Scientific Editing - Sample work

Phenotypic Variations of Atopic Dermatitis: A Systemic Review of Dupilumab Efficacy and Safety

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Abstract

Walking epidural analgesia (WEA) has been found to be positively associated with short labor duration as well as decreased incidence of instrumental mode of vaginal birth and c-section delivery. The current study has been framed with the objectives of evaluating the experience of patients by introducing WEA in a retrospective manner. The aims of this article are to do an updated literature review of WEA and to share our institutional experience with readopting this technique. The current study involved the reviewing of questionnaires filled by medical professionals, i.e., nurses (n = 500) in the labor room to define the experiences of the patients. The current review analyses and reports the updated literature on WEA. In the present study, patient-controlled epidural analgesia (PCEA) was maintained by using 0.0625% bupivacaine combined with fentanyl 2µg/ml. Initial settings were a bolus dose of 8 mL, lockout interval of 20 mins, and background infusion of 6 mL/hr. Along with the questionnaire analysis, data on impact of ambulation on labor, techniques like combined spinal epidural, local anesthetics, maintenance of epidural, maternal satisfaction, urinary catheterization, maternal and fetal safety, cost and healthcare logistics were collected and analyzed for this current study. The WEA is a technique permitting ambulation during labor under epidural. From the current findings, we report that WEA may not influence the obstetric outcomes but it significantly influences the maternal satisfaction and lower needs for urinary catheterization in a positive manner. According to our observation, lack of interest represents the most common cause of non-ambulation followed by short labor. Although it has been considered as a safe form of labor analgesia, we reported two cases of fall but neither maternal nor fetal complications were reported. So, for safe ambulation the parturient should pass all the pre-ambulation tests and be accompanied by someone throughout ambulation.

Keywords: ambulation. analgesia, bupivacaine epidurals, retrospective

Introduction

Walking epidural analgesia (WEA) during labor became popular in the late 1990s and early 2000s. It was thought to be associated with a shorter duration of labor and a lower incidence of instrumental vaginal birth and cesarean delivery. However, recent studies have failed to support these ideas (Anim-Somuah et al., 2018; Lawrence et al., 2009; Roberts et al., 2005). Consequently, this technique has been abandoned due to a lack of evidence of obstetrical benefits, the requirement of additional nursing care, the potential risk of falling, and maternal disinterest, ascribed either to fatigue or to cultural reasons (Mayberry et al., 2003)**.** Despite the fact that ambulatory epidural analgesia has not been shown to improve labor outcomes, it has been associated with higher maternal satisfaction and a decreased need for urinary catheterization (Stewart & Fernando, 2011) (Wilson et al., 2009). This is relevant, as decreased maternal satisfaction with their labor experience in hospital has led to an increase in planned home childbirth in western countries. Indeed, the ability to freely move during labor is one of the causes that motivate women to choose planned home childbirth (Murray-Davis et al., 2014)**.** In spite of the fact that some studies suggest a small but significant increase in neonatal death and adverse outcomes for planned home birth compared to hospital delivery (Cheng et al., 2013; Kennare et al., 2010; Grünebaum et al., 2014), its use has doubled in the past twenty years in the United Kingdom, and currently accounts for 20% of all childbirths in the Netherlands (Zielinski et al., 2015).

One of the most common technique used in relieving labor pain is regional analgesia. The spinal analgesia combined with epidural analgesia is commonly referred to as "walking epidural analgesia" (Schrock & Harraway-Smith, 2012). The quality and duration of the epidural drugs may be enhanced by the adjuvant drugs. Relaxation therapy, distraction tactics, hypnosis, and ongoing support are thought to aid women in labour in coping with discomfort using their own resources. Acupuncture, acupressure, aromatherapy, transcutaneous electrical nerve stimulation, reflexology and intradermal injection of sterile water are some of the other nonpharmacological pain relief treatments (Madden et al., 2016; Bohren et al., 2017). When compared to placebo, no therapy, and acustimulation, epidural analgesia led to reduced perceived pain. In trials comparing

epidural to inhaled analgesia or continuous support, pain severity was not recorded. Serious maternal adverse effects were identified in just a few trials (Anim-Somuah et al., 2018).

Using a low local anesthetic concentration and adding lipophilic opioids to epidural anesthetics decreases the risk of having a subsequent motor block of the lower extremities. In the absence of a lower limb motor block, giving the parturient the option to change their recumbent position, walk in their rooms, use the toilet and have more privacy during labor, which can last for several hours, has a positive impact on their level of satisfaction with the delivery experience (Silva et al., 2017; Preston, 2010). For this reason, we became interested in readopting the ambulatory epidural technique in our maternity unit and in doing this review.

