

### Comparison of Patient Controlled Epidural Analgesia (PCEA) with basal infusion and Programmed Intermittent Epidural Bolus (PIEB) with PCEA in labour analgesia – A Year Retrospective Study

Zawiah Kassim<sup>1</sup>, Norliza Mohd Nor<sup>2</sup>, Ariffah Mokhtar<sup>2</sup>, Suhaina Mohamad<sup>2</sup>, Sarina Osman<sup>2</sup>, Isqandar Adnan<sup>1</sup>

1 Department of Anaesthesiology and Intensive Care, Faculty of Medicine, Universiti Teknologi MARA, Selangor, Malaysia

2 Department of Anaesthesiology and Intensive Care, Hospital Selayang, Selangor, Malaysia.

#### Received

28<sup>th</sup> October 2020

#### Received in revised form

17<sup>th</sup> February 2021

#### Accepted

20<sup>th</sup> February 2021

#### Corresponding author:

**Dr. Zawiah Kassim,**

Department of Anaesthesiology and

Intensive Care,

Faculty of Medicine,

Universiti Teknologi MARA (UiTM),

Jalan Hospital, 47000

Sungai Buloh, Selangor,

Malaysia

Email: drzawiah@gmail.com

#### ABSTRACT

**Introduction:** Over three decades, patient-controlled epidural analgesia with a basal infusion regimen (PCEA+BI) has successfully improved labour analgesia quality due to its advantage in allowing self-titration by the parturients. Recently, a newer programmed intermittent epidural bolus with PCEA regimen (PIEB+PCEA) was suggested to improve the epidural spread of local anaesthetic hence resulted in better analgesia quality and higher maternal satisfaction.

**Methods:** We conducted a one-year retrospective analysis of data from obstetric analgesia service record sheet and hospital information system comparing maternal satisfaction towards their labour analgesia quality, mode of delivery and neonatal Apgar scores between these two methods of epidural delivery techniques. A total of 343 parturients were recruited in this study (PCEA+BI  $n=171$ , PIEB+PCEA  $n=172$ ). **Results:** There were no significant difference in maternal satisfaction between the two groups ( $P=0.398$ ) with a higher percentage of excellent satisfaction were found in the PIEB+PCEA group (PIEB+PCEA 146/172 (84.9%) vs PCEA+BI 138/171 (80.7%)). No significant difference in the mode of delivery ( $P=0.296$ ). However, the PIEB+PCEA group shown a higher spontaneous vaginal delivery rate (PIEB+PCEA 87/172 (50.6%) vs PCEA+BI 70/171 (40.9%) and lower Caesarean delivery rate (PIEB+PCEA 71/172 (41.3%) vs PCEA+BI 87/171 (50.9%)). Despite statistically significant differences found in Apgar scores at 1 minute ( $P=0.036$ ), there was no significant difference in the scores at 5 minutes ( $P=0.107$ ). Mean Apgar scores (SD) at 1 minute and 5 minutes for PIEB+ PCEA were 7.77(0.85) and 8.91(0.55) respectively and for PCEA + basal infusion, the scores for 1 minute and 5 minutes were 7.92(0.39) and 8.98(0.19) respectively. **Conclusion:** PIEB with PCEA is a newer epidural delivery technique for labour analgesia which produces a comparable outcome to PCEA with basal infusion.

**KEYWORDS:** Epidural analgesia, Programmed Intermittent Epidural Bolus (PIEB), Patient Controlled Epidural Analgesia (PCEA)

#### INTRODUCTION

Labour pain is the most intense pain experienced by women in their lifetimes that necessitates feasible analgesia with minimal side effect on the mother and fetus [1]. A recent meta-analysis has supported epidural analgesia as the most effective technique to manage labour pain with superior maternal satisfaction and lower incidence of adverse events compared to other analgesic techniques [2,3]. Since its introduction in the 1960s, this technique has become the gold standard for

labour analgesia [2]. Nowadays, with the widespread use of obstetric regional analgesia, epidural delivery techniques have evolved to suit the multifaceted labour pain. From a traditional midwife-administered intermittent epidural bolus to a continuous epidural infusion (CEI), maintenance regimens have revolutionised to patient-controlled epidural analgesia (PCEA). This technique is thought to be the superior method of epidural labour analgesia as it allows the parturients to individualize their analgesia [4]. In 2007, the American Society of Anaesthesiologists (ASA)



