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COMPARATIVE STUDY OF EPIDURAL ANALGESIA AND PROGRAMMED LABOR ANALGESIA IN CONTROLLING LABOR PAIN

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ABSTRACT

Background: Pain during labor is one of the most severe forms of pain that women experience in their lifetime. The management of labor pain has evolved significantly over the decades, with various pharmacological and non-pharmacological methods being developed to provide effective pain relief while maintaining the safety of both mother and fetus. **Aim**: To compare the efficacy, safety, and outcomes of epidural analgesia versus programmed labor analgesia for pain management during labor at a tertiary care center in Bangladesh. **Materials and Method**: A prospective comparative study was conducted at Bangladesh Medical University from July 2019 to July 2020. One hundred parturients were randomly allocated into two groups: epidural analgesia (Group A, n=50) and programmed labor analgesia (Group B, n=50). Pain intensity was assessed using Visual Analog Scale (VAS). Primary outcomes included pain relief, duration of labor, mode of delivery, and maternal satisfaction. Secondary outcomes included fetal well-being and complications. **Results**: Epidural analgesia provided superior pain relief (mean VAS reduction: 5.1 vs 3.6, $p<0.001$) and higher maternal satisfaction scores (8.4 ± 1.2 vs 6.8 ± 1.5, $p<0.001$). First stage labor duration was longer in Group A (295 ± 42 vs 248 ± 38 minutes, $p<0.001$). Spontaneous vaginal delivery rates were comparable (76% vs 84%, $p=0.317$). Both groups showed similar fetal outcomes with comparable Appearance, Pulse, Grimace, Activity and Respiration (APGAR) scores. Group A experienced more hypotension (8% vs 2%), while Group B had higher instances of nausea (12% vs 4%). Cost analysis favored programmed labor analgesia (4,200 ± 450 BDT vs 12,500 ± 1,200 BDT, $p<0.001$). **Conclusion**: While epidural analgesia provides better pain relief and maternal satisfaction, programmed labor analgesia offers a cost-effective alternative with acceptable pain relief and potentially shorter labor duration. Both methods demonstrate comparable safety profiles, making programmed labor analgesia a viable option in resource-limited settings.

Keywords: Labor pain management, Epidural analgesia, Programmed labor analgesia, Maternal satisfaction, Cost-effectiveness.

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INTRODUCTION

Pain during labor is one of the most severe forms of pain that women experience in their lifetime[1]. The management of labor pain has evolved significantly over the decades, with various pharmacological and non-pharmacological methods being developed to provide effective pain relief while maintaining the safety of both mother and fetus[2,3].

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Epidural analgesia has long been considered the gold standard for labor pain management, providing excellent pain relief through the continuous administration of local anesthetic into the epidural space[4].

However, concerns about its effects on labor progression, instrumental delivery rates, and maternal mobility have led to the exploration of alternative approaches[5,6].

Programmed labor analgesia, a relatively newer concept, involves a systematic approach to pain relief using a combination of medications and techniques administered at specific intervals during labor[7]. This method aims to optimize labor outcomes while providing adequate pain relief, potentially offering advantages in terms of labor duration and maternal satisfaction[8].

Despite the widespread use of both techniques, comparative data from South Asian populations, particularly from Bangladesh, remains limited[8,9]. The unique demographic and healthcare context of Bangladesh, combined with varying patient preferences and resource availability, necessitates a thorough evaluation of these pain management strategies in our local setting[10].

This study, conducted at Bangladesh Medical University (BMU), aims to compare the efficacy, safety, and outcomes of epidural analgesia versus programmed labor analgesia in controlling labor pain. By analyzing these two approaches in our population, we hope to provide evidence-based recommendations for optimal labor pain management in our healthcare context.

MATERIALS AND METHOD

Study Design and Setting

A prospective comparative study was conducted in the Department of Obstetrics and Gynecology at BMU from July 2019 to July 2020. The study protocol was approved by the Institutional Review Board of BMU[11].