In our institution, we have been using low dose bupivacaine (0.0625%) with the addition of 2µg/ml of fentanyl for epidural analgesia since 2012. We started to offer WEA after additional nursing training in (**date**)… To evaluate our experience with this reintroduced technique, we retrospectively reviewed questionnaires filled out by nurses in the labor room regarding their patients' experiences. The aims of this article are to do an updated literature review of WEA and to share our institutional experience with readopting this technique.

Methods

Before starting the walking epidural, several educational sessions for walking epidural protocol were given to labor and delivery nurses by obstetric anesthesiologists. 500 questionnaires were attached to pre-labor analgesia assessment forms for the first 500 patients given epidural analgesia. All questionnaires were asked to be filled out by labor and delivery nurses even in case of recumbent epidural analgesia. The inclusion criteria of the study include, women with gestational age >37 weeks, singleton fetus and spontaneous onset of labour. The women with known contradictions to epidural analgesia, complicated pregnancy or delivery risk or with co-morbidities preventing safe ambulation were excluded from the study. All the participants were provided with informed consent form. In the absence of contraindications, the possibility of doing WEA was proposed to parturients. Then, the epidural was done by anesthesiologist or anesthesia resident. No restrictions were imposed with regards to the type of neuraxial technique (epidural, combined spinal-epidural or dural puncture epidural), initial bolus or test doses. These choices were left to the discretion of the anesthesiologist who performed the

epidural technique. Then, patient-controlled epidural analgesia (PCEA) was maintained by using 0.0625% bupivacaine combined with fentanyl 2µg/ml. Initial settings were a bolus dose of 8 mL, lockout interval of 20 mins, and background infusion of 6 mL/hr. The anesthesiologist could change the PCEA settings or double the bupivacaine concentration if needed especially with advanced labor. One hour after the initial epidural bolus given by anesthesiologist, the nurse could test the ability of patient to walk (pre-ambulation test) as shown in the instruction box. Patient were allowed to walk to toilet, to sit on the couch and to walk around inside their rooms. The questionnaires were designed to answer several simple questions: did the patient ambulated or not, the cause of non-ambulation, nurses' opinions, the need for urinary catheterization and the presence of complications.

Results

Out of 500 questionnaires, 325 questionnaires were filled out by labor and delivery nurses on all work shifts. Seventy-five (23%) women ambulated. The details on ambulated patients are provided in Table 1. Of these, 72% needed urinary catheterization at some point during their labor. Two cases of fall were registered, but no maternal or fetal complication resulted from these falls. A majority of patients found that the protocol was easy to understand and a majority of nurses found that the protocol was safe. With regard to patients who did not ambulate, the most frequent cause was the lack of interest (37%) followed by short labor (Table 2). No increase in ambulation rate was observed over time (Table 3).

Variable	Number (%)
Nulliparas	56 (77.8)
Parturient understanding the instruction for ambulation	71 (94.7)
Nurses satisfaction	61 (81.3)
Nurses found the protocol is safe	63 (84)
Failure of pre-ambulation test	8 (10.7)
Urinary catheterization	54 (72)
Fall	2 (2.7)

Table 1: Ambulating parturients

Variable	Number (%)
Causes of non-ambulation	
• Not interested	93 (37.2)
• Short labor	76 (30.4)
• Obstetric contra-indications	41 (16.4)
• Failed to meet the ambulation criteria	46 (18.4)
Failure times of pre-ambulation test	
• 1	26
• >1	6
Cause failed per-ambulation test	
• High-sensitive block level (>T4)	4 (1.6)
• Motor block	7 (2.8)
• Failure to squat	1 (0.4)
• Hypotension	None
• Orthostatic hypotension	1 (0.4)

Table 2: Non-ambulating parturients

Sequence of patients	Percentage of ambulation (%)
First 100 patients	29
101-200	21
201-300	18
301-325	28

Table 3: Progress of ambulation among laboring women with time

Impact of Ambulation on Labor

Ambulation aids in the early descent of the fetus due to gravity's impact during labor, enhances the strength and frequency of uterine contractions, aids in the advancement of active labor, and improves the labor outcome. It is economical and reduces the need for medical intervention during childbirth. The impact of ambulation on labor remains controversial. The effects of ambulation, with or without epidural analgesia, have been studied in several clinical trials. A recent systematic review demonstrated that the upright position and walking during the first stage of labor, in patients without an epidural, were associated with a shorter duration of the first stage of labor and a lower incidence of cesarean section (Lawrence et al., 2013). However, these results were of very low level of evidence owing to a high degree of heterogeneity and bias in the studies included in this review. When a walking epidural is used during labor, both the ambulation and the local anesthetic concentration used for the epidural may affect labor outcomes. In a multicenter, randomized controlled trial entitled “Comparative Obstetric Mobile Epidural Trial” (COMET), the authors found a significantly higher rate of spontaneous vaginal delivery in two ambulating groups of patients, who had either a combined spinal epidural (CSE) or low dose infusion (LDI) analgesia, compared to a group that was non-mobile and had high dose epidural analgesia (Comparative Obstetric Mobile Epidural Trial (COMET) Study Group UK, 2001).

