

# INTRAPARTUM EPIDURAL CATHETER DISPLACEMENT: COMPARISON OF THREE DRESSING METHODS.

## MIGRACIÓN DE CATÉTER EPIDURAL INTRAPARTO: COMPARACIÓN DE TRES MÉTODOS DE FIJACIÓN

## MIGRAÇÃO DO CATETER PERIDURAL INTRAPARTO: COMPARAÇÃO DE TRÊS MÉTODOS DE FIXAÇÃO

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### Key concepts:

- The method of epidural catheter fixation affects the rate of epidural failure in labor.
- The use of Tegaderm™ as an epidural catheter fixation method in labor is not recommended.
- The addition of a pad to fix the epidural catheter limits catheter migration during labor.

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### Resumen:

**Objetivo:** Comparar el efecto de tres diferentes tipos de fijación sobre la migración del catéter epidural durante el trabajo de parto.

**Introducción:** El fallo del bloqueo epidural en el trabajo de parto se debe a múltiples factores incluyendo la migración de catéter. La migración de catéter epidural se ha relacionado con el índice de masa corporal y la posición, así como con movimientos del paciente. La técnica de fijación también afecta la migración de catéter y el riesgo de bloqueo epidural fallido.

**Métodos:** Las pacientes fueron aleatorizadas y asignadas a uno de tres grupos según el tipo de fijación: Tegaderm™ (Grupo T), Tegaderm™ con almohadilla adhesiva (Grupo P) y Tegaderm™ con Steri-Strip™ (Grupo S). Las variables evaluadas incluyeron paridad, edad gestacional, índice de masa corporal (IMC), nivel de punción y distancia de migración del catéter epidural.

**Resultados:** Se detectó una diferencia en la distancia de migración de catéter epidural entre los diferentes grupos ( $p < 0.05$ ). La comparación reveló diferencia únicamente entre los grupos P y T ( $0.76 \pm 1.35$  vs.  $-0.14 \pm 1.03$ ,  $p < 0.01$ ).

**Conclusión:** Tegaderm™ como método de fijación de catéter epidural en el trabajo de parto resultó ser inferior al Tegaderm™ con almohadilla adhesiva o con Steri-Strip™ en términos de migración de catéter. No existe una asociación entre migración de catéter epidural e IMC.

**Palabras clave:** anestesia epidural; anestesia obstétrica; trabajo de parto.

### Abstract

**Aim:** To compare the effect on epidural catheter migration of three different types of dressing used in labor.

**Introduction:** Failure of labor epidural is due to multiple factors including catheter migration. Epidural catheter migration has been showed to be related to body mass index and patient position. The dressing technique also influences catheter migration and the risk of epidural failure.

**Methods:** Patients were randomly allocated to one of three groups based on type of dressing of labor epidural: Tegaderm™ (Group T), Tegaderm™ with sticky pad (Group P), and Tegaderm™ with Steri-Strip™ (Group S). Measured variables included parity, gestational age, body mass index (BMI), level of puncture and distance of epidural catheter migration.

**Results:** There was an overall difference in epidural catheter migration (ECM) distance among different groups ( $p < 0.05$ ). Pairwise comparison revealed only a significant difference between groups P and T ( $0.76 \pm 1.35$  vs.  $-0.14 \pm 1.03$ ,  $p < 0.01$ ).

**Conclusion:** Taping the lumbar epidural catheter used for labor analgesia with Tegaderm™ is inferior to Tegaderm™ with sticky pad or with Steri-Strip™ in terms of catheter migration. There is no association of catheter migration and BMI.

**Keywords:** epidural anesthesia; obstetric anesthesia; labor.

### Resumo:

**Objetivo:** Comparar o efeito de três tipos diferentes de fixação na migração do cateter peridural durante o trabalho de parto.

**Introdução:** A falha do bloqueio epidural no parto deve-se a múltiplos fatores, incluindo a migração do cateter. A migração do cateter epidural tem sido associada ao índice e posição da massa corporal, bem como aos movimentos dos pacientes. A técnica de fixação também afeta a migração do cateter e o risco de falha no bloqueio peridural.

**Métodos:** Os pacientes foram randomizados e distribuídos em um dos três grupos de acordo com o tipo de fixação: Tegaderm™ (Grupo T), Tegaderm™ com almofada adesiva (Grupo P) e Tegaderm™ com Steri-Strip™ (Grupo S). As variáveis avaliadas incluíram paridade, idade gestacional, índice de massa corporal (IMC), nível de punção e distância de migração do cateter epidural.

**Resultados:** Foi detectada diferença na distância de migração do cateter epidural entre os diferentes grupos ( $p < 0,05$ ). A comparação revelou diferença apenas entre os grupos P e T ( $0,76 \pm 1,35$  vs.  $-0,14 \pm 1,03$ ,  $p < 0,01$ ).

**Conclusão:** O Tegaderm™ como método de fixação do cateter epidural em trabalho de parto foi inferior ao Tegaderm™ com almofada adesiva ou com Steri-Strip™ em termos de migração do cateter. Não há associação entre a migração do cateter epidural e o IMC.