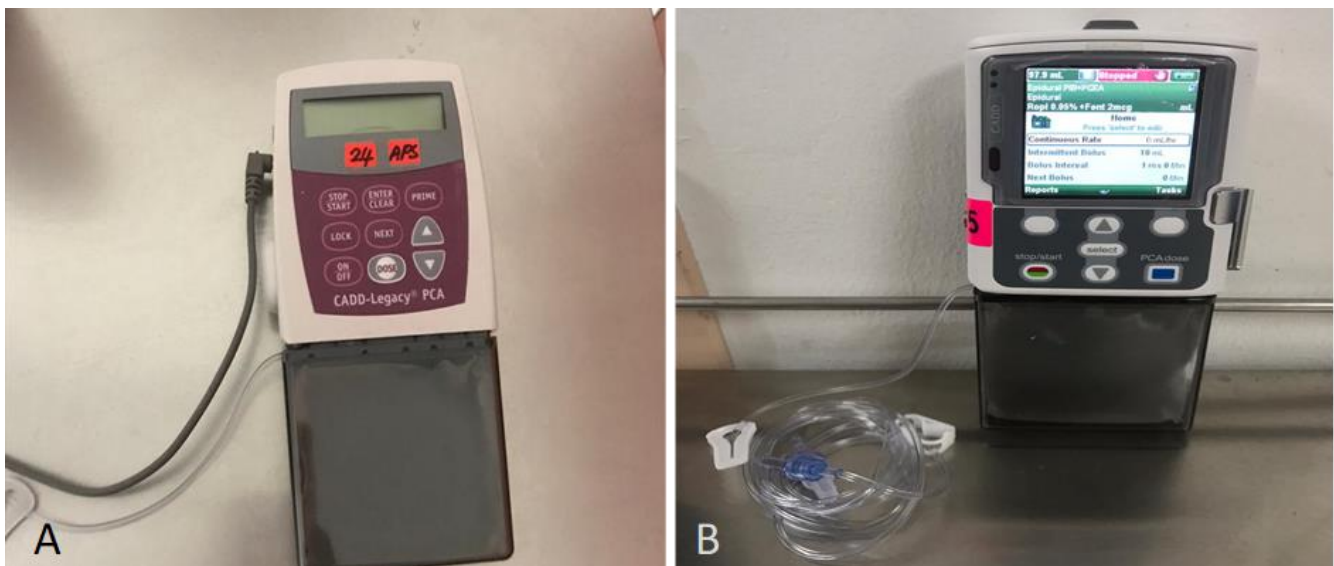
practice guidelines for obstetric anaesthesia supported the addition of basal infusion into the PCEA regime to improve maternal analgesia and reduce clinician boluses [5]. PCEA with a basal infusion regime also enables a lower concentration of epidural cocktail to be used, hence the lower incidence of motor blockade and instrumental vaginal deliveries.

Recently, programmed intermittent epidural bolus (PIEB), which delivers fixed boluses of the epidural mixture at a predetermined interval has been developed and its conjunction with PCEA has been approved for clinical use since 2014 [6]. Multiple studies have consistently shown benefits to PIEB + PCEA compared to PCEA + basal infusion [7-9]. We did a study in our centre comparing 2 regimens of maintenance epidural labour analgesia techniques, which are PCEA + basal infusion versus PIEB + PCEA from the aspect of maternal satisfaction, mode of delivery and neonatal outcomes after the introduction of PIEB at our institution.