A randomised trial study was conducted by Frenea et al. (2004) to predict how prolonged ambulation combined with epidural analgesia influences the labour pain and duration of labor in a positive manner. The study reported that labour duration and pain were not altered by ambulation, but the dosage of anesthetics, bupivacaine and oxytocin, was found to be received in lower quantities in the case of ambulatory women (Frenea et al., 2004). Another study has reported that walking during labor did neither altered the pain nor had any detectable effect on labor pain and duration. Being erect and ambulating all through labor was hypothesized to be linked to expanded pelvic diameter and increased contractions of uterine and frequency coordination. The uterine and muscle contractions of pelvic floor have been reported to be influence by the administration of oxytocin (Karahan et al., 2018; Albers et al., 1997). The upright posture was linked to an 18% reduction in instrumental deliveries and a slight decrease in the duration of the second phase of labor in women who did not receive epidural analgesia

(Gupta & Hofmeyr, 2005). The concentration of the medicine employed is more essential than the choice of local anesthetic. It has long been known that high-dose epidural analgesia (bupivacaine concentration of 0.25%) is linked to poor obstetric outcomes (Garmon & Huecker, 2022; Anim Somuah et al., 2011).

The risk of falling as a result of postural hypotension and somatosensory impairment was a major worry. In fact, the ambulant parturient's blood pressure is regarded to be more stable than the parturient who is confined to bed in the supine posture. It has been reported that, likewise, upright or ambulating patients have a lower risk of aortocaval compression. According to Stewart & Fernando (2011), only one case report in the literature of a pregnant patient falling while ambulating after receiving low-dose epidural analgesia has been reported Stewart & Fernando (2011).

Another study was conducted by Vallejo et al. (2001) to find out the role of ambulation combined with ambulatory epidural analgesia in the alteration of the duration of labor. The duration of labor considered in the reported study was the period between the insertion of epidurals and the completion of dilation of the cervix. The study involved ropivacaine (0.07%) combined with 100 µg of fentanyl at an infusion rate of 15 to 20 ml per hour. The results of the study have shown that the epidural anesthetics administered were not involved in decreasing the duration of labor considered for the study (Vallejo et al., 2001).

The ropivacaine at the concentration of 0.125% in combination with 50 µg of fentanyl showed similar results of treatment with bupivacaine of same concentration and fentanyl proportion during labor. A study has reported that ropivacaine provides significant satisfaction in mothers, that is similar and equivalent to bupivacaine of same concentration (Gündüz et al., 2017). Another study by Bhatia et al. (2017) have reported that combination of clonidine and lignocaine enhances the analgesic reaction and period.

A study by Cohen et al. (2000) was performed to determine the role of bupivacaine bolus as well as lidocaine epinephrine in the effectiveness of analgesics and the walking ability during labor. The study involved the infusion of 0.0625% bupivacaine combined with sufentanil at 0.33 µg/ml at 13 to 15 ml/hour throughout the labor. The results of the study have shown that for most parturients who choose this method, except for a lidocaine-epinephrine test dosage, employing

0.125% bupivacaine for the first bolus should allow ambulation in the early post block period (Cohen et al., 2000). Dystocia is characterized as labor lasting more than 12 to 24 hours or showing indicators of difficulties. A study was carried out to see if combination spinal–epidural analgesia, which allows for ambulation during labor, is linked to a lower incidence of dystocia than persistent lumbar epidural analgesia. The study involved the insertion of an epidural catheter 3 cm into the epidural space after a 5 ml test dose administration of 0.25 % bupivacaine through the syringe. Through the catheter, a bolus administration of 6 ml of 0.25 % bupivacaine along with 1 ml of fentanyl (50 μg) was injected, followed by a continuous intravenous infusion of 0.125 % bupivacaine with 2 μg of fentanyl/ml at a rate of 10 ml/hour. The study has concluded that there were no substantial variations in the overall rate of caesarean section, dystocia incidence, the frequency of maternal or fetal problems, the patients' or nursing staff's judgement of analgesic sufficiency, or general wellbeing. This was reported by Clark et al. (2013).

A study was conducted by Sharma et al. (2007) on 50 women who has vertex positioned single fetus. The study involved the insertion of epidural catheter in the interspinous region of L2 – 3 / L3 – 4, followed by the administration of 10 ml 0.1 % bupivacaine solution combined with 0.0002 % fentanyl solution at the rate of 5 ml per hour during the labor. The results have shown that the combination of 0.1 % bupivacaine and 0.0002 % fentanyl provides maximum pain relief while minimizing adverse effects (Sharma et al., 2007).

