ORIGINAL ARTICLE

Interscapular Pain During Epidural Labour Analgesia and Its Associated Risk Factors

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ABSTRACT

Introduction: Epidural analgesia is a gold standard for the management of labour pain. Despite that, there was a small incidence of interscapular pain, which can be as severe as contraction pain and interfere with patient management. This study's objective was to identify possible risk factors associated with interscapular pain during epidural labour analgesia and its delivery outcome. **Materials and methods:** This study was carried out in the Department of Anaesthesia, Hospital Sultan Ismail, Johor Bharu. A total of 256 parturient who received epidural labour analgesia from January 2017 to December 2019 were recruited. Patients' demographics, epidural technique, local anaesthetic drugs used, and delivery data were recorded. **Results:** : Simple logistic regression analysis showed primigravida, odds ratio 2.66 (95% CI 1.48, 4.76), maternal obesity, odds ratio 7.73 (95% CI 3.99, 14.97), conventional technique during epidural initiation, odds ratio 4.22 (95% CI 2.29, 7.79) and use of patient controlled epidural analgesia (PCEA) machine, odds ratio 3.62 (95% CI 1.06, 12.31) were associated with increased risk of interscapular pain. However, further analysis showed only high volume of local anaesthetic, odds ratio 29.74 (95% CI 5.12, 172.64) was significantly associated with increased risk. Moreover, interscapular pain did not significantly associated with the delivery outcome (P = 0.546). **Conclusion:** A higher volume of local anaesthetic infused epidurally was associated with an increased risk of interscapular pain during epidural labour analgesia. The other risk factors such as primigravida, maternal obesity, conventional epidural, and PCEA machine use showed an association with interscapular pain but did not significantly increase the risk.
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Keywords: Caesarean delivery, Epidural labour analgesia, Interscapular pain, Maternal, Risk factors

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INTRODUCTION

Epidural analgesia for labour is the gold standard for pain management intrapartum as it is associated with better maternal satisfaction, less neonatal depression, and no increased risk of caesarean delivery (1, 2). The current practice of epidural analgesia for labour includes continuous epidural infusion (CEI), patient-controlled epidural analgesia (PCEA), combined spinal-epidural (CSE) analgesia, dura puncture epidural (DPE) technique, and automated mandatory epidural boluses (2). A fifteen-year systemic review by Gizzo et al. (2) concluded that there was no significant difference between different techniques of neuraxial labour analgesia in terms of complications such as hypotension, pruritis, and nausea. Despite the epidural labour analgesia's effectiveness and safety, there were several known complications associated with epidural analgesia technique, such as post dural puncture headache (PDPH), pruritis, hypotension, nausea, vomiting and interscapular pain (3-5). Unexplained interscapular pain was described as cervical, shoulder, upper thoracic, and pain between scapula during labour epidural analgesia (5). Although interscapular pain incidence was low, reported as 0.46%, the severity of the pain can be as severe as contraction pain causing discomfort to the parturient (5). Interscapular pain during epidural labour analgesia was long discussed in the last three decades (6-8). Edwards and Sprigge (7) reported the first case of interscapular pain following epidural boluses in February 1984. Another case report by Campbell (6) in September 1984 was a parturient who developed interscapular pain after two hours on continuous epidural infusion. Recently in 2016, Klumpner et al. (9) reported a case series of interscapular pain during epidural labour analgesia

involving three parturients receiving labour epidural analgesia using PCEA. To date, the aetiology and risk factors of interscapular pain during epidural labour analgesia were not well studied.

Therefore, this study's main objective was to evaluate the risk factors and labour outcome associated with interscapular pain during epidural labour analgesia, specifically looking at the association with patients' factors, epidural labour analgesia technique, and drugs used.

MATERIALS AND METHODS

The study protocol was approved by the Institutional Research & Ethics Committee, Universiti Sains Malaysia (JEPeM-USM) with study protocol code USM/JEPeM/19100563 and the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia with study protocol code NMRR-19-2645-4873 (IIR). This clinical research was done following the ethical principles for medical research involving human subjects in accordance with the Helsinki Declaration 2013.