## MATERIALS AND METHODS

With the approval of the Hospital Selayang Research Ethics Committee (NMRR No 53780), we conducted a

one-year retrospective review of the obstetric analgesia service (OAS) record sheet and hospital information system from 1 January 2019 until 31 December 2019. All parturients who had received epidural labour analgesia at Hospital Selayang within that period were included in the study. Exclusion criteria were patients with incomplete OAS record sheet and patients who received non-neuraxial labour analgesia techniques. We used universal sampling method based on the inclusion and exclusion criteria as this is a retrospective observational study on a one-year obstetric form and datasheet. In our centre, all parturients with no contraindications for neuraxial analgesia will be offered epidural labour analgesia either with PCEA + basal infusion regimen or PIEB + PCEA regimen regardless of their parity and stage of labour. Our study recruited all parturients who received epidural labour at any stage of labour and this included both nulliparous multiparous women. Two modes of epidural delivery techniques, which are PCEA + basal infusion and PIEB + PCEA were compared to identify the primary outcome of maternal satisfaction and secondary outcomes of the mode of delivery and neonatal Apgar score (Figure 1).



**Figure 1** Epidural delivery machine A: PCEA with basal infusion B: PIEB with PCEA

Setting protocol for each technique was as follows: PCEA with basal infusion regimen (CADD Legacy Epidural Pump, Smiths Medical ASD Inc. MN, United States); setting protocol PCEA bolus 10 millilitres (mL), PCEA lockout 10 minutes, basal infusion 10 mL per hour; PIEB with PCEA regime (CADD Solis Epidural Pump, Smiths Medical ASD Inc. MN, United States); setting protocol PCEA bolus 10 mL, PCEA lockout 10 minutes, PIEB bolus 10 mL, PIEB lockout 60 minutes, no basal infusion. Both techniques used ropivacaine 0.05% with 2 micrograms per mL of fentanyl as an epidural mixture solution. This is the standard concentration of local anaesthetic (LA) for labour pain management with PCEA or PIEB at our institution. The same concentration was used in all steps of analgesia in PCEA or PIEB (initial bolus, basal infusion, pump bolus).

Level of maternal satisfaction towards labour analgesia was elicited upon obstetric analgesia service review on the first day after delivery by using a 4-point verbal rating scale (excellent, good, satisfactory, poor). Their obstetric outcomes either spontaneous vaginal delivery, assisted vaginal delivery or operative Caesarian delivery and neonatal Apgar score were also documented. Data of maternal satisfaction and obstetric outcome were statistically analysed using Chi-square test whereby neonatal outcomes presented by Apgar scores at 1 minute and 5 minutes were statistically analysed using an independent t-test. P value < 0.05 was considered statistically significant.

## RESULTS

A total of 343 parturients received epidural labour analgesia between 1 January 2019 until 31 December 2019. From this, 171 and 172 parturients received PCEA + basal infusion and PIEB + PCEA regimen respectively. There was no difference in demographic characteristics between the PCEA + basal infusion and PIEB + PCEA group (Table 1). No significant differences were found between the two groups in terms of maternal satisfaction ( $P=0.398$ ) (Table 2). However, a higher percentage of excellent satisfaction was reported in PIEB + PCEA group compared to that in the PCEA + basal infusion group (PIEB + PCEA - 84.9%; PCEA + basal infusion - 80.7%) (Figure 2). No significant difference was found in obstetric outcome between the two groups ( $P=0.296$ ) although PIEB + PCEA had a higher percentage of spontaneous vaginal deliveries (SVD) (PIEB+PCEA 50.6%; PCEA + basal infusion 40.9%) and a lower percentage of Caesarean deliveries (PIEB + PCEA 41.3%; PCEA + basal infusion 50.9%) (Table 3). Despite significant difference found in Apgar score in 1 minute ( $P=0.036$ ), there was no significant difference in the score at 5 minutes ( $P=0.107$ ) between the two groups. Mean Apgar scores (SD) at 1 minute and 5 minutes for PIEB + PCEA were 7.77(0.85) and 8.91(0.55) respectively and for PCEA + basal infusion the scores for 1 minute and 5 minutes were 7.92(0.39) and 8.98(0.19) respectively (Table 3).