For both mobile techniques, this study used a low concentration of bupivacaine (0.1%) compared to 0.25% in the non-mobile group. Moreover, only 36% of parturients in both mobile groups were actually mobilized. It is therefore possible that the lower assisted vaginal delivery rate found in the mobile groups was attributed to the use of a lower concentration of bupivacaine rather than a direct effect of ambulation. To eliminate the influence of lowered anesthetic concentration, Vallejo et al. (2001) used the same low anesthetic concentration in both ambulatory and recumbent groups (Vallejo et al., 2001). No positive impact of ambulation on either pain or duration of labor was found in this study. WEA is a good option to be offered to interested parturient, however, no improvement of obstetric outcomes has been found according to evidence based medical practice.

Techniques in Epidural Analgesics

Both CSE and low dose epidural analgesia have been used to initiate WEA. Compared to a low dose epidural, CSE results in a faster onset of effective analgesia, but has been associated with a higher incidence of maternal pruritus (Simmons et al., 2012). No differences between CSE and low dose epidural analgesia were identified in relation to patient mobilization during labor, the incidence of post-dural puncture headache, or urinary retention in this study (Simmons et al., 2012). Fetal bradycardia after labor neuraxial analgesia is controversial. While Abrão et al. (2009) found that CSE was associated with a significantly greater incidence of fetal heart rate abnormalities compared to epidural analgesia (Abrão et al., 2009) especially when higher doses of opioids are used (Van de Velde et al., 2004) (Vercauteren et al., 1997) (Clarke et al., 1994) (Gaiser et al., 2005), other studies failed to show a significant increase in fetal bradycardia following CSE (Patel et al., 2014; Skupski et al., 2009). On rare occasions, CSE analgesia during labor and delivery has been linked to fetal bradycardia. Possible main causative factors include a reduction in the cardiac index and uterine hypertonia. Yacoubian et al. (2017) have reported that on comparison, labor analgesia with epidural analgesia, labor analgesia with CSE is linked with a considerable reduction in heart rate and cardiac index. **Abrão et al. (2009)** have reported that CSE is positively associated with elevated uterine tone. The blood flow in uteroplacental has also been reported to be altered by CSE in some cases.

According to a research conducted by Langesaeter et al. (2008), low-dose bupivacaine (with sufentanil), in combination with a low-dose phenylephrine infusion and considerable cohydration, provides the best hemodynamic stability after cesarean birth (Langesaeter et al., 2008). During labor, CSE analgesia has been linked to abnormalities in the heart rate of the fetus, with a frequency varying from 4% to 21% (Carvalho et al., 2007). Another study conducted by Patel et al. (2014) has reported a contrasting report that CSE does not influence the risk or incidence of abnormalities in the heart rate of fetus, when compared to the epidural analgesia. Umbilical artery base overload has not been measured in most research comparing CSE and epidural analgesia. pH, which may be influenced by maternal respiration, is usually a better indication of newborn metabolic health than base excess (Reynolds, 2000).

According to a randomised study including 300 parturients, women getting 7.5 μg of spinal sufentanil alone had a higher rate of irregularities in the heart rate of their fetus and uterine

hypertonus than those receiving 1.5 μg of spinal sufentanil combined with 2.5 mg of bupivacaine and 2.5 μg of adrenaline, or epidural analgesia (Van de Velde et al., 2004). Dural puncture epidural technique was recently added to labor analgesic options. This technique is a modified CSE where the dura is perforated by a spinal needle without injecting an intrathecal dose of local anesthetic (Cappiello et al., 2008). Compared to a classic epidural technique, it has been shown to be associated with less asymmetric block and with more sacral spread of local anesthesia. On other hand when it is compared with CSE, it has a slower onset but has a significant lower incidence of pruritus, hypotension and physician top-up interventions or breakthrough pain (Chau et al., 2017).

One of the recent techniques is ultrasound assisted neuraxial analgesics. With the growing use of ultrasonography in anesthesia for procedures including local nerve blockage, vascular access, and point-of-care ultrasound, the value of ultrasonography in aiding with neuraxial block placement has been highlighted (Weiniger & Sharoni, 2017). In several investigations, presumably because of the rising prevalence of midline insertion and optimum interspace choice, ultrasonography has been linked to improved labor analgesia and maternal comfort (Grau et al., 2002). The use of ultrasound may result in neuraxial blocks being placed in lower interspaces, which are much more likely to provide appropriate analgesics during the second phase of labor. Women with scoliosis, prior back surgery, being obese, or impalpable bone features may benefit from using ultrasound to aid with neuraxial implantation (Balki et al., 2009) (Chin et al., 2011).

