analogue scale (VAS). The mean VAS score significantly more reduced in the study group compared to the placebo group at 10 min, 45 and 90 minutes after treatment. However, the requirement of pethidine was similar in both groups. The workers speculated that the mode of action of sterile water blocks resembles that of acupuncture.

In ***1991, Trolle et al,*** randomly assigned 272 women in labor complaining of severe low back pain, to two groups which were equal with regard to age, parity, fetal size, progression of labor and initial pain scoring. The first group was treated with sterile water and the second with saline solution blocks. The pain intensity was assessed on a visual analogue scale before the blocks were given and again 1 and

2 hours after. A significantly higher degree of analgesia was noticed in the sterile water group. In this group, no adverse effects were noted and patients' acceptability was high.

In a report by ***Reynolds (1994),*** he mentioned that intracutaneous sterile water appears to be simple, easy to learn and effective for relieving back pains including that in labor. Reynolds advocated the importance of intracutaneous sterile water for family doctors who often practice obstetrics in small or isolated units that have limited options for pain relief in labor.

Ranta et al (1994) conducted a comparative study on the management of pain in the first stage labor using the visual analogue scores for assessing pain levels before and after using water block, nitrous oxide, pethidine, paracervical block and epidural analgesia. The investigators found no reduction in pain scores following water blocks, nitrous oxide or pethidine while they recorded significant analgesia following the epidural and to lower extent the paracervical blocks.

In 1999, Labrecque et al carried out a controlled trial of non-pharmacological approaches for relief of low back pain during labor. They randomly assigned 34 women suffering from low back labor pain to receive either intracutaneous sterile water injections, transcutaneous nerve stimulation or standard care including back massage, whirlpool and liberal mobilization. Pain intensity was evaluated using visual analogue scales. Women in the sterile water group rated the intensity and unpleasantness of pain during the experimental period and just before delivery to be significantly lower than women in the other groups.

Martensson and Wallin (1999) performed a comparative study to evaluate the effect of intracutaneous injection of sterile water and the subcutaneous injection of sterile water on the severe lower back labor pain. They randomly assigned 99 pregnant women, in the first stage of lobar, to one of three groups. The first group received four injection of 0.1 ml sterile water intracutaneously, the second group received four injection of 0.5 ml sterile water subcutaneously and the third group received four injections of 0.1 ml isotonic saline subcutaneously (placebo treatment). The injections were given in the lumbo-sacral region. The injections were administered during a contraction while the woman simultaneously breathed nitrous oxide and oxygen. The women were asked to fill visual analogue scale for evaluation of labor pain just before the injections and 10, 45 and 90 minutes after the treatment. The woman filled also a separate visual analogue scale two minutes after the injections to reflect the pain from the treatment itself. The median visual analogue pain score 10 minutes after treatment was found to be reduced compared with that before treatment in all three groups. However, the pain reduction was more pronounced in the two groups treated with intracutaneous and subcutaneous injections of sterile water than in the placebo group. A similar result was found 45 minutes after treatment while after 90 minutes the difference did not reach statistical significance. If in need of treatment in the future, the women in the two groups of study were significantly more enthusiastic about their treatment than those in the placebo group. ***Martensson and Wallin (1999)*** concluded that there were no significant differences in the analgesic effect or pain experienced during administration between the intracutaneous and subcutaneous injection methods and that both methods were effective for the relief of pain in labor.

Most recently; ***Martensson et al (2000)*** conducted a double blind controlled trial with crossover design to investigate whether during injections of sterile water, there is any difference in perceived pain between intracutaneous and subcutaneous injections. They randomized 100 healthy female volunteers into two groups and subjected them to two trials, within one week of each other. During the first trial, one group (n=50) received the intracutaneous injection first, followed by the subcutaneous injection. The second group (n=50) was given the subcutaneous injection first, followed by intracutaneous injection. In both groups, all the injections were given in reverse order during the second trial. The analysis showed intracutaneous injections to be significantly more painful than subcutaneous injections, even after adjusting for injection day and left / right site of injection.

PATIENTS AND METHODS

This study included 150 pregnant women with gestational age between 37 and 42 weeks, who had been admitted to the labor ward at Damanhour Teaching Hospital in the period from 1/7/2000 to 31/1/2001 with established labor and assigned for vaginal delivery.

To qualify for participation in the study, they had to be in the first stage of labor with cervical dilatation less than or equal to 5 cm. and require pain relief for severe lower back pain on admission or during their stay in the ward. No one had received opioid analgesics within three hours prior to or after inclusion in the study. Only cases with singleton pregnancy and vertex presentation were included.

All included women were interviewed and subjected to :

1) History taking
2) General examination
3) Abdominal examination
4) Local pelvic examination