**Table 1** Association between demographic characteristics and methods of labour analgesia

Characteristics	PCEA+basal infusion n (%)	PIEB+PCEA, n (%)	p-value
<sup>a</sup> Age (years), mean (sd)	28.19 (4.87)	28.39 (5.13)	0.707
<sup>b</sup> Race			
Malay	120 (70.2)	119 (69.2)	0.123
Chinese	35 (20.5)	27 (15.7)	
Indian	14 (8.2)	17 (9.9)	
Others	2 (1.2)	9 (5.2)	
<sup>a</sup> Body Mass Index (kg/m <sup>2</sup> ), mean (sd)	29.22 (5.10)	29.62 (5.59)	0.494

a: Independent-t test, b: Chi-square test \*Significant if p-value < 0.05

**Table 2** Maternal satisfaction between PCEA with basal infusion regimen and PIEB with PCEA regimen

Outcome	PCEA+basal infusion, n (%)	PIEB+PCEA, n (%)	p-value
<b><sup>b</sup>Maternal satisfaction</b>			
Excel	138 (80.7)	146 (84.9)	0.398
Good	32 (18.7)	26 (15.1)	
Satisfactory	1 (0.6)	0 (0.0)	
Poor	0 (0.0)	0 (0.0)	

b:Chi-square test      \*Significant if p-value < 0.05

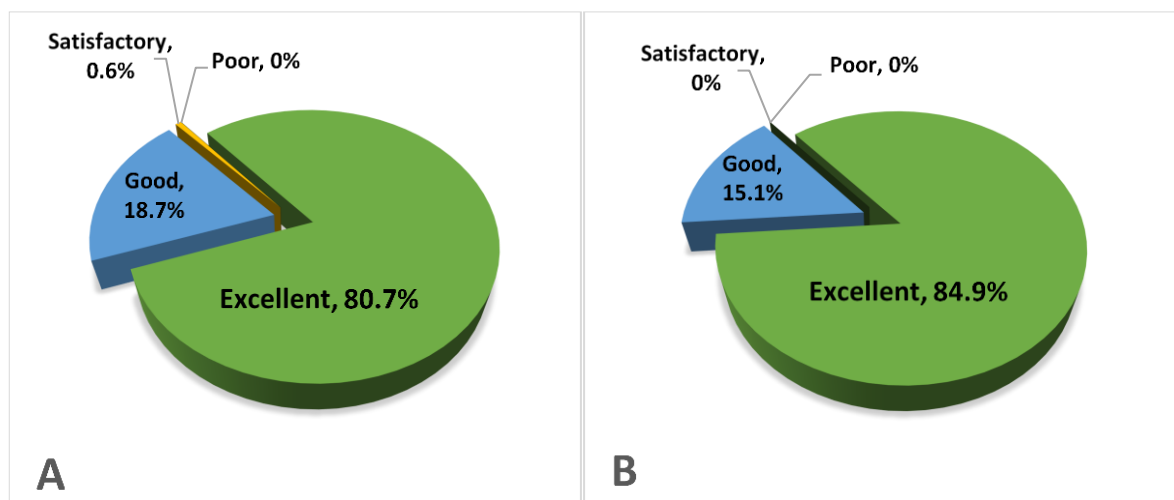
**Table 3** Obstetric and neonatal outcomes between PCEA with basal infusion regimen and PIEB with PCEA regimen

Outcome	PCEA+basal infusion, n (%)	PIEB+PCEA, n (%)	p-value
<b><sup>b</sup>Obstetric outcome</b>			
SVD	70 (40.9)	87 (50.6)	0.296
Caesarean	87 (50.9)	71 (41.3)	
Assisted vacuum	11 (6.4)	12 (7.0)	
Assisted forceps	3 (1.8)	2 (1.2)	
<b><sup>b</sup>Causes of caesarean (n=158)</b>			
Fetal distress	31 (35.6)	24 (33.8)	0.278
Poor progress	26 (29.9)	20 (28.2)	
Failed induction	26 (29.9)	23 (32.4)	
Secondary arrest	0 (0.0)	3 (4.2)	
Others	4 (4.6)	1 (1.4)	
<b><sup>a</sup>Neonatal outcome (Apgar score), mean (sd)</b>			
1 minute	7.92 (0.39)	7.77 (0.85)	0.036*
5 minutes	8.98 (0.19)	8.91 (0.55)	0.107

a:Independent-t test

b:Chi-square test

\*Significant if p-value < 0.05



**Figure 2** Maternal satisfaction towards A: PCEA with basal infusion regimen and B: PIEB with PCEA regimen

## DISCUSSION

Maternal satisfaction towards childbirth experience is a multidimensional measure that incorporates numerous components from the multifaceted labour pain to a complex physical and psychosocial state of the parturient. Therefore, intrapartum pain score assessment alone will not truly reflect labour analgesia quality as labouring mothers may not be at their best psychometric condition for assessment. Maternal satisfaction has been used in many studies as a surrogate measure of labour analgesia quality despite satisfaction itself has proven difficult to describe and quantify, and no accurate measurement standards have been accepted.