**Palavras chave:** anestesia peridural; anestesia obstétrica; trabalho de parto

## Introducción

Failure of labor epidural is a well-recognized situation in obstetric anesthesia practice. Incidence of epidural failure was shown to be 12% in a retrospective analysis of 19.259 deliveries<sup>(1)</sup>. Epidural migration has been documented in both the obstetric and non-obstetric settings<sup>(2, 3)</sup>. It has been argued that prevention of epidural displacement is a potential remedy to at least part of the incomplete or failed epidurals in obstetrics<sup>(4, 5)</sup>. Motamed *et al* showed that 45% of epidural failures in major abdominal surgery could be attributable to catheter migration<sup>(6)</sup>. Phillips *et al* studied epidural catheter migration in labor finding an incidence of 54%<sup>(7)</sup>. Migration was 2 cm on average and tended to be directed inward. Crosby *et al* found a similar incidence of catheter migration but in an outward direction<sup>(8)</sup>. Although the observation of external migration of the epidural catheter does not necessarily mean that the tip of the catheter abandons the epidural space, it puts the patient at an increased risk of having non-working labor analgesia.

We hypothesized that the use of adjuncts such as Steri-Strip™ and skin pad to the Tegaderm™ dressing, decreases epidural catheter migration compared with Tegaderm™ alone. Therefore, we conducted a randomized controlled trial to compare three types of epidural catheter dressing for their ability to minimize the incidence of epidural catheter migration. The relevance of our study lies in the heterogeneity of practice in regards to dressing methods for the epidural catheter. On one hand, we wanted to determine the best method to limit catheter migration, and on the other hand, once the ideal method is determined, a uniform practice would potentially reduce costs.

## Methods

After approval by the Institutional Review Board (IRB approval number 1048027), ninety pregnant patients who requested labor epidural were invited to participate in the study and signed the informed consent. This study is registered in Clinicaltrials.gov (NCT03574441). Patients in the sitting position, an epidural puncture was performed, followed by identification of the epidural space by the loss of resistance to saline technique. A 19G epidural catheter (B. Braun Medical Inc, Bethlhem, PA, USA) was inserted (by an anesthesia resident or an attending anesthesiologist), leaving 5 centimeters within the epidural space. A test dose of Lidocaine 1.5% with epinephrine 1:200.000 was administered to rule out intrathecal and intravascular position of the catheter. The segment of the catheter external to the skin was directed vertically over the shoulder. Before application of the dressing, the patients were asked to sit up straight. Patients were randomly allocated to one of three dressing technique groups, based on a sealed envelope technique. In group P, the epidural catheter was placed in a groove of a pad fixed to the skin after forming a loop around the insertion site. Then, a 10 x 25 cm Tegaderm™ dressing was applied (3M Health Care, St Paul, MN, USA) (Figure 1).

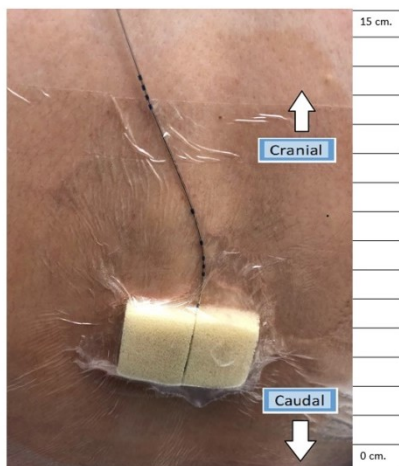


Figure 1. Epidural catheter dressing with Tegaderm™ and skin pad

In group S, after forming the loop around the insertion site, the epidural catheter was secured with Steri-Strip™ (3M Health Care, St Paul, MN, USA) followed by the application of a 10x25 cm Tegaderm™ dressing (Figure 2). In group T, a single 10 x 25 cm Tegaderm™ dressing was applied directly on the epidural catheter at the insertion site after forming a loop (Figure 3).