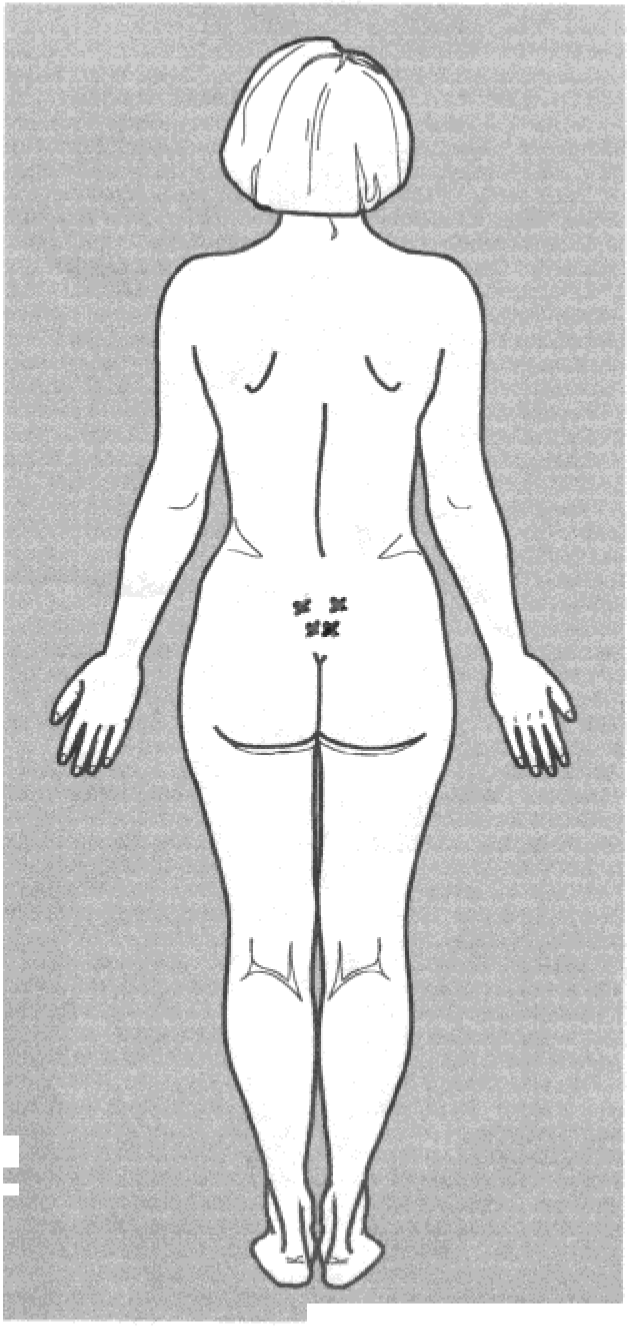
Basic knowledge of reading and writing was taken as an index to education level of cases in this study.

Women were randomly assigned to one of two equal groups:

- **Group A** : using the intracutaneous method for sterile water injection.

- **Group B** : using the subcutaneous method for sterile water injection.

Immediately prior to carrying out the injections, each woman was asked to assess the severity of low back pain associated with her contractions (intermittent back pain) and the severity of the low back pain felt between the contractions (continuous back pain). Every woman was asked to grade her pains as (0:none, 1: mild, 2:moderate, 3:severe or 4:horrible).



Procedure of sterile water injection :

The posterior superior iliac spines were palpated and a mark made on the overlying skin on each side. Two further marks were made approximately 2 cm. inferior and 1 cm. medial to the first marks.

After cleansing the skin with alcohol swaps, and using insulin syringe with fine needle (gauge 28), 0.1 ml of sterile water was injected intracutaneously at each point in group A and 0.5 ml of sterile water was injected subcutaneously at each point in group B.. Injections were administered rapidly during contractions.

The participants were asked to assess the severity of pain associated with the injection itself using the same grading system used for assessing the labor pains (0:none, 1:mild, 2:moderate, 3:severe or 4:horrible), and they were asked to tell when that pain disappeared.

Women were also asked whether they noticed any analgesic effect from the injections, if so, the length of time before the effect began, was also recorded and considered onset of analgesic effect.

After 15 minutes, each woman was asked to reassess her continuous and intermittent back pains using the same grading system. The difference between the pre and post injection grading was recorded as (no reduction – one, two, three, or four degrees reduction).

Then five more readings were taken at 30 minutes intervals. The reading at which any of the two types of back pain reached back its pre- injection degree was recorded and considered the offset for the analgesic effect on that type of pain. Cases delivered while still did not regain their pre-injection pain degree were not included in studying the duration of effectiveness.

The course and progress of labor was observed for each case and the following data were recorded: length of time from inclusion in the study till reaching full cervical dilation, if any augmentation was used, length of second stage of labor and the mode of delivery whether normal vaginal delivery, vacuum extraction or cesarean section.

After delivery, women were asked if they would request the same type of analgesia at a subsequent delivery or not.

Statistical methods

Statistical analysis was done using the following parameters when appropriate ***(Bland M, 1995):***

$$\text{The mean} = \frac{\text{The sum of the observed measurements}}{\text{Number of observations}}$$

$$\overline{X} = \frac{\Sigma x}{n}$$

Standard deviation: a measure of the average distance of the observations from their mean.

$$\textbf{SD} = \pm \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$$

The median: that measurement level below which half of the observations fall

Also the hypothesis was tested at a significance level 0.05 using the following tests when appropriate:

t – test = for comparing two means

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{SD_1^2}{n_1} + \frac{SD_2^2}{n_2}}}$$

Chi – square = to compare proportion

$$X^2 = \sum \frac{(O - E)^2}{E}$$

Computation was done using statistical computer soft ware (SPSS/win).

RESULTS

One hundred and fifty women had received sterile water injections over their lower back area. Injections were given via the intracutaneous route in group A (75 women) and via the subcutaneous route in group B (75 women).

Table I. Demographic data of patients.

Demographic factors	Group A (n=75)	Group B (n=75)	*P* value
Age (years):			
Range	17 - 35	17 - 40	
Mean ± SD	24.13 ±3.67	24.39 ± 5.28	0.733 (a)
Education: no (%)	32 (42.7%)	30 (40%)	0.740 (b)
Parity: Primi: no (%)	44 (58.7%)	47 (62.7%)	0.616 (b)
Multi: no (%)	31 (41.3%)	28 (37.3%)	

(a) *t* test **(b) χ^2tests**

Table I shows the demographic data of cases in each group (age, education and parity). No significant difference was found on comparing the two groups.