Isobaric bupivacaine induced a faster start of labor analgesia, greater sensory levels, and reduced motor block compared to hyperbaric bupivacaine, but at the cost of increased pruritus, hypotension, and persistent fetal bradycardia. Pruritus was common in the bupivacaine–fentanyl group, although it was only temporary and went away without therapy (Rofaeel et al., 2007). Other characteristics implicated in heart rate of the fetus alterations following CSE comprise older maternal age and increased pain levels, non-engagement of the head of the fetus in the pelvis, parity, oxytocin usage, and analgesia beginning late in labor (Nicolet et al., 2008; Gaiser et al., 2005; Patel et al., 2014; Abrão et al., 2009). A study conducted by Parkland researchers randomly assigned mixed-parity women to receive CSE analgesia (intrathecal sufentanil 10 mg in combination with epidural bupivacaine and fentanyl) or intravenous meperidine (50 mg)

epidural. Despite the fact that only 60% of the parturients received the medication they were assigned, an intent-to-treat assessment demonstrates a Caesarean birth rate of 6% in the CSE group compared to 5.5 % in the meperidine group. The findings of the study imply that neuraxial analgesia does not enhance the probability of Caesarean birth when used alone (Sharma et al., 2004).

According to several studies and meta-analyses, CSE resulted in a much faster start of labor analgesia than a typical epidural. It may also lead to better pain management, with fewer additional dose requirements, very few unilateral blocks, fewer epidural catheter malfunctions, and greater mother satisfaction (Simmons et al., 2012; Gambling et al., 2013; Heesen et al., 2014; Booth et al., 2016). Dural puncture epidural is a more lately reported epidural commencement strategy that aims to eliminate some of the negative effects of CSE (such as fetal bradycardia and pruritus) while also outperforming the usual labor epidural. Cappiello et al. (2008) have reported that when compared to epidurals, dural puncture epidural had a slightly faster start of analgesia, greater sacral coverage, and a lower frequency of unilateral block (Cappiello et al., 2008). Chau et al. (2017) have compared dural puncture epidural with CSE as well as with standard epidurals in case of labor analgesia. The study has reported that CSE approach was much faster than dural puncture epidural method as well as standard method of epidurals. But additionally, it was also reported that dural puncture epidural usage resulted in minimal side effects than CSE (Chau et al., 2017).

Local Anesthetics

Long-acting local anesthetics like bupivacaine, levo-bupivacaine or ropivacaine are used for labor analgesia. Ropivacaine is 40 % less potent than bupivacaine, so higher concentrations and higher total doses of ropivacaine are needed to produce acceptable levels of sensory and motor block (Kuthiala & Chaudhary, 2011) (Polley et al., 1999). A meta-analysis of fifteen randomized controlled trials with a total of 2097 women found that patients who received ropivacaine had a significantly lower incidence of motor block when compared to those who received bupivacaine (Guo et al., 2015). However, the studies included in this meta-analysis compared equal doses of bupivacaine and ropivacaine and did not account for the potency differences between these two local anesthetics, which can explain the higher incidence motor block in case of bupivacaine (Capogna et al., 1999) (Chethanananda et al., 2017).

The concentration of local anesthetic in epidural analgesia is also a well-known factor affecting the degree of motor block, the ability to ambulate, and overall obstetric outcomes. Sultan et al. demonstrated that a low concentration of epidural analgesia resulted in less motor blockade and greater ambulation without compromising analgesia (Sultan et al., 2013). They also found that high concentrations of local anesthetic are associated with an increased incidence of assisted vaginal delivery and prolonged duration of the second stage of labor. These findings support our conclusion from the COMET study results that a higher incidence of assisted vaginal delivery is associated with higher local anesthetic concentrations rather than lesser ambulation.

Adding lipid-soluble opioids to epidural analgesia reduces the concentration and total dose of local anesthetic required to produce a good quality of analgesia, as well as decreasing the incidence of motor blockade. Modern epidural analgesic mixture usually contains bupivacaine 0.0625% or ropivacaine 0.1% in combination with either fentanyl or sufentanil. This mixture has minimal effect on motor function and allow for ambulation in most cases (Guo et al., 2015).

In our case series, the failure of pre-ambulation test represented 18% of causes of non-ambulation and in most of the cases this test was not repeated table-2. Therefore, once the WEA is desirable, we have to pay attention to the dosage of initial bolus and test dose because most of the women with the failed first pre-ambulation test would eventually not repeat the test and hence not ambulated. Although we did not investigate the cause of non-repeating the pre-ambulation test but we think it might be due to fear of maternal fall.