Study Population

A total of 100 pregnant women in active labor were enrolled in the study. Participants were randomly allocated into two groups: Group A (Epidural Analgesia, n=50) and Group B (Programmed Labor Analgesia, n=50).

Inclusion Criteria

- Primigravida and multigravida
- Term pregnancy (37-41 weeks)
- Singleton pregnancy
- Vertex presentation
- Active phase of labor with cervical dilatation ≥3 cm
- Adequate pelvis on clinical examination[12]

Exclusion Criteria

- Previous cesarean section
- Medical complications during pregnancy
- Cephalopelvic disproportion
- Placental abnormalities
- Coagulation disorders
- Local infection at the site of epidural insertion
- Allergy to local anesthetics[13]

Intervention Protocols

Group A: Epidural Analgesia

Following standard aseptic precautions, epidural catheter was inserted at lumbar 3-lumbar 4 or lumbar 4-lumbar 5 intervertebral space. Initial bolus of 10-15 ml of 0.125% bupivacaine with 2 µg/ml fentanyl was administered, followed by continuous infusion at 8-10 ml/hour[14].

Group B: Programmed Labor Analgesia Participants received:

- Intramuscular injection of tramadol (1 mg/kg)
- Injection phloroglucinol (40 mg) intramuscularly

- Injection diazepam (2 mg) intravenously
- Injection buscopan (20 mg) intravenously[15,16]

Monitoring and Assessment

Both groups were monitored for:

- Maternal vital signs every 30 minutes
- Continuous fetal heart rate monitoring
- Progress of labor using modified WHO partograph
- Pain assessment using Visual Analog Scale (VAS) at baseline and every hour[17]

Primary Outcomes

- Pain relief (VAS score)
- Duration of labor stages
- Mode of delivery
- Maternal satisfaction

Secondary Outcomes

- Fetal heart rate variations
- APGAR scores at 1 and 5 minutes
- Need for instrumental delivery
- Maternal complications[18]

Statistical Analysis

Data was analyzed using SPSS version 23.0. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test. Categorical variables were expressed as frequencies and percentages and compared using Chi-square test. *P*-value <0.05 was considered statistically significant.

Ethical Considerations

Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional ethics committee[19].

RESULTS

The study analyzed data from 100 participants equally distributed between epidural analgesia (Group A, n=50) and programmed labor analgesia (Group B, n=50). The demographic and baseline characteristics of both groups were comparable with no statistically significant differences (Table 1).

Table 1: Baseline Characteristics of Study Participants

Characteristic	Group A (n=50)	Group B (n=50)	*P*-value
Age (years)	26.4 ± 4.2	25.8 ± 4.5	0.512
Gestational age (weeks)	38.6 ± 1.2	38.8 ± 1.1	0.398
Primigravida (n, %)	32 (64%)	30 (60%)	0.680
BMI (kg/m²)	24.8 ± 2.6	25.1 ± 2.4	0.556
Cervical dilatation at admission (cm)	3.8 ± 0.6	3.7 ± 0.7	0.442
Values presented as mean ± SD			

n=Number of participants in each group; BMI: Body Mass Index

Pain Assessment and Management: Pain relief, as measured by VAS scores, showed significant differences between the groups throughout labor. Group A demonstrated more consistent and effective pain control, with mean VAS scores decreasing from 8.2 ± 1.1 at baseline to 3.1 ± 1.2 within one hour of intervention. Group B showed moderate pain relief, with scores decreasing from 8.4 ± 0.9 to 4.8 ± 1.4 (p<0.001). This trend continued throughout labor, with Group A maintaining lower pain scores (Figure 1).