A case-control study involving 256 parturients with one case to three controls ratio (64 cases and 192 controls) was performed. All participants were obstetric patients who received epidural labour analgesia services at Hospital Sultan Ismail, Johor Bahru within three years period from January 2017 to December 2019.

Sample size estimation was calculated using Power and Sample version 3.1.2 software. The probability of exposure in the control group (P_0) was 0.205 (22). With the power of study 0.8 and an odds ratio (OR) of 2.5, the total number of cases required was 64, including 10% drop out. Three controls were plan for each case, giving the number of controls of 192. The *P-value* to reject the null hypothesis was 0.05.

The parturient list who received epidural labour analgesia from January 2017 to December 2019 was retrieved from Obstetric Analgesia Service (OAS) data recorded in Acute Pain Service (APS) office of Hospital Sultan Ismail, Johor Bahru. In the case group, the parturient developed interscapular pain, which was defined as pain over the shoulder, between scapula blades, upper thoracic or lower cervical following epidural boluses, or during epidural infusion, and the pain subsided after delivery, the treatment involves stopping the epidural infusion or removal of the epidural catheter. Parturient who had pre-existing interscapular pain before receiving epidural labour analgesia (due to fibromyalgia, chronic diabetes mellitus, neuropathy, cervical spondylosis, or other spine pathology) and those who developed interscapular pain during epidural labour analgesia with established diagnosis such as PDPH, acute myocardial infarction, or dissecting aortic aneurysm were excluded from the study. The control group was parturient who received epidural labour analgesia and did not experience any interscapular pain. They were randomly selected using Excel Office software from the OAS data list who did not experience interscapular pain during epidural labour analgesia.

Cases were identified for both the case and control groups, all demographic data, the technique of epidural labour analgesia, types, and volume of local anaesthetic drugs used, duration of epidural labour analgesia services, and mode of delivery were recorded in the data collection form. All the details of the data from cases and controls were retrieved retrospectively from the patient's Power Chart using Hospital Information System (HIS) or patients' Bed Health Ticket (BHT).

Data collected were entered into an electronic database, and statistical analysis was performed using Statistical Package for Social Science (SPSS) software version 26 (Armonk, NY: IBM Corp). All measurement data were analysed for its distribution and homogeneity. Descriptive statistics were used to summarize the socio-demographic characteristics of subjects. Numerical data were presented as mean values with standard deviation (SD) or median value with interquartile range (IQR) based on their normality of distribution. Categorical data were presented as frequency (percentage) with the corresponding 95% confidence intervals (CI). Numerical demographic data were analysed using an independent t-test, while categorical data were analysed using the Chi-square test.

Univariable analysis was first performed using Simple Logistic Regression to determine the association between the independent and dependent variables. Significant results or clinically important variables were then selected for multiple logistic regression. A preliminary main effect model was obtained after comparing the model using forward likelihood ratio selection, backward likelihood ratio elimination, and manual removal. The best model was selected based on three factors which were the best fit, parsimonious, and biological sound. Final independent variables were analysed using Multiple Logistic Regression, at which the data were presented as adjusted OR with their corresponding 95% CI. A *P-value* of less than 0.05 was used to determine the significant association of the risk factors.

RESULTS

A total of 256 parturient records were analysed in this study, with 64 cases and 192 controls. The mean age in the case group was 26.67 (SD = 4.51), while 29.07 (SD = 4.92) in the control group. The majority of the parturient who experienced interscapular pain were primigravida (62.5%). Based on independent *t*-test, there was a significant association between interscapular pain with younger age (*P* = 0.045; 95% CI: -2.77, -0.30), lower

parity (*P* = 0.028, 95% CI: -0.66, -0.04), higher weight (*P* = < 0.001; 95% CI: 7.81, 16.32), higher BMI (*P* = < 0.001; 95% CI: 3.54, 6.69) , longer duration of epidural infusion (*P* = 0.001; 95% CI: 0.68, 2.74) and higher volume of local anaesthetic drugs infused epidurally (*P* = < 0.001; 95% CI: 56.41, 76.11). (Table I)

Table I: Patient demographics (*n* = 256)