Maintenance of Epidural Analgesics

During the last two decades, PCEA has gained popularity over continuous epidural infusion (CEI). A meta-analysis conducted by Van der Vyver and colleagues to compare PCEA with CEI found a 25 to 30% reduction in the total quantity of local anesthetic used during labor, a decrease in the incidence of motor blockade and fewer health care provider interventions for patients using PCEA (Van der Vyver et al., 2002). Other studies showed that adding a continuous infusion of local anesthetic to PCEA resulted in both a reduction of physician-delivered boluses and fewer PCEA boluses initiated by patients (Heesen et al., 2015; Bremerich et al., 2005; Missant et al., 2005; Srivastava et al., 2009).

The use of the programmed intermittent epidural bolus (PIEB) technique allows for an improved spread of local anesthetic within the epidural space, as a result of the high-pressure boluses it provides, compared to the low-pressure infusion created by CEI. When compared to CEI, PIEB results in a reduction in local anesthetic used, higher maternal satisfaction and a lower, but not statistically significant, incidence of motor block (George et al., 2013). Another study which used both PCEA and PIEB showed that this combination resulted in a reduction in break-through pain during labor and a lower requirement for manual rescue boluses of anesthetic (Wong et al., 2006). Since PIEB is a relatively new technique which has not been tested for walking epidural, it is not known whether giving parturient mandatory boluses just before or during ambulation could increase the risk of falling. However, a recent study by Zakus et al. (2018) suggests that PIEB equal to or less of 10 ml every 40 minutes do not increase the incidence of motor block (Zakus et al., 2018). Although promising, this approach needs further research.

Rodríguez-Campoó et al. (2019) conducted a randomized control trial to predict the better analgesic combination between PIEB with CEI and PCEA with CEI. The study has concluded that the conjunction of CEI with PIEB shows better maternal satisfaction rate than the combination with PCEA. A patient controlled randomized analytical study involving PCEA have been conducted by Ledin Eriksson et al. (2003). The study involved CEI in combination with ropivacaine and sufentanil compared against PCEA, in which PCEA has been observed to show better results than CEI.

In some investigations, PCEA has been demonstrated to minimize local anesthetic needs, reduce motor block, reduce the necessity for provider-administered top-ups, and increase analgesia and maternal fulfilment in some investigations when compared to continuous epidural infusions (Van der Vyver et al., 2002). A study has concluded that PCEA with a baseline PIEB is the best approach for maintaining epidural labor analgesia. PCEA enables for additional individualization of dose to account for variations in labor progress and variances in patient preference, whereas PIEB allows for a baseline level of analgesia (Nanji & Carvalho, 2018). Song et al. (2021) have reported that dural puncture epidural method is interlinked with speedy onset of neural analgesia but it was not found to alter labor period or satisfaction rate of the mothers.

Maternal Satisfaction in Epidural Analgesics

In a previous report, greater maternal satisfaction with allowed ambulation was attributed to a decrease in the sensation of dense motor blockade associated with the use of high concentrations of local anesthetic (bupivacaine ≥0.25%) (40). In addition, the need to maintain a bed-bound supine position for prolonged periods was found to have a negative impact on a parturient's level of comfort. The higher level of satisfaction related to the use of an ambulatory epidural could also be due to the decreased need for urinary catheterization or bedpan use. Thus, giving women in labor the chance to stand and walk around the bed or to go to the toilet and have more privacy was seen to have a positive impact on maternal satisfaction (Preston, 2010).

Poor dependability, safety concerns, and the sense of lower limb paralysis patients experienced when given heavy doses of local anesthetic all contributed to dissatisfaction with neuraxial analgesia. The use of continuous infusions instead of physician boluses improved patient safety and satisfaction (Silva & Halpern, 2010; Evans & Carrie, 1979). Optimal labor analgesia has the following characteristics: pain treatment that works, should be safe, and has little impact on labor progress or outcome. Also, the effects on the fetus or baby should be minimal, and maternal side effects like motor stuttering in the lower limbs, pruritus, and nausea should be minimal. The neuraxial analgesia was reported to have the optimal characteristics, which supports maternal satisfaction.

According to Norris et al. (2001)**, t**he combined spinal–epidural approach provides fast analgesia with little or no ambulation restriction. In most cases, 1–2 mg of bupivacaine is mixed with 5–15 µg of fentanyl and administered intravenously. A catheter is inserted into the epidural space for immediate or delayed activation with patient-controlled epidural analgesia. As a result, significant analgesia is achieved faster than with previous low-dose neuraxial procedures. Obstetric outcomes, such as the rate of emergency caesarean section or labor length, are unaffected (Norris et al., 2001).