The important finding of this study was a higher incidence of an excellent maternal satisfaction score towards labour analgesia provided by PIEB + PCEA regimen compared to PCEA + basal infusion regimen (84.9% vs 80.7%) despite no significant difference found between the two groups ( $P=0.398$ ) (Figure 2). This finding may be explained by the postulated mechanism of superior analgesic quality produced by PIEB. It has been suggested that delivery of large volumes and correspondingly high injectate pressure of LA into the epidural space will produce a more uniform spread of LA and therefore a better sensory blockade and better analgesic quality [10]. A systematic review by Xu et al (2019) also reported a higher maternal satisfaction score in the PIEB + PCEA groups compared to PCEA + CEI. Most of the studies used a verbal rating scale (VRS) to evaluate maternal satisfaction in which 0 represented very dissatisfied and 10 or 100 represented extremely satisfied [11]. We used a simplified 4-point verbal rating scale to categorize maternal satisfaction in which excellent represents extreme satisfaction with labour analgesia quality followed by good, satisfactory and poor, which represent very dissatisfied with labour analgesia quality. None of our patients gave poor feedback towards their labour analgesia experience with either mode of epidural techniques (Figure 2). However, since maternal satisfaction is a subjective assessment of the overall labour analgesia experience, our future assessment should also document number of times breakthrough pain is experienced by parturient that

requires clinician intervention and types of neuraxial anaesthesia (combined spinal-epidural (CSE) versus epidural) used to initiate labour analgesia as subarachnoid anaesthesia may enhance analgesic quality received by labouring mother and might have influenced maternal satisfaction.

Our study found no significant difference in obstetric outcome between the two groups. However, higher incidence of spontaneous vaginal deliveries (50.6% vs 40.9%) and lower incidence of Caesarean delivery (CD) (41.3% vs 50.9%) was found in patients who received PIEB + PCEA as compared to PCEA with basal infusion (Table 3). A systematic review and meta-analysis by Xu et al (2019) found no difference in the CD rate between PIEB + PCEA and PCEA+basal infusion [11]. The lower incidence of CD, which reduced overall risks to both mother and newborn from obstetric and anaesthesia complications is another crucial clinical finding in our study. In both groups of patients, we found that the main causes of the Caesarian section are fetal distress, poor progress and failed induction of labour (Table 3). The rate of instrumental delivery did not significantly differ between our study groups (PIEB + PCEA -8.14%; PCEA + basal infusion - 8.19%) likely because we are using an ultra-low concentration of LA solution in both regimens, which is unlikely to cause a motor block to parturients. The literature suggests that lower concentration of LA for epidural analgesia is not associated with increased instrumental birth rate, and may even decrease the incidence of assisted vaginal delivery [12]. Capogna et al (2011) in his study found a reduction of motor blockade and rate of assisted vaginal delivery in PIEB + PCEA group compared to PCEA + basal infusion group [13].

Although our study found a statistically significant difference in Apgar scores at 1 minute, it has no clinically significant impact as both groups demonstrated Apgar score at 1 minute and 5 minutes of more than 7 which is reassuring (Table 3). Wang et al (2017) [12] and Fang et al (2016) [15] demonstrated no significant difference in the Apgar score of neonates between PIEB and CEI for labour analgesia [14,15]. The use of Apgar score alone does not predict individual neonatal mortality or neurological outcome as the

interpretation itself is very subjective and highly influenced by inter-observer variability and gestational age, which reflect the maturity of the infant. Therefore, the use of the new expanded Apgar score, which accounts for resuscitative intervention should provide a better reflection of a newborn's clinical status [16].

## CONCLUSION

PIEB with PCEA is a newer epidural delivery technique for labour analgesia in our centre, which produces a comparable outcome to PCEA with basal infusion.

## Conflict of Interest

Authors declare none.