Variable	ISP		Mean difference (95% CI)	t-statistic (df)	P-value[a]
	Yes (n = 64) Mean (SD)	No (n = 192) Mean (SD)			
Age (years)	27.7 (4.51)	29.1 (4.92)	-1.4 (-2.77, -0.30)	-2.01 (245)	0.045
Parity	1.7 (0.93)	2.1 (1.14)	-0.3 (-0.66, -0.04)	-2.21 (254)	0.028
Gestation (weeks)	38.9 (1.39)	38.6 (1.44)	0.3 (-0.08, 0.74)	1.59 (254)	0.113
Weight (kg)	72.2 (15.78)	60.2 (11.47)	12.1 (7.81, 16.32)	5.64 (86.2)	< 0.001
Height (cm)	155.1 (5.72)	154.98 (4.47)	0.06 (-1.49, 1.62)	0.81 (90.1)	0.936
BMI (kg/m^2)	30.0 (5.84)	24.9 (4.24)	5.1 (3.54, 6.69)	6.46 (86.2)	< 0.001
Cervix dilatation at initiation of epidural (cm)	3.2 (0.67)	3.4 (0.81)	-0.15 (-0.35, 0.05)	-1.45 (128.4)	0.149
Duration of epidural infusion (hours)	9.4 (3.26)	7.7 (3.72)	1.7 (0.68, 2.74)	3.28 (254)	0.001
Volume of epidural infused (ml)	148.2 (36.21)	81.9 (34.14)	66.3 (56.41, 76.11)	13.24 (254)	< 0.001

Note: BMI = body mass index; ISP = interscapular pain; [a]Independent t-test

There was no significant association between interscapular pain with gestational age, height, parturient cervix dilatation during initiation of epidural analgesia, and type of local anaesthetic used for epidural infusion. The epidural space identifications technique was not analysed as all parturient in both cases, and control groups were using the LORS technique.

Using a Simple Logistic Regression analysis, primigravida, maternal obesity with BMI more than 30 kg/m^2, longer length of epidural catheter in epidural space, conventional epidural during epidural initiation, epidural maintenance with PCEA machine, longer duration of epidural infusion, and higher volume of local anaesthetic infused epidurally were significantly associated with increased risk of interscapular pain during epidural labour analgesia (Table II, Table III, Table IV). A preliminary main effect model was obtained after comparing the model using the manual, forward likelihood ratio, and backward likelihood ratio method. A *P-value* of less than 0.25 was used for variable selection. Variable that did not have a significant *P-value* was removed, and the remaining variables were tested for multicollinearity and interactions. The preliminary main effect model showed interscapular pain during epidural labour analgesia was significantly associated with maternal obesity (*P* = < 0.001), higher volume of local anaesthetic infused epidurally (*P* = < 0.001), and longer duration of epidural infusion (*P* = < 0.001).

Table II: Patient factors and association with interscapular pain during epidural labour analgesia (*n* = 256)

Variable		ISP		Crude b	Crude OR (95% CI)	P-value[b]
		Yes (n = 64) n (%)	No (n = 192) n (%)			
Age (years)[a]		27.7 (4.51)	29.1 (4.92)	-0.06	0.94 (0.88, 0.99)	0.047
Parity	Multipara[c]	24 (16.9)	118 (83.1)	0	1	-
	Primigravida	40 (35.1)	74 (64.9)	0.98	2.66 (1.48, 4.76)	0.001
BMI (kg/m^2)	BMI < 30[c]	32 (15.8)	170 (84.2)	0	1	-
	BMI ≥ 30	32 (59.3)	22 (40.7)	2.05	7.73 (3.99, 14.97)	< 0.001
Cervix dilatation during epidural initiation (cm)	Os > 3cm[c]	21 (20.6)	81 (79.4)	0	1	-
	Os ≤ 3cm	43 (27.9)	111 (72.1)	0.402	1.49 (0.82, 2.71)	0.186

Note: BMI = body mass index; ISP = interscapular pain; OR = odds ratio; [a]Mean (SD); [b]Simple logistic regression; [c]the reference category

Table III: Technique of epidural and association with interscapular pain during epidural labour analgesia (n = 256)