A study by Silva & Halpern (2010) have reported that the neuraxial analgesia is a procedure that is often used to alleviate labor discomfort. It is the most effective kind of analgesia when compared to other treatments. Recent advancements in medication combinations and delivery techniques have resulted in a versatile strategy that is safe and successful for the

majority of parturients. Low-dose local anesthetics mixed with lipid-soluble opioids do not slow down labor or depress the infant. The study has added that the patient satisfaction is enhanced by the addition of patient-controlled epidural analgesia and new technology developments Silva & Halpern (2010).

Urinary catheterization

Neuraxial analgesia can cause urinary retention through blockade of sacral nerve roots, with higher local anesthetic concentrations resulting in denser epidural block and more alteration of bladder function. In the case of CSE use, added intrathecal opioid causes dose-dependent suppression of detrusor muscle contractility and influences the voiding urge sensation via sacral parasympathetic outflow inhibition (Chestnut et al., 2019)**.** A study by Bucklin et al. (2005) has reported that in the United States, the proportion of parturients who preferred neuraxial analgesia during labor increased from 21% in 1981 to 77% in 2001; in the United Kingdom, a little more than 33% of parturients preferred neuraxial analgesia for delivery in the years, 2008 to 2009. Studies have reported that despite the growing use of neuraxial labor analgesia, the rate of Caesarean section in nulliparous women in natural labor has remained stable. A number of additional evaluations showed no significant link between C section childbirth percentages and epidural treatment rates (Segal et al., 2000).

Choi et al. (2012) has conducted a systematic review to report the inter-relationship between neuraxial anesthesia and the dysfunction of urinary bladder during the perioperative period, since the infection risk is higher in cases of urinary retention that necessitates catheterization. The researchers have reported that the duration of urinary bladder muscle dysfunction following intrathecal anaesthesia is associated with the dosage and strength of the local anesthetic. The study also added that urinary retention follows a similar pattern, and is exacerbated by the presence of neuraxial opioids, especially long-acting versions. Catheter-related urinary tract infection was found to be uncommon (Choi et al., 2012).

Early-labor neuraxial analgesia was compared to systemic opioid analgesia preceded by neuraxial analgesia at a dilatation of the cervix of 4–5 cm in randomized clinical trials (Ohel et al., 2006) Surgical anesthetic, intraoperative muscle relaxation, and intrapartum and postoperative pain management are all provided by epidural blocks, which have extensive direct

and indirect effects on various physiologic systems. The severity of these physiologic consequences is determined by the degree of placement and the number of blocked spinal segments (Mauermann et al., 2006).

Weiniger et al. (2009) demonstrated that ambulation during labor reduced post-void residual urinary volume and decreased the need for urinary catheterization in parturients with low dose epidural analgesia (Weiniger et al., 2009). Yun et al. (2014) have conducted a study to compare the anesthetic effects of lower doses of spinal bupivacaine with epidural top-ups to those of spinal bupivacaine, and to establish the appropriate drug dosages for lower extremity interventions. The study involved the usage of three different analgesics like 10 mg of spinal bupivacaine, 7.5 mg of spinal bupivacaine along with 10 ml of epidural analgesic, 1.5% lidocaine and 5 mg of spinal bupivacaine combined with 10 ml of epidural analgesic, 1.5% lidocaine. The researchers concluded that, in patients undergoing lower extremities procedures, 7.5 mg of spinal bupivacaine and 10 ml of epidural 1.5 percent lidocaine induced quicker motor recovery than 10 mg of spinal bupivacaine during combined spinal-epidural anaesthesia (Yun et al., 2014).

It has been reported that acting directly on the sacral nociceptive neurons and autonomic fibres, spinal and epidural opioid infusions affect the function of the lower urinary tract. In the context of spinal or epidural anaesthesia, bladder catheterization is a routine procedure. Excessive transurethral catheter usage is unquestionably linked to severe morbidity, including patient pain, urinary tract infections, catheter entrapment, bladder calculi development, urethral trauma, and stricture. A single catheterization increases the chance of infection by 1 to 2 %, which can escalate to 3 to 7 % every day.

Wilson et al. compared a high dose epidural regime with two mobile epidural techniques, both of which employed low dosages of local anesthetic (Wilson et al., 2009). They demonstrated that epidural techniques allowing mobility encourage the retention of normal bladder function and reduce the risk of urinary catheterization for women in labor. In their two mobile groups (CSE and low dose epidural), the catheterization rates were 68% and 62% respectively. These rates are slightly lower than the rate of catheterization (72%) we found in our mobile patients. Our rate may be higher simply because the nurses were not familiar with the

walking epidural protocol and continued to follow their old practice of inserting a urinary catheter in almost all parturients. It is possible that in a standardized, controlled research project, we would see a lower rate of urinary catheter insertion than what we found in our study.