## Acknowledgements

We would like to thank Dr Sabrizan Osman who did the statistical analysis of the data used in this manuscript.

## Authors' Contributions

SM and SO involved in data collection. AM prepared the first draft. ZK, NMN and IA contributed to the final revision of the manuscript writing. All authors read and approved the final version.

## REFERENCES

- Hawkins JL. Epidural analgesia for labor and delivery. *New England Journal of Medicine*. 2010;362(16):1503-10.
- Anim-Somuah M, Smyth RM, Cyna AM, Cuthbert A. Epidural versus non-epidural or no analgesia for pain management in labour. *Cochrane database of systematic reviews*. 2018(5).
- Sng BL, Kwok SC, Sia AT. Modern neuraxial labour analgesia. *Current opinion in anaesthesiology*. 2015;28(3):285-9.
- Gambling DR, Cole PY, McMorland GH, Palmer L. A comparative study of patient controlled epidural analgesia (PCEA) and continuous infusion epidural analgesia (CIEA) during labour. *Canadian Journal of Anaesthesia*. 1988;35(3):249-54.
- American Society of Anesthesiologists Task Force on Obstetric Anaesthesia. Practice guidelines for obstetric anaesthesia: an updated report by the American Society of Anesthesiologists Task Force on Obstetric Anaesthesia. *Anaesthesiology*. 2007;106:843-63
- Carvalho B, George RB, Cobb B, McKenzie C, Riley ET. Implementation of programmed intermittent epidural bolus for the maintenance of labor analgesia. *Anesthesia & Analgesia*. 2016;123(4):965-71.
- Sia AT, Lim Y, Ocampo C. A comparison of a basal infusion with automated mandatory boluses in parturient-controlled epidural analgesia during labor. *Anesthesia & Analgesia*. 2007;104(3):673-8
- Leo S, Ocampo CE, Lim Y, Sia AT. A randomized comparison of automated intermittent mandatory boluses with a basal infusion in combination with patient-controlled epidural analgesia for labor and delivery. *International journal of obstetric anesthesia*. 2010;19(4):357-64.
- McKenzie CP, Cobb B, Riley ET, Carvalho B. Programmed intermittent epidural boluses for maintenance of labor analgesia: an impact study. *International journal of obstetric anesthesia*. 2016;26:32-8.
- Hogan Q. Distribution of solution in the epidural space: examination by cryomicrotome section. *Regional anesthesia and pain medicine*. 2002;27(2):150-6.
- Xu J, Zhou J, Xiao H, Pan S, Liu J, Shang Y, Yao S. A systematic review and meta-analysis comparing programmed intermittent bolus and continuous infusion as the background infusion for parturient-controlled epidural analgesia. *Scientific reports*. 2019;9(1):1-1.
- Wang TT, Sun S, Huang SQ. Effects of epidural labor analgesia with low concentrations of local anesthetics on obstetric outcomes: a systematic review and meta-analysis of randomized controlled trials. *Anesthesia & Analgesia*. 2017;124(5):1571-80.
- Capogna G, Camorcia M, Stirparo S, Farcomeni A. Programmed intermittent epidural bolus versus continuous epidural infusion for labor analgesia: the effects on maternal motor function and labor outcome. A randomized double-blind study in nulliparous women. *Anesthesia & Analgesia*. 2011;113(4):826-31.

14. Wang Z, Shiqin XU, Feng S, Qian R, Shen X. Efficacy of programmed intermittent epidural bolus for labor analgesia in parturients and the effect on neonates. *Chinese Journal of Anesthesiology*. 2016;36(9):1134-7.
15. Fang X, Xie L, Chen X. Clinical efficacy of programmed intermittent epidural bolus and continuous epidural infusion for labor analgesia. *The Journal of Clinical Anaesthesiology*. 2016;32(8):757-60.
16. Kristi LW, Susan A, William EB, James JC, Eric CI, Jay G, Brenda BP, Karen P, Dan LS, Kasper SW. American Academy of Pediatrics Committee on Fetus and Newborn, American College of Obstetricians and Gynecologists Committee on Obstetric Practice. The APGAR Score. *Pediatrics*. 2015;136(4):819-22. doi: 10.1542/peds.2015-2651.