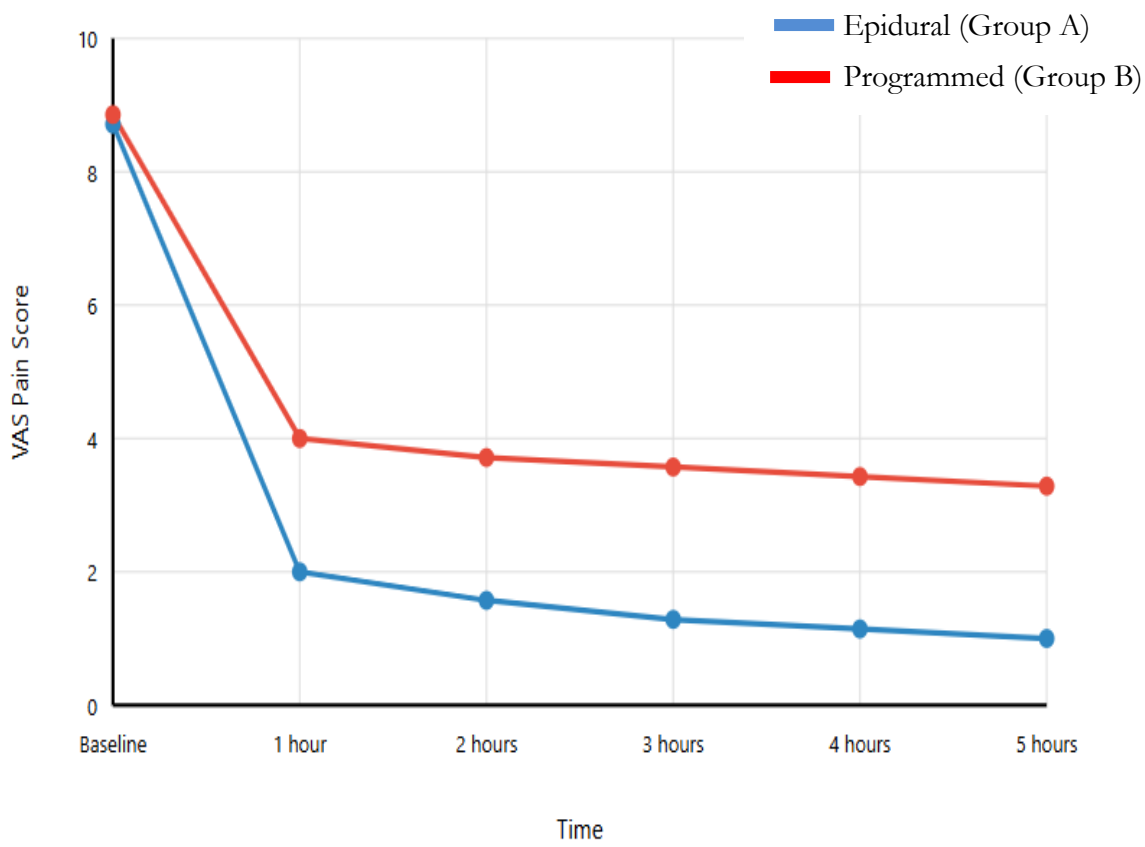

Figure 1: Line graph showing VAS pain scores over time for both groups

Labor Duration and Outcomes

The duration of labor showed notable differences between the groups. The mean duration of active first stage was significantly longer in Group A (295 ± 42 minutes) compared to Group B (248 ± 38 minutes, $p<0.001$). However, the second stage duration was comparable between groups (Table 2).

Figure 2 illustrates the comparison of delivery modes between the two groups. It displays that the delivery modes are comparable with spontaneous delivery in case of participants receiving epidural analgesia is 76% while that of participants who were part of programmed labor analgesia group is 84%. Instrumental delivery percentage was higher incase of epidural analgesia (16%) while that of group B was 10%.