Variable		ISP		Crude b	Crude OR (95% CI)	P-value[b]
		Yes (n = 64) n (%)	No (n = 192) n (%)			
Length of catheter in epidural space (cm)[a]		4.81 (0.47)	4.56 (0.50)	1.08	2.95 (1.55, 5.62)	0.001
Epidural initiation technique	CSE[c]	19 (13.4)	123 (86.6)	0	1	-
	Conventional epidural	45 (39.5)	69 (60.5)	1.44	4.22 (2.29, 7.79)	< 0.001
Epidural maintenance	CEI[c]	3 (9.4)	29 (90.6)	0	1	-
	PCEA	61 (27.2)	163 (72.8)	1.29	3.62 (1.06, 12.31)	0.04

Note: CSE = combined spinal epidural; CEI = continuous epidural infusion; PCEA = patient controlled epidural analgesia; ISP = interscapular pain; OR = odd ratio; [a]Mean (SD); [b]Simple logistic regression; [c]the reference category

Table IV: Local anaesthetic drugs and association with ISP

Variable		ISP		Crude b	Crude OR (95% CI)	P-value[b]
		Yes (n = 64) n (%)	No (n = 192) n (%)			
Drugs	Ropivacaine 0.05% + Fentanyl 2mcg/ml[c]	42 (30.0)	98 (70.0)	0	1	-
	Bupivacaine 0.05% + Fentanyl 2mcg/ml	15 (22.7)	51 (77.3)	-0.38	0.69 (0.35, 1.35)	0.278
	Bupivacaine 0.1% + Fentanyl 2mcg/ml	4 (14.8)	23 (85.2)	-0.90	0.41 (0.13, 1.25)	0.115
	Levobupivacaine 0.05% + Fentanyl 2 mcg/ml	3 (27.3)	8 (72.7)	-0.13	0.88 (0.22, 3.46)	0.849
Volume of LA infused (per 10ml)[a]		14.8 (3.62)	8.2 (3.41)	0.53	1.69 (1.47, 1.95)	< 0.001
Duration of LA infused (Hours)[a]		9.4 (3.26)	7.7 (3.72)	0.13	1.14 (1.05, 1.23)	0.002

Note: LA = local anaesthetic drugs; ISP = interscapular pain; OR = odds ratio; [a]Mean (SD); [b]Simple logistic regression; [c]the reference category

Thus, additional analysis with Multiple Logistic Regression was done for maternal obesity, the volume of local anaesthetic infused epidurally, and epidural infusion duration. The results showed that only a high volume of local anaesthetic infused epidurally was significantly associated with an increased risk of interscapular pain (P = < 0.001). While the longer duration of epidural infusion showed a significant reduction in the risk of interscapular pain, and maternal obesity did not show any statistically significant association with interscapular pain (P = 0.076) (Table V).

Table V: Associated factors of interscapular pain during epidural labour analgesia (n = 256)

Variable		b	Adjusted OR	95% CI	*P-value*[a]
BMI (kg/m^2)	BMI ≥ 30 vs BMI < 30[b]	2.66	14.22	0.76, 266.89	0.076
Volume of LA infused (per 10ml)		3.39	29.74	5.12, 172.64	< 0.001
Duration of LA infused (hours)		-2.54	0.079	0.02, 0.28	<0.001

Note: BMI = body mass index; LA = local anaesthetic drugs; OR = odds ratio; [a]Multiple logistic regression; [b]the reference category

A Chi-square analysis was done to determine the association between interscapular pain and delivery outcome. Among parturients who delivered via cesaerian delivery, 28.4% experienced interscapular pain during epidural labour analgesia, while 71.6% did not experience interscapular pain. Besides, in cases group (parturients with interscapular pain), 45% delivered via SVD, while 42% delivered via caesarean section. Thus, analysis with Chi-square test showed interscapular pain did not significantly associated with the delivery outcome (P = 0.546). (Table VI)

Table VI: Association between interscapular pain and delivery outcome

Variable		ISP		n	X^2-statistic[a] (df)	*P-value*[a]
		Yes (n = 64) n (%)	No (n = 192) n (%)			
Delivery	SVD	29 (22.1)	102 (77.9)	131	1.21 (2)	0.546
	Instrumental	8 (26.7)	22 (73.3)	30		
	LSCS	27 (28.4)	68 (71.6)	95		