Table II. Clinical data of labor

Obstetrical data	Group A (n=75)	Group B (n=75)	*P* value
❖ Labor:			
- Spontaneous: no. (%)	67 (89.3%)	64 (85.3%)	0.461 (b)
-Induced: no. (%)	8 (10.7%)	11 (14.7%)	
❖ Position:			
-occipito-anterior: no.(%)	43 (57.3%)	37 (49.3%)	0.326 (b)
-occipito-posterior: no.(%)	32 (42.7%)	38 (50.7%)	
❖ station:			
- not engaged: no. (%)	57 (76%)	53 (70.7%)	0.460 (b)
- engaged: no. (%)	18 (24%)	22 (29.3%)	
❖ membrane:			
intact: no. (%)	33 (44%)	36 (48%)	0.623 (b)
ruptured: no. (%)	42 (56%)	39 (52%)	
❖ cervical dilatation (cm): (mean ± SD)	4.2 ± 0.88	4.41± 0.70	0.104 (a)
❖ effacement:(%) (mean ± SD)	53.60 ± 16.82	56.40 ± 15.30	0.288 (a)

(a) *t* test **(b) χ^2 tests**

Table II shows the clinical data of labor obtained from examining women just before carrying out the injection, in both groups. Statistical analysis of these data did not show significant difference between the two groups.

Table III. Pain evaluation before sterile water injection in both groups.

Pain type	Degree	Group A (n=75)	Group B (n=75)	*P* value[(a)]
Continuous Back Pain	None: no (%) Mild: no (%) Moderate: no (%) Severe: no (%)	14 (18.7%) 34 (45.3%) 18 (24.0%) 9 (12.0%)	18 (24.0%) 32 (42.7%) 19 (25.0%) 6 (8.0%)	0.756
Intermittent Back Pain	Moderate: no (%) Severe: no (%) Horrible: no (%)	22 (29.3%) 46 (61.3%) 7 (9.3%)	18 (24.0%) 47 (62.7%) 10 (13.3%)	0.625

(a) χ^2 tests

Table III shows the evaluation stated by women for their back pains during labor before sterile water injection. The table reveals that 14 women in group A and 18 women in group B had back pain only with contractions (intermittent back pain), but none between them (continuous back pain). The median value of continuous back pain in both groups was the mild degree while that of the intermittent back pain was the severe degree.

Again the two groups proved to be comparable as no statistically significant difference could be detected between them.

Table IV. Degree of low back pains reduction after sterile water injection.

Pain type	Pain reduction	Group A	Group B	*P* value(a)
Continuous Back Pain	Valid: no reduction	4 (6.56%)	1 (1.75%)	0.667
	One degree	36 (59.02%)	38 (66.67%)	
	Two degrees	15 (24.59%)	13 (22.80%)	
	Three degrees	6 (9.84%)	5 (8.77%)	
	Missing	14	18	
	Total	75	75	
Intermittent Back Pain	Valid: no reduction	13 (17.3%)	15 (20.0%)	0.680
	One degree	9 (12.0%)	11 (14.7%)	
	Two degrees	27 (36.0%)	31 (41.3%)	
	Three degrees	23 (30.7%)	15 (20.0%)	
	Four degrees	3 (4.0%)	3 (4.0%)	
	Total	75	75	

Values are given as frequency and valid percentage.
(a) χ^2 tests

Table IX shows the severity of irritation associated with the process of injection itself. The intracutaneous method was found to be significantly more irritant than the subcutaneous one. While the duration, which this irritation took to fade out was significantly longer in the subcutaneous method than in the intracutaneous one.

Table V. Extent of pain relief achieved by the two injection methods

Pain type	Pain relief	Group A	Group B	*P* value(a)
Continuous	Valid :			0.42

Back Pain	Complete relief Incomplete relief No relief Missed Total	49 (80.3%) 8 (13.1%) 4 (6.6%) 14 75	49 (85.9%) 7 (12.3%) 1 (1.7%) 18 75	
Intermittent Back Pain	Valid : Complete relief Incomplete relief No relief Missed Total	35 (46.7%) 27 (36%) 13 (17.3%) - 75	32 (42.7%) 28 (37.3%) 15 (20%) - 75	0.86

Values are given as frequency and valid percentage.
(a) χ^2 tests

Table V shows the extent of pain relief achieved by the two injection methods. No significant difference was observed when comparing the two study groups.

Table VI. Onset of analgesic effect of sterile water injection

	Group A (n=75)	Group B (n=75)	*P* value[(a)]
Median (sec) Mean ± SD	60 82.4 ± 130.14	120 87.71 ± 90.63	0.001

(a) *t* test.

Table VI shows the onset of analgesic effect of the two methods of sterile water injection. The subcutaneous route was found to take longer time to exert analgesia than intracutaneous route. This difference was statistically significant.

Table VII. Offset of sterile water analgesic action on continuous back pain.

Time of pain assessment	Group A	Group B	*P* value[(a)]
Valid :			
45 m.	8 (17.8%)	10 (20%)	
75 m.	5 (11.1%)	9 (18%)	
105 m.	7 (15.6%)	9 (18%)	
135 m.	3 (6.7%)	4 (8%)	
165 m.	5 (11.1%)	2 (4%)	
> 165 m.	17 (37.8%)	16 (32%)	0.740
total	45	50	
missing: no pain	14	18	
no effect	4	1	
delivered	12	6	
Total	30	25	
Total	75	75	

Values are given as frequency and valid percentage.
(a) χ^2 tests

After determining the reduction in pain scores, 5 consecutive readings were taken at 30 minutes intervals to determine the offset of water blocks effect. The first reading in which pain regained the same degree recorded before injection was considered, roughly, as the offset time. Cases delivered while still did not regain their pre-injection pain degree were not included in studying the duration of effectiveness. There was no association between the two types of back pain in this aspect.