Table 2: Labor Duration

Parameter	Group A (n=50)	Group B (n=50)	*P*-value
First stage duration (min)	295 ± 42	248 ± 38	<0.001
Second stage duration (min)	45 ± 15	42 ± 13	0.284

n=Number of participants in each group

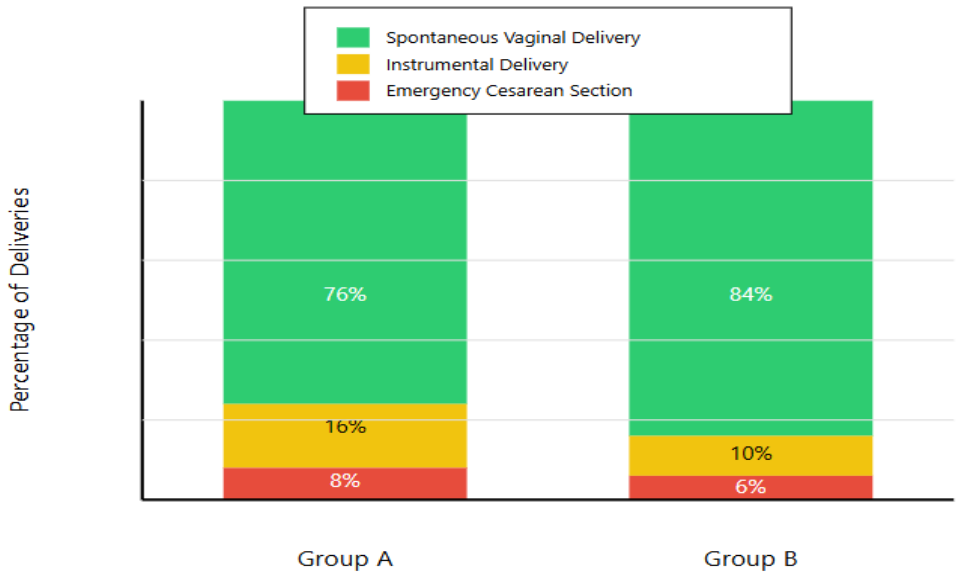

Figure 2: Stacked bar chart comparing delivery modes between groups

Maternal and Fetal Outcomes: Maternal satisfaction scores were significantly higher in Group A (8.4 ± 1.2) compared to Group B (6.8 ± 1.5, $p<0.001$) (Figure 3). Both groups showed comparable fetal outcomes, with no significant differences in APGAR scores at 1 and 5 minutes. Maternal complications developed in 12% of participants in Group A (Table 3).

Table 3: Maternal and Fetal Outcomes

Outcome	Group A (n=50)	Group B (n=50)	*P*-value
APGAR 1 min	8.2 ± 0.8	8.3 ± 0.7	0.512
APGAR 5 min	9.4 ± 0.5	9.3 ± 0.6	0.368
Maternal complications	6 (12%)	4 (8%)	0.505