Note: SVD = spontaneous vaginal delivery; LSCS = lower segment caesarean section; ISP =

DISCUSSION

As a gold standard of pain management during labour, epidural analgesia is effective and safe for both mother and fetus. Cochrane Database of Systemic Review in 2018 showed that epidural labour analgesia did not increase the risk of caesarean delivery, long-term backache or compromise neonatal status based on the APGAR score and neonatal intensive care unit admission (10). Despite epidural labour analgesia's effectiveness and safety, interscapular pain was reported and discussed for decades (6-8). It is a rare complication that may be difficult to manage, yet not much study being conducted to investigate its possible underlying aetiologies and risk factors.

All the risk factors are likely to be related to patients' anatomical and physiological factors. Pregnancy and obesity are known to be associated with an increases intra-abdominal pressure and causes compression of the inferior vena cava, which leads to the engorgement of the epidural venous plexus and increases the pressure of the epidural space. A higher block level was also observed in obese parturients for a similar dose and volume of local anaesthetic in non-obese parturients (11). Thus, maternal obesity was hypothesised to be associated with interscapular pain during epidural labour analgesia due to lower epidural volume and higher epidural space pressure.

However, in our study, even though initial analysis with Simple Logistic Regression showed maternal obesity with BMI of more than 30 kg/m^2 was significantly associated with increased risk of interscapular pain during epidural labour analgesia but further analysis with Multiple Logistic Regression showed maternal obesity did not increase the risk of interscapular pain as compared with non-obese parturient. Our finding was contradicted with a previous study by Ferrer et al. (12), in which he concluded that higher maternal weight was one of the risk factors to develop interscapular pain (P = 0.0001). However, they did not define weight as body mass index (BMI), which was clinically more relevant, and the concentration of local anaesthetics used were higher than the concentration used in standard

clinical practice guideline by the Malaysian Ministry of Health. They also only utilized an independent t-test to determine the association between possible risk factors of interscapular pain. They did not further analyse their data using multivariate analysis; thus, possible confounding factors were not excluded in their analysis. In our study, it was demonstrated that maternal obesity could be an associated risk factor on its own but did not increase the risk of developing interscapular pain when adjusted with other factors such as local anaesthetic volume infused and duration of epidural infusion (Table V).

A higher volume of local anaesthetic infused into the epidural space was found to be associated with interscapular pain during epidural labour analgesia in our study. Our finding was consistent with the previous case-control study by Ferrer et al. (12). They found that parturients who experienced interscapular pain during epidural labour analgesia had a higher volume of local anaesthetic being infused epidurally ($\mu = 183$; $P = 0.004$). The high volume of local anaesthetic infused into the epidural space led to an increase in epidural space pressure, which theoretically may cause thoracic nerve compression and radiculopathy manifested as interscapular pain (8, 13). In 1993, Shah JL. (14) observed that parturients experiencing severe interscapular pain exhibited elevated epidural space pressure, surpassing 24 cmH2O. Notably, those who developed interscapular pain had received a greater volume of epidurally infused saline at a rate of 1 L per 24 hours. The pain alleviated within one hour of reducing the infusion rate to 600 ml per 24 hours. Another study by Higuchi et al. (15) showed that the distribution of saline injected into epidural space in term pregnant women were confined to the posterior epidural space and did not sip through the intervertebral foramina as compared with non-pregnant women due to engorged lateral epidural venous plexus. This showed that limited horizontal distribution of local anaesthetic in epidural space among parturients caused a reduction in the epidural space compliance. Therefore, we concluded that a higher volume of local anaesthetic drugs infused leads to a higher epidural pressure, thus increased the risk of interscapular pain during epidural labour analgesia due to nerve root compression.