Table VII shows the duration of effectiveness of the two injection methods on the continuous back pains as recorded for the valid cases along the reading times. Data included in this table shows no statistically significant difference between the two groups.

Table VIII. Offset of sterile water analgesic action on intermittent back pain.

Time of pain assessment	Group A	Group B	*P* value[(a)]
Valid:			
45 m.	5 (9.8%)	3 (6.97%)	
75 m.	16 (31.4%)	7 (16.3%)	
105 m.	12 (23.5%)	12 (27.9%)	
135 m.	---	3 (6.97%)	
165 m.	1 (1.96%)	2 (4.6%)	0.202
> 165 m.	17 (33.3%)	16 (37.2%)	
Total	51	43	
Missing: no effect	13	15	
delivered	11	17	
total	24	32	
total	75	75	

Values are given as frequency and valid percentage
(a) χ^2 **tests**

Table VIII shows the duration of effectiveness of the two injection methods on the intermittent back pain as recorded for valid cases along the reading times. Again no statistically significant difference was observed between the two study groups

Table IX. Irritation associated with the process of sterile water injection

Degree and duration of injection irritation		Group A (n=75)	Group B (n=75)	*P* value
Degree	Moderate: no (%) Severe: no (%) Horrible: no (%)	9 (12%) 27 (36%) 39 (52%)	19 (25.3%) 36 (48%) 20 (26.7%)	0.004 [(a)]
Duration (seconds): Mean ± SD		13.63 ± 6.85	33.2 ± 34.46	0.000 [(b)]

(a) χ^2 tests **(b) *t* test**

Table IX shows the severity of irritation associated with the process of injection itself. The intracutaneous method was found to be significantly more irritant than the subcutaneous one. While the duration, which this irritation took to fade out was significantly longer in the subcutaneous method than in the intracutaneous one.

Table X. Course and outcome of labor in both groups.

	Group A	Group B	*P* value

	(n=75)	(n=75)	
Augmentation: yes: no (%) no (%)	32 (42.7%) 43 (57.3%)	38 (50.7%) 37 (49.3%)	0.326 [(a)]
Time to full dilatation (minutes): mean ± SD median (range)	135.22± 71.71 115 (55-315)	138.18 ± 101.83 107.5 (25-450)	0.845[(b)]
Duration of second stage (minutes): mean ± SD median (range)	14.14 ± 10.69 15 (2-60)	13.72 ± 10.89 10 (3 - 54)	0.821 [(b)]
Outcome: normal vaginal: no (%) Vacuum: no (%) C.S.: no (%)	 66 (88%) 4 (5.3%) 5 (6.7%)	 67 (89.3%) 3 (4%) 5 (6.7%)	0.928 [(a)]

(a) χ^2 **tests** **(b)** ***t*** **test**

Table X shows the course of labor and method of delivery for the two groups under study. There was no significant difference between them.

Table XI. Willingness of cases to reuse the same method again

	Group A (n=75)	Group B (n=75)	*P* value[(a)]
Yes: no (%) No : no (%)	52 (69.3%) 23 (30.7%)	51 (68%) 24 (32%)	0.860

(a) χ^2 **tests**

Table XI shows that almost the same number of women in each group refused to use the same method of analgesia in future labors.

Table XII. Effect of gravidity on analgesic efficiency of the two methods of sterile water injection.

Injection methods & types of pain	Primipara	Multipara	*P* value[(a)]
Group A:			
continuous back pain	29/36 (80.6%)	21/25 (84%)	1.00
intermittent back pain	24/44 (54.5%)	11/31 (35.5%)	0.1
Group B:			
- Continuous back pain	31/38 (81.6%)	19/19 (100%)	.08
- Intermittent back pain	20/47 (42.5%)	12/28 (42.9%)	0.97

The efficiency of the injection method is expressed in the table as the number of cases having complete pain relief / total valid number.

(a) χ^2 **tests**

Table XII shows the effect of gravidity on analgesic efficiency of the two sterile water injection methods on each of the continuous and the intermittent back pains.

In both methods of injection, the percentages of multiparae having complete relief of their continuous back pains were higher than those of the primiparae, however this difference was statistically insignificant.

Although primiparae, having intermittent back pain showed higher percentage of complete relief following intracutaneous sterile water injection than the corresponding multiparae, yet such difference was statistically insignificant. The subcutaneous injection technique gave almost equal percentage of pain relieving efficiency in both primi- and multiparae cases.

Table XIII. Effect of age on analgesic efficiency of the two sterile water injection methods.

Injection methods & types of pain	≤30 years	> 30 years	*P* value[a]
Group A:			
continuous back pain	43/55 (78.2%)	6/6 (100%)	0.58
intermittent back pain	35/69 (50.7%)	0/6 (0.0%)	0.02
Group B:			
- Continuous back pain	44/51 (86.3%)	6/6 (100%)	1.00
- Intermittent back pain	26/63 (41.3%)	6/12 (50%)	0.57

The efficiency of the injection method is expressed in the table as the number of cases having complete pain relief / total valid number.

(a) χ^2 tests

Table XIII shows the effect of age on the analgesic efficiency of the two sterile water injection methods on each of the continuous and intermittent back pains. Cases studied were collected in two age groups, namely (≤30 years) and (> 30 years).

In the age group (> 30 years) there were higher percentages of complete relief of continuous back pain than in the (≤ 30 years) group. This was observed with both methods of sterile water injection, however, this difference was statistically insignificant. The same applies for the effect of age on the relief of intermittent back pain by using the subcutaneous method of injection.

In the case of the intradermal method for sterile water injection, there was statistically significant benefit for the method in the ≤ 30 years group. On the contrary, none of the six (>30 years) cases reached complete relief of their intermittent back pains.