Maternal and fetal safety

Several factors increase the risk of falling for women during labor. Pregnancy per se can affect the postural balance of a parturient. Moreover, epidural analgesia may cause lower limb motor weakness and alter proprioception and vibration sensation. These factors, together with postural hypotension commonly associated with epidural-induced sympathetic blockade, can increase the risk of falls. Despite these risks, the incidence of falls related to ambulation during labor is very low, with only one case reported in the literature (Aslan et al., 2018).

This very low incidence of falls among women ambulating during labor reflects the strict conditions that must be met before women in labor are allowed to walk. Several tests should be performed before ambulation is allowed, including but not limited to: a) documented intact proprioception, b) normal straight leg raises, c) normal hip flexion, and d) the ability to squat (Zakus et al., 2018). In our case series, two parturients fell down while doing the pre-ambulation test. The first woman while standing from recumbent position to perform she felt weakness in her lower extremities then she restrains herself on the edge of the bed and her right knee touches the floor. The other parturient while she tried to perform squat test, she lost her balance and she supported herself by placing her right hand on the floor and she was also held by the nurse and her partner. No maternal or fetal complications were resulted in both cases and no intravenous (IV) lines were pulled out. In both cases, although Bromage scores were zero (no motor blockade) this did not exclude the risk of fall.

Kuberan et al. (2018) conducted a randomized control study on determining the effect of epidurals on uterine tone and the heart rate of fetus. The uterine tone was examined by intra-uterine catheter. The participants were treated with hyperbaric bupivacaine (2 mg) along with the combination of fentanyl (15 μg) or with hyperbaric bupivacaine (2.5 mg). The study has reported a change in baseline uterine tone of more than 10 mmHg in the 30-minute interval after spinal injection. Only 20 % women who received a bupivacaine–fentanyl spinal had a baseline tone rise of more than 10 mmHg, compared to none who got bupivacaine (**Kuberan et al., 2018)**.

In addition, a suitable environment for ambulation is important for safety, which should include an absence of slippery floors, dangling wires, cables or IV's, and either no IV pole or one that is lightweight. Ensuring good epidural catheter fixation is also necessary for avoiding catheter displacement during ambulation and the subsequent need for additional anesthetic intervention. Maternal safety is essential for fetal safety. Intermittent fetal heart rate monitoring every 15 minutes or telemetric fetal monitoring is recommended to ensure fetal well-being, especially in the case of prolonged ambulation (Weiniger et al., 2009).

Cost and Healthcare Logistics

The total cost of delivering epidural analgesia can be separated into two parts: a baseline-cost element that includes the expenses of hospital treatment for patients obtaining intravenous analgesia for labor and birth, and (ii) an accumulative component that includes the costs of accumulative epidural analgesia care. The baseline component could be built using data from hospital cost accounting for actual obstetric patients. The incremental component is built using a list of known problems of epidural and intravenous analgesics, as well as associated incidence rates and cost estimates from the standpoint of society (Huang & Macario, 2002). As noted above, with prolonged ambulation, close caregiver supervision and the availability of special equipment, such as continuous external telemetric fetal heart rate monitors, are necessary (De la Chapelle et al., 2006). Providing this extra care leads to increased costs. However, with more limited ambulation, such as around the bed or to the bathroom, a reliable and cooperative partner can provide supervision with proper training. In either case, the time necessary for instruction and training of personnel doing the extra care and the additional resources needed to modify caregiving procedures and staffing may increase the cost of maternity care (Mayberry et al., 2003). In our institution, the nurses were paid once for attending off-duty training sessions, no other extra cost were spent and no new nursing staff was recruited. Like many other centers, our labor unit suffer from chronic understaffing especially at night. Therefore, we did not see any increase in the rate of ambulation over time, despite the fact that the nurses became more familiar with the protocol with time.

Limitations of the study

Our study has several limitations worth noting. Being single center, retrospective observational study is one of them. No standardized research protocol for initiation and

maintenance of neuraxial analgesia or for urinary catheterization. Low compliance of nurses to fill the research questionnaire with only 65% of forms were filled. However, we believe that our study provides an update in ambulatory labor analgesia especially in the presence of paucity of research during last year's regarding this subject. Hence, our future studies are aimed at overcoming these limitations.

Conclusion

The WEA is a technique permitting ambulation during labor under epidural. Although it does not improve the obstetric outcomes it is associated with higher maternal satisfaction and lower needs for urinary catheterization. According to our findings, lack of interest represents the most common cause of non-ambulation followed by short labor. Although it has been considered as a safe form of labor analgesia, we reported two cases of fall but neither maternal nor fetal complications were reported. So, for safe ambulation the parturient should pass all the pre-ambulation tests and be accompanied by someone throughout ambulation.

Conflicts of interest

Acknowledgements

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