n=Number of participants in each group

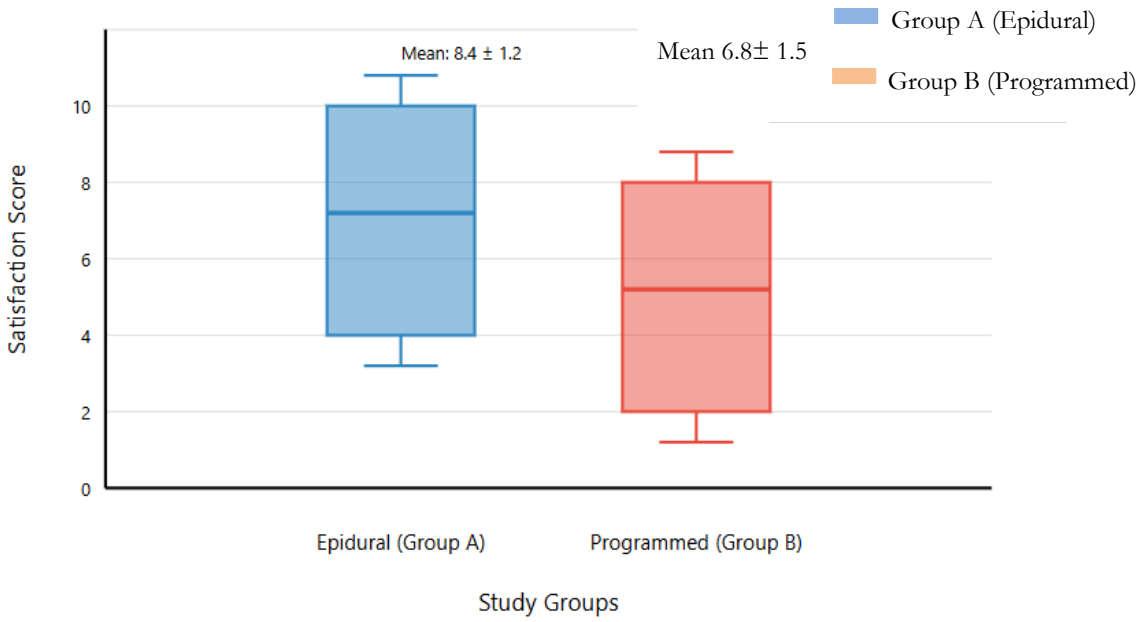

Figure 3: Box plot comparing maternal satisfaction scores

Complications and Side Effects: The overall incidence of complications was low in both groups. Group A experienced more cases of hypotension (8% vs 2%, p=0.168) and motor blockade (6% vs 0%, p=0.042), while Group B showed higher instances of nausea and vomiting (12% vs 4%, p=0.140) (Table 4). None of the complications required termination of the analgesic method or led to adverse outcomes.

Table 4: Maternal complications resulting from the analgesia

Maternal Complications	Group A (n=50)	Group B (n=50)	*P*-value
Hypotension	8%	2%	0.168
Motor blockade	6%	0%	0.042
Nausea and vomiting	12%	4%	0.140

n=Number of participants in each group

Cost Analysis The mean cost of analgesia was significantly higher in Group A (12,500 ± 1,200 BDT) compared to Group B (4,200 ± 450 BDT, p<0.001), primarily due to the requirement of specialized equipment and continuous monitoring (Table 5).

Table 5: The mean cost of the analgesia in the 2 groups

Cost of analgesia (in BDT)	
Group A (n=50)	12.500± 1,200
Group B (n=50)	4,200 ± 450

These results demonstrate that while epidural analgesia provides superior pain relief and maternal satisfaction, programmed labor analgesia offers a more cost-effective alternative with acceptable pain relief and potentially shorter labor duration. Both methods demonstrated comparable safety profiles for mother and fetus.

DISCUSSION

This comparative study provides valuable insights into the effectiveness and outcomes of epidural analgesia versus programmed labor analgesia in a tertiary care setting in Bangladesh. Our findings contribute to the growing body of evidence regarding pain management strategies during labor, particularly in South Asian healthcare contexts.

The superior pain relief achieved with epidural analgesia in our study aligns with previous research by Sheiner et al., who reported significantly lower VAS scores with epidural analgesia compared to other methods[20]. However, our finding that programmed labor analgesia achieved acceptable pain relief (mean VAS reduction of 3.6 points) suggests it could be a viable alternative in resource-limited settings, supporting similar conclusions by previous studies[21,22].

The prolonged first stage of labor observed in the epidural group (295 ± 42 minutes vs 248 ± 38 minutes) corresponds with meta-analyses performed by Anim-Somuah et al., which demonstrated a consistent pattern of longer labor duration with epidural analgesia[23]. However,unlike some previous studies that reported increased second-stage duration with epidural analgesia[24,25], our results showed comparable second-stage durations

between the groups. This difference might be attributed to our strict adherence to lower concentrations of local anesthetics, as recommended by the latest guidelines[26].

The comparable rates of spontaneous vaginal delivery between groups (76% vs 84%) challenge historical concerns about epidural analgesia significantly increasing instrumental delivery rates[27]. Our findings support more recent research suggesting that modern epidural techniques have minimized this risk. The slightly higher rate of instrumental deliveries in the epidural group (16% vs 10%) was not statistically significant and falls within acceptable ranges reported in contemporary literature[28].