Table XIV. Effect of position on analgesic efficiency of the two methods of sterile water injection.

Injection methods & types of pain	Occipito anterior	Occipito posterior	*P* value[a]
Group A:			
- continuous back pain	29/37 (78.4%)	20/24 (83.3%)	0.74
- intermittent back pain	18/43 (41.9%)	17/32 (53.1%)	0.33
Group B:			
- Continuous back pain	20/25 (80%)	30/32 (93.7%)	0.22
- Intermittent back pain	12/37 (32.4%)	21/38 (55.3%)	0.04

The efficiency of the injection method is expressed in the table as the number of cases having complete pain relief / total valid number.

(a) χ^2 **tests**

Table XIV shows the effect of the fetal head position on analgesic efficiency of the two sterile water injection methods on each of the continuous and intermittent back pains.

In both methods of injection, the percentages of cases with occipito-posterior positions having complete relief of their continuous back pain were higher than those with occipito - anterior positions, however such difference was statistically insignificant. The same applies for the effect of fetal head position on the relief of intermittent back pain using the intradermal method. On the other hand, there was a significantly higher percentage of complete intermittent back pain relief by the subcutaneous method of sterile water injection in the case of occipito-posterior positions than in the occipito-anterior positions

DISCUSSION

Melzack and Schaffelberg (1987) recognized three different pains during the first stage of labor, namely; front contractions, back contractions and continuous low back pain. The later was not only common but it was the most severe aspect of labor pains.

The low back pain of labor is assumed to be referred pain. This assumption is based on the fact that the impulses coming from the uterine cervix and corpus and those coming from the skin area over the lower back converge to the dorsal horns of the same segments of the spinal cord (T10 – L1) ***(Bonica, 1979)***. Thus techniques entailing anesthesia or stimulation of this area has been attempted in order to inhibit pain transmission to the dorsal horns ***(Martensson and Wallin, 1999)***.

Effective pain relief is recommended for a number of reasons, important among which is relieving the severe physiological stress encountered during labor which may cause harmful adverse effects to both mother and fetus (Moore, 1993), besides it is also humane to attempt to relief such intolerable pain (Reynolds, 1997).

Many attempts have been made to manage pains including low back labor pains using various pharmacological and non pharmacological interventions, each of which have advantages and disadvantages (Cunningham *et al*, 1997).

The pharmacological methods, besides being invasive, they require the attendance of a well-trained specialist in most cases as for conducting epidural analgesia (Millar Jones, 1980).

Among the nonpharmacological methods, water blocks have been tried with varying degrees of success for treating different types of pain such as whiplash (Byrn *et al*, 1991), cervicogenic headache (Sand *et al*, 1992), myofacial pain (Wreje and Brorsson, 1995) and low back pain including that of labor (Trolle *et al*, 1986; Lytzen *et al*, 1989; Ader *et al*, 1990; Labrecque *et al*, 1999; Martensson and wallin 1999).

Water blocks, being simple and non-invasive have encouraged some workers to assess its effectiveness in relieving low back labor pain. Since in most of these studies, sterile water was injected intracutaneously resulting in local irritation, attempts were made to reduce such irritation. Little work has been carried out along this line by injecting the sterile water subcutaneously in an attempt to alleviate its irritating effect (Martensson and Wallin, 1999).

In the present study, the effect of water blocks on low back labor pains has been compared using the two methods mentioned, i.e. the intracutaneous and subcutaneous routes.

A number of methods have been used to assess the intensity of labor pain following different modalities. Visual analogue scale method was the most commonly used (Trolle *et al*, 1991; Martensson and Wallin, 1999). However, this method requires educated patients. In our study about 60% of the cases studied were illiterate so this method could not be used. Miller Jones (1980), and Perriss (1980) used a simplified method of evaluating pain relief by asking their patients to grade analgesic effect as good or mild, in the former and good, fair or none in the later. Melzack and Schaffelberg, (1987) used the so-called McGill Pain Questionnaire, the part which dealt with evaluation of pain intensity consisted of (0-5) scale; o: no pain, 1: mild, 2: discomforting, 3: distressing, 4: horrible and 5: excruciating.

In the present study, we introduced a scale consisting of 4 degrees (0-4) namely (none, mild, moderate, severe and horrible) to assess pain intensity before and after water blocks which seemed to be more suitable for our population.

The points selected for injecting sterile water in this study (at four spots in the low back are corresponding to the borders of the sacrum) are the same points described by Trolle et al, (1991) and Martensson and Wallin, (1999).

In the present study , we used the same doses of sterile water used by other investigators; 0.1 ml. at each point for the intracutaneous route (Trolle et al , 1991; Martensson and Wallin, 1999), and 0.5 ml. at each point for the subcutaneous route (Byrn et al, 1993 ; Martensson and Wallin, 1999).

In the present study, 2 groups each of 75 cases in the first stage of labor were allocated to the comparative study of the effects of water blocks on the continuous and intermittent low back pain; in the first group sterile water was injected intracutaneously while in the second group it was injected subcutaneously.

The two groups were comparable regarding age, parity, education, labor conditions and intensity of continuous and intermittent back pains since there was no statistically significant difference in these parameters among the two groups.

The two groups were compared regarding degree and duration of low back pain relief, progress of labor and its outcome, irritability of the method and willingness of the women to reuse the same method in future labor.

In our study, both methods resulted in comparable degrees of reduction in both the continuous and the intermittent back pains. The corresponding medial values of reduction were one degree and two degrees respectively.

The recorded intermittent pain intensity was found to be reduced in 80% and 82.7% of cases in group A and group B respectively whereas the recorded intensity of continuous low back pain was found to be reduced in 93.4% and 94.9% of cases in group A and group B respectively.