Longer duration of local anaesthetic infused epidurally was hypothesised to be associated with an increased risk of interscapular pain during epidural labour analgesia due to the higher volume of local anaesthetic drugs being infused. Our study's initial analysis showed longer duration of epidural infusion was associated with an increased risk of interscapular pain. Interestingly, further analysis with Multiple Logistic Regression showed a longer duration of epidural infusion was associated with significant protective risk against interscapular pain during epidural labour analgesia. This is due to the complex pharmacokinetics of the local anaesthetic drugs. It is shown that local anaesthetic drugs which was administered epidurally will be distributed non-uniformly into the epidural space horizontally and longitudinally, followed by absorption into many channels between nerves, fat lobules, posterior ligament fascia, dura, and intervertebral lamina where the nerve roots exit (15-17).

Therefore, we concluded that when the local anaesthetic drugs were infused at a low steady rate of infusion, the volume will remain constant in the epidural space due to absorption of the local anaesthetic drugs to various site giving its analgesic or anaesthetic properties. This probably gave a protective risk against interscapular pain during epidural labour analgesia when a certain local anaesthetic volume was infused over a longer period rather than a high volume was given as a single bolus. As reported by Klumpner et al. (9), one of the parturients experienced intense interscapular pain after an epidural bolus of 20 mls lignocaine 2% with adrenaline 1:200 000 during caesarean delivery but was uneventful during epidural maintenance throughout her labour.

The interplay of patient factors, individual variations, epidural space compliance during pregnancy, the size of epidural boluses and infusions, and the duration of epidural infusion may collectively influence the occurrence of interscapular pain during epidural labor. In our study, being a primigravida, having maternal obesity, opting for conventional epidural during initiation, maintaining with a PCEA machine, undergoing a lengthier duration of epidural infusion, and receiving a higher volume of epidurally infused local anesthetic may individually pose potential risk factors. However, when collectively analyzed, only a high volume of epidurally infused local anesthetic showed an elevated risk of interscapular pain, while a longer duration was associated with a protective effect.

There were several limitations to our study. Firstly, the data was taken from a single centre and not all parturients were offered epidural labour analgesia. The services were only offered to those with high-risk pregnancies such as heart disease in pregnancy, pre-eclampsia, and those with anticipated long hours of labour such as primigravida. Therefore, as observed in the result, majority of the parturient was primigravida, giving the possibility of increased risk of interscapular pain among primigravida compared to multipara. Thus, a larger sample size from the various centre with homogeneity in terms of parity should be obtained.

There are several limitations to our study. Firstly, the data was taken from a single centre and not all parturients were offered epidural labour analgesia because the services were only offered to those with high-risk pregnancies such as heart disease in pregnancy, pre-eclampsia, and those with anticipated long hours of labour such as primigravida. Consequently, as

evident in the results, the majority of parturients were primigravida, potentially leading to an increased risk of interscapular pain among primigravida compared to multipara. Hence, obtaining a larger sample size from various centers with homogeneity in terms of parity is recommended.

Another limitation of our study is the inability to analyze the loss of resistance (LOR) technique during epidural space identification, as all parturients in both the case and control groups received epidurals using the LOR to saline technique. The anesthetists at our center were more accustomed to the LOR to saline technique rather than using the LOR to air technique. Therefore, we were unable to determine whether the use of air during epidural space identification was associated with an increased risk of interscapular pain during epidural labor analgesia. This is noteworthy, given that Rajanna (8), in her case report, postulated that the presence of air in the epidural space was a contributing factor to unexplained interscapular pain during epidural labor analgesia. Hence, conducting a prospective randomized controlled trial that compares various epidural techniques would be valuable in the future. This could help identify potential risk factors and elucidate the etiologies associated with interscapular pain.

CONCLUSION

A higher volume of local anaesthetic infused epidurally was associated with an increased risk of interscapular pain during epidural labour analgesia. Nevertheless, the other postulated risk factors such as primigravida, maternal obesity, conventional epidural during epidural initiation, and use of PCEA machine for epidural maintenance did show an association with interscapular pain but did not significantly increase the risk. A lower epidural infusion rate could be beneficial to prevent interscapular pain during epidural labour analgesia among primigravida and those with higher BMI. However, further study needs to be done to identify the optimal rate of epidural infusion, ensuring optimum analgesia, simultaneously preventing interscapular pain among those at risk.

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