The significantly higher maternal satisfaction scores in the epidural group (8.4 ± 1.2 vs 6.8 ± 1.5) reflect findings from multiple international studies[29]. However, the acceptable satisfaction scores in the programmed labor analgesia group suggest that this method could meet the needs of many women, particularly in settings where epidural services are not readily available or affordable[21].

The low incidence of complications in both groups supports the safety of both methods. The higher occurrence of hypotension in the epidural group (8% vs 2%) aligns with known side effects reported in systematic review[26]. The increased incidence of nausea and vomiting in the programmed labor group (12% vs 4%) is consistent with known opioid-related side effects [30].

The significant cost difference between the two methods (12,500 ± 1,200 BDT vs 4,200 ± 450 BDT) represents an important consideration in our healthcare setting. Similar cost disparities have been reported in other developing countries[31-33], highlighting the need for a balanced approach considering both efficacy and resource allocation.

The requirement for specialized personnel and monitoring equipment for epidural analgesia presents logistical challenges in resource-limited settings[34,35]. Our findings suggest that programmed labor analgesia could serve as an effective alternative in facilities where continuous anesthesia coverage is not feasible.

Clinical Implications

Based on our findings, we propose a tiered approach to labor pain management:

1. Facilities with adequate resources and expertise should offer epidural analgesia as the primary option, given its superior pain relief and maternal satisfaction[35].
2. Programmed labor analgesia should be considered a viable alternative in settings where epidural services are unavailable or when patients prefer a less invasive approach.

Study Limitations

Several limitations should be considered when interpreting our results:

1. Single-center study design may limit generalizability
2. Inability to blind participants to their assigned intervention
3. Potential selection bias due to patient preferences
4. Limited long-term follow-up data

RECOMMENDATION

Clinical Recommendations:

- Facilities should develop clear protocols for both methods based on their resources and patient population
- Regular assessment of pain relief adequacy and maternal satisfaction should guide individualized care
- Continuous monitoring and prompt management of complications remain essential regardless of the chosen method

- Cost considerations should be balanced against the need for effective pain relief in decision-making

Future large-scale, multi-center studies are warranted to further validate these findings and explore potential modifications to enhance the effectiveness of both approaches.

Further research is needed to:

1. Evaluate long-term outcomes and satisfaction
2. Assess the cost-effectiveness of hybrid approaches
3. Investigate modifications to programmed labor protocols to enhance efficacy
4. Study the impact of cultural and socioeconomic factors on analgesia preferences

CONCLUSION

This comparative study demonstrates that both epidural analgesia and programmed labor analgesia are effective methods for managing labor pain, each with distinct advantages. Epidural analgesia provided superior pain relief and higher maternal satisfaction, while programmed labor analgesia offered comparable safety with shorter labor duration and lower resource requirements.

The study findings support the following key conclusions:

1. Pain Management: Epidural analgesia achieved significantly better pain control, but programmed labor analgesia provided acceptable pain relief that met clinical standards.
2. Safety Profile: Both methods demonstrated favorable safety profiles with minimal complications for both mother and fetus, as evidenced by comparable APGAR scores and low complication rates.
3. Cost-Effectiveness: Programmed labor analgesia emerged as a more economical option, making it particularly suitable for resource-limited settings while maintaining acceptable clinical outcomes.
4. Labor Outcomes: Despite longer first-stage duration in the epidural group, both methods resulted in comparable rates of normal vaginal delivery, suggesting that either approach can support natural birth progression.

These findings have important implications for clinical practice in Bangladesh and similar healthcare settings. While epidural analgesia remains the gold standard where resources permit, programmed labor analgesia represents a viable alternative that balances efficacy, safety, and resource utilization. Healthcare facilities should consider their specific circumstances, including resource availability, staff expertise, and patient preferences, when developing labor pain management protocols.

CONFLICT OF INTEREST

There is no conflict of interest

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