Complete relief of the continuous pain was observed in 80.3% and 85.6% of cases in group A and group B respectively compared to 42.7% and 46.7% of cases for the intermittent back pain in group A and group B respectively.

Values reported in the literature dealt with either labor pains in general or low back pain without specification of its continuous and intermittent types. For instance; Lytzen *et al* (1989) reported complete relief of low back pain in 92.77% of the cases after intracutaneous injection with sterile water. The intensity of pain, assessed by the visual analogue scale, showed a reduction in the total pain scores from 6.05 to 2.92.

Ader *et al* (1990) reported that the intracutaneous injection of sterile water reduced the pain scores after 10 minutes of injection significantly. Similar conclusion was reached by Trolle et al (1991) who reported that 89.4% of the cases received intracutaneous sterile water injection,had noted an analgesic effect compared with 45% in the saline solution group.

Ranta et al (1994) found no reduction in pain scores following water blocks, but equally they found none following nitrous oxide or pethidine.

In ***1999, Labrecque et al*** carried out a controlled trial of non-pharmacological approaches for relief of low back pain during labor. They randomly assigned 34 women suffering from low back labor pain to receive either intracutaneous sterile water injections, transcutaneous nerve stimulation or standard care including back massage, whirlpool and liberal mobilization. Pain intensity was evaluated using visual analogue scales. Women in the sterile water group rated the intensity and unpleasantness of pain during the experimental period and just before delivery to be significantly lower than women in the other groups.

Martensson and Wallin, 1999 reported that pain reduction was significantly more pronounced in the cases treated with intracutaneous injection of sterile water and subcutaneous injection of sterile water respectively than in the placebo group (5.0and 4.5 Vs. 1.7) *P= 0.002.* No statistically significant difference in pain reduction scores was observed between the intracutaneous and the subcutaneous methods.

There is no apparent agreement on the exact mechanism by which sterile water injection gives such a beneficial action on low back labor pain. Many theories were suggested for explanation, most of which are discussed below.

In the clinically controlled double-blind study by Bengtsson et al (1989), acute ureteric colic was treated by injecting four papules of sterile water over the cutaneous area where projected pain from the kidney and the upper urinary tract was felt. Papules of isotonic saline solution were used as placebo. A significantly better effect was demonstrated using sterile water than with isotonic saline solution where no pain was felt at the site of injection. Similar results were observed by Trolle et al (1991), and Martensson and Wallin (1999), on studying the comparative effect of the painful sterile water injections and the much less painful saline injections on the low back labor pain. The stimulation of nociceptors seem to be an important factor for the treatment to be effective (Lytzen et al, 1989).

One may speculate that the mode of action of sterile water can be described by the gate control theory, in which afferent stimulation affecting interneurones in the dorsal horn of the spinal cord inhibits traffic in the other afferent systems (Cailliet, 1993). However inhibition of pain is not restricted to one specific segment, which suggests a more nonspecific modulation of pain than the gate control mechanism (Martensson and Wallin, 1999).

The brain modulates pain through a system that involves opiate receptors. Dense clusters of these opiate receptors are found in the ascending and descending pain pathways and in portions in the brain believed to be essential to the pain modulating system (Stimmel, 1983).

Endogenous opioids may modulate pain through positive and negative feedback systems. Thus a given nociceptive stimulus activates both peripheral pain transmission pathways (causing pain and termed positive feedback) and the brain’s modulatory network (inhibiting pain and termed negative feedback) making the sensation of pain a partial summation of these two processes. Other neurotransmitters known to play a role in pain regulation include acetylcholine, dopamine, norepinephrine and serotonine (Baumann, 1997).

Experimental work by Watkins and Mayer (1982) has shown that stress may precipitate profound analgesia via both endorphinergic and non-endorphinergic mechanisms. Stress in the form of painful stimulation leads to activation of pain inhibiting systems in the brain and spinal cord . the combination of great intensity and long duration stress leads to non-opioid analgesia whereas the combination of low intensity and short duration of stress leads to opioid analgesia which can be reversed by opioid antagonists (Lytzen et al, 1989).

Opioid and non-opioid analgesia can be evoked by procedures stressful to the patient, including acupuncture, transcutaneous nerve stimulation (TENS), and sterile water injection because of the initial painful stimulus (Lytzen et al, 1989). But with this explanation, it would be expected that methods as transcutaneous nerve stimulation and sterile water injection alleviate all types of labor pain.

In a study by Bundsen et al (1981), they observed that transcutaneous nerve stimulation had a good effect on low back pain whereas suprapubic pain was not alleviated. Also Lytzen et al (1989), observed that intracutaneous injection of sterile water has a profound effect on the low back pain but with no alleviation of the suprapubic pain.

It is also difficult to explain the analgesic effect of sterile water injection in labor as stress induced analgesia, since the woman in labor requiring analgesia is already under considerable stress (Lytzen et al, 1989).

The analgesic effect of sterile water injection can be more easily explained as a mode of counter-irritation (Lytzen et al, 1989).

Counter-irritation or "hyperstimulation" analgesia refers to a noxious stimulus applied to one part of the body that reduces pain somewhere else. The underlying mechanism has been called "diffuse noxious inhibitory control" refering to widspread inhibition of the input from nociceptive afferents to convergent dorsal horn cells. The inhibition is long lasting and requires intact connections to supra-spinal centers, indicating that sura-spinal mechanisms are also involved (Byrn et al, 1993). The reduced sensation of pain is assumed to be achieved by inhibiting mutireceptive neurones to the brain (Morgan and Whitney, 1996).

In this study, we could not strictly control for every feature of labor or for all factors that may affect the analgesic efficiency of sterile water injection techniques. Meanwhile, we found that the analgesic efficiency of sterile water injections during labor did not vary significantly, in general, with maternal age, gravidity, or position of the fetal head. These factors seem to have no direct relation to the proposed mechanism of action. No data regarding the impact of these factors on the efficiency of sterile water injection methods as analgesic during labor was found is the literature.

As regards the need for augmentation of labor in this study, there was no statistically significant difference between the two methods. 42.7% of cases in the intracutaneous group and 50.7% of cases in the subcutaneous group received oxytocin stimulation.

Trolle et al (1991), reported lower percentages of cases necessitating oxytocin stimulation which was 39.7% of cases in the saline solution group and 32.6% of cases in the sterile water group. The relatively higher rate of augmentation observed in our study may be attributed to the difference in the policy of managing normal labor ,based on lack of facilities where the strength of uterine contractions were roughly assessed by manual palpation.

Progression of labor , expressed as time from application of the water blocks until full cervical dilatation was comparable in both groups. Median values were 115 m.(range: 55 to 315) in the intracutaneous route group and 107.5 m.(range: 25 to 450) in the subcutaneous route group. The mean cervical dilatation at application was 4.2 ± 0.88 in the intracutaneous route group and 4.41± 0.7 in the subcutaneous route group.

Trolle et al (1991), reported similar results, the corresponding median time was 120 m. (range: 0 to 660). They reported that there was no significant difference in this aspect between the sterile water group and the saline solution group. The mean cervical dilatation at application of the blocks in their study was 4.73 ±1.91 for sterile water group and 4.68±1.91 for the saline solution group.

In our study, the second stage of labor had a median value of 15 minutes (range: 2 to 60) in the intracutaneous route group and 10 minutes (range: 3 to 54) in the subcutaneous route group.

Trolle et al (1991), reported that the median duration of the second stage of labor in their study was 30 minutes (range: 0 to 135) in both the sterile water and the saline solution groups. The difference in the percentage of primiparous women participating in each study may -in part- explain the difference in the duration reported for the second stage of labor as they reported a primiparous women percentage of 70.2% and 75.6% in the sterile water and saline solution groups respectively. In our study , such percentage was 58.7% and 62.7% in the intracutaneous and subcutaneous sterile water groups respectively.

On studying the method of delivery for women participating in this study, no statistically significant difference between the two injection techniques was found. Five cases in each group (6.7%) were delivered by cesarean section. Indications were either obstructed labor or fetal distress.

Lytzen et al (1989) reported that cesarean section was ultimately performed in seven cases of the 83 studied (8.43%).

Martensson and Wallin (1999) reported only one case (3.03%) of cesarean delivery in each one of the three studied groups, namely; intracutaneous sterile water, subcutaneous sterile water, and subcutaneous saline "placebo" groups.

Earlier, Trolle et al (1991) reported that the rate of cesarean sections was significantly higher in the group receiving intracutaneous injections of saline solution than in the group receiving intracutaneous sterile water injections (11.45% Vs. 4.25%) . They stated that this was caused predominantly by a higher incidence of cephalopelvic disproportion and malposition of the occiput in the saline solution group.

The percentage of cases having vacuum extractions in our study was 5.3% of cases in the intracutaneous route group and 4% of cases in the subcutaneous route group.

Martensson and Wallin (1999) reported a rate of 3.03% for vacuum extraction in each of the three studied groups, namely; intracutaneous sterile water injection group (n=33), subcutaneous sterile water injection group (n=33) and subcutaneous saline injection as "placebo" group (n=33) .

Trolle et al (1991) reported that 15% of cases in their intracutaneous sterile water group (n=141) and 9.92% of cases in the intracutaneous saline solution group (n=131) had undergone vacuum extraction of their babies.

No statistically significant difference in vacuum extraction rates was found between the studied groups within each study.

The difference in the number of cases involved in each study may have a role in explaining the difference in the vacuum extraction rates.

A drawback of intracutaneous injection of sterile water is a transient intense pain accompanying administration. This has been observed is several studies involving different painful conditions including labor pain (Lytzen *et al*, 1989; Adee *et al*, 1990; Trolle *et al*, 1991).

Byrn *et al* (1993) reported that subcutaneous injection of sterile water in chronic pain cases following whiplash injuries was tolerable. Recently, Martensson and Wallin (1999) conducted a comparative study for intracutaneous and subcutaneous injection of sterile water for pain relief during labor and reached the conclusion that no significant difference either in analgesic effect or in pain experienced during administration exists between the two methods.

In the present study, however, the subcutaneous method was found to be significantly less painful than the intracutaneous method as judged by the lower degrees of pain associated with its usage.

Most recently; Martensson *et al* (2000) conducted a double blind controlled trial with crossover design to investigate whether during injections of sterile water, there is any difference in perceived pain between intracutaneous and subcutaneous injections. They randomized 100 healthy female volunteers into two groups and subjected them to two trials, within one week of each other. During the first trial, one group (n=50) received the intracutaneous injection first, followed by the subcutaneous injection. The second group (n=50) was given the subcutaneous injection first, followed by intracutaneous injection. In both groups, all the injections were given in reverse order during the second trial. The analysis showed intracutaneous injections to be significantly more painful than subcutaneous injections, even after adjusting for injection day and left / right site of injection.

Martensson and Wallin (1999) attributed the intense pain resulting from sterile water injection to osmotic stimulation from the salt free water and distension of the firm cutaneous layers in case of intracutaneous injection and to osmotic stimulation only in case of subcutaneous injection. They also attributed the unexpected similarity of the pain intensity resulting from sterile water injection by the intrcutaneous and subcutaneous methods to the relatively small size of the study and to the fact that women in their study breathed nitrous oxide and oxygen during the injections and that the injections were given during a contraction. All these factors may have diminished the pain from injections in all groups, reducing the suggested difference between the groups.

Earlier, Lytzen et al (1989) stated that intracutaneous injection of sterile water causes distension in the skin, thereby stimulating the nociceptors and mechanoreceptors producing a sharp pain of short duration.

Trolle et al (1991) noticed that intracutaneous injection of isotonic saline solution is less painful than the sterile water but not painless. It is worth noting that the same dose (0.1 ml.) of both sterile water and saline was injected at each point.

This makes the hypotonicity of the sterile water the most probable mechanism producing local irritation as this irritation occurs both when sterile water is injected inrtacutaneously "where distension of the cuticle occurs" as well as subcutaneously "where no distension of the cuticle occurs", while isotonic saline solution injection causes mild pain when injected intracutaneously, although distending the cuticle.

It seems that the loss of the distension factor in the subcutaneous route made it less painful (as evidenced by the results of Martensson and Wallin, (2000) and the results obtained from this study), but still as effective as the intrcutaneous route (as evidenced by the results of Martensson and Wallin (1999) and the results of this study). This makes a prospective for further work to achieve the minimum intensity of pain accompanying sterile water injection without affecting its analgesic efficiency.

The time lapsed till the woman noticed the analgesic effect of the injections was significantly less when the intracutaneous method was used than when the subcutaneous method was used. The corresponding median values were 60 sec. (range: 25 to 740) and 120 sec. (range: 10 to 300).

Trolle et al (1991) using the intracutaneous route to inject sterile water, reported that the median number of minutes before the effect was apparent was 2 minutes (range: 1 to 30). The wider range of recorded time lapse in our study may be responsible for this difference.

To assess and compare the duration of action of both methods of injection used in our study, five consecutive readings were taken at 30 minutes intervals. We found that analgesia following sterile water injection by the two methods was still observable for more than 165 minutes in 32% and 37% of valid cases for the continuous back pain ,and in 33.3% and 37.2% of valid cases for the intermittent back pain in the intracutaneous and subcutaneous groups respectively.

Lytzen et al (1989) asked their patients to fill in a visual analogue scale every hour to assess the duration of effectiveness of the intracutaneous sterile water blocks. They reported that analgesia lasted for up to 4 hours.

Trolle et al (1991) found that there was still a significant difference between the pain scores in the sterile water group and the saline solution group at the end of the two hours observation period.

Martensson and Wallin (1999) found that both the intracutaneous and subcutaneous methods of sterile water injection were significantly more effective in reducing low back pain scores than the "placebo" group at 45 minutes after treatment. Ninety minutes after treatment, the difference did not reach statistical significance.

Data in this study show that 69.3% and 68% of the women in group A and group B respectively would consider using the sterile water injection in future labors and this agrees with Trolle *et al* (1991) who, using the intracutaneous method, reported a willingness value of 68.1%. Higher figures have been reported by Martensson and wallin (1999). They reported values of 88.9% and 80.6% for intradermal and subcutaneous methods respectively.

The data obtained throughout this study clearly show that both the intracutaneous and subcutaneous methods for injecting sterile water are of the same degree of effectiveness is alleviating low back labor pains especially the continuous one.

SUMMARY & CONCLUSIONS

This study was undertaken to evaluate the comparative effect of the intradermal and subcutaneous injection of sterile water as methods for alleviating continuous and intermittent low back labor pains.

One hundred and fifty women in the first stage of labor were selected and randomly assigned to two equal groups (group A and group B). Women in group A received four injections each of 0.1 ml sterile water intradermaly while those in group B received four injections each of 0.5 ml sterile water subcutaneously. In all cases, injections were given at four specified spots in the low back area corresponding to the borders of the sacrum. The involved women were asked to grade their pains as none (0), mild (1), moderate (2), severe (3) or horrible (4). The effect of sterile water injection on the low back labor pains was assessed by comparing the pain severity prior to and 15 minutes after injection in each case.

The data and results collected were tabulated and statistically analyzed.

The demographic and obstetrical data of the cases as well as severity of their continuous and intermittent back pains prior to injections in both groups were found to be statistically comparable.

Both methods resulted in comparable degrees of reduction in continuous and intermittent back pains. The corresponding median values of reduction were one degree and two degrees respectively. Complete pain relief was more observed in case of continuous pain (80.3-85.9% of valid cases) than the intermittent pain (42.7-46.7% of valid cases) in both groups.

The intracutaneous method was found to take significantly shorter time to exert analgesia (median = 60 sec) than the intracutaneous method (median = 120 sec). Analgesia following sterile water injection by the two methods was still observable for more than 165 minutes in 32-37% and 33.3-37.2% of valid cases having continuous and intermittent back pain respectively.

The intracutaneous method was found to be significantly more irritant than the subcutaneous method. On the other hand, the irritation caused by the subcutaneous method lasted for a significantly longer time (33.2 ± 34.46 vs. 13.63 ± 6.85 sec).

The course and outcome of labor did not vary significantly between the two groups. In general, variations in gravidity, age and position of the fetal head were found to have no significant effect on the efficiency of analgesia exerted by both methods of sterile water injection.

About two thirds (68-69.3%) of women in each group expressed their willingness to use the same method of analgesia is future labors.

From the data of the present work the following conclusions are made:

- Both the subcutaneous and intradermal methods of sterile water injection are almost equally effective in alleviating continuous and intermittent low back pains during labor.
- Analgesic efficiency of sterile water injection during labor is not significantly effected, is general, by gravidity, age or position.
- Since the subcutaneous method produced less irritation than the intracutaneous method, its use is recommended for alleviating low back labor pains.

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