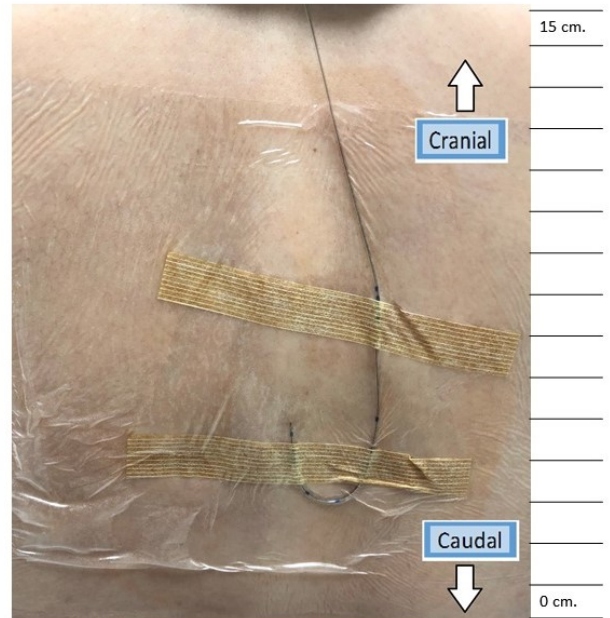


Figure 2. Epidural catheter dressing with Tegaderm™ and Steri-Strip™

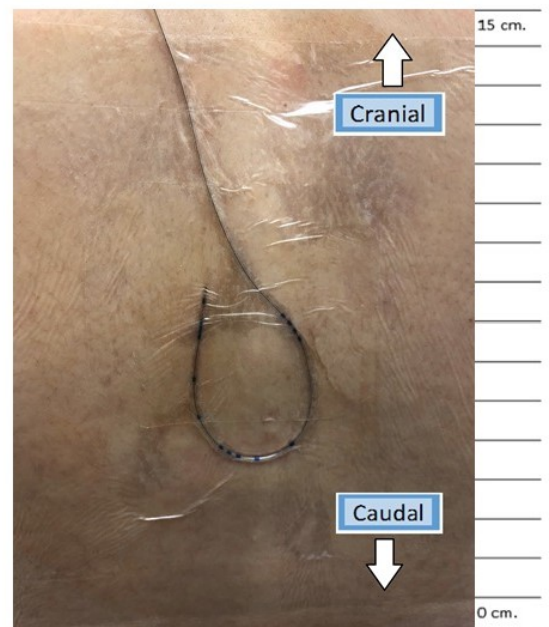


Figure 3. Epidural catheter dressing with Tegaderm™

We used three methods that include Tegaderm™, as is standard in the United States; however, Steri-Strip™ and skin pads were considered as potential adjuncts for protection from catheter migration at a still reasonable cost. Adjuncts such as Lockit Plus® and Epi-Fix™, albeit widely used in Europe, are not routinely used in the United States, and were not used in our study. The epidural catheter was connected to a Sapphire Multi-therapy epidural infusion pump (QCore Medical, Netanya, Israel), with an extension set. Epidural analgesia was started per institutional protocol with a solution containing bupivacaine 0.125% and fentanyl 2mcg/mL, at a rate of 10 mL/h with demand boluses of 5 mL and lockout time of 20

minutes. Patients were able to move on the bed and positioned as needed by clinical reasons, but ambulation was not allowed. Demographic variables and time of dressing application were recorded. Distance from skin to epidural space and length of catheter visible at the skin were also recorded. After delivery, before removal of the epidural catheter, time was noted as well as dressing condition and length of the catheter visible at skin. Epidural catheter migration (ECM) was defined as the difference between length of catheter visible at the skin between dressing application and removal. If the difference was positive, there was outward migration and if the number was negative, the catheter migrated inwardly.

Statistical analysis

Sample size: Based on previous experiences for a measurable difference of 0.5 cm, we included 30 patients in each group to have a power of 90% and a statistical significance level of 0.05. The statistical analysis was performed with SAS software (SAS Institute Inc., Cary, NC, USA.). Non-parametric analysis (Kruskal-Wallis test) was conducted to analyze the differences in epidural catheter migration among different dressing groups.

Results

Ninety-one patients were included in this study. Thirty patients were assigned to group P, thirty to group S and thirty-one to group T (Chart 1). No patients had failure of epidural analgesia. Regression analysis revealed no correlation between the patient's age, gestational age, BMI, insertion level and initial insertion distance with ECM. The number of top-up doses, unilateral block and total epidural dose were not correlated with the dressing types. There was an overall difference in epidural catheter migration (ECM) distance among different groups (p<0.05). Pairwise comparison revealed only a significant difference between groups P and T (0.76±1.35 vs. -0.14±1.03, p<0.01) (Figure 4).

ECM Distances for Different Dressings

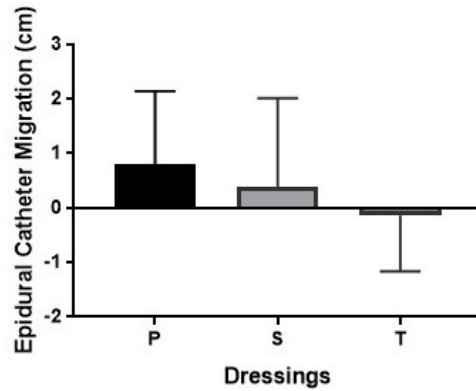


Figure 4. Catheter migration with three dressing methods for labor epidural. P, Tegaderm™ with sticky pad. S, Tegaderm™ with Steri-Strip. T, Tegaderm™ alone.

In the three groups, around 50% of the patients did not have catheter migration at all. Among the patients who received dressing P, 44.8% had outward migration, and 6.9% had inward migration. Among the patients who received dressing S, 25% had outward migration and 15.6% had inward migration. Among the patients who received dressing T, 17.2% had outward migration (Figure 5). The average time from epidural insertion to delivery was similar in the three groups (310±190 minutes, 321±212 minutes, and 289±190 minutes, for Groups P, S, and T, respectively).

ECM Direction of Different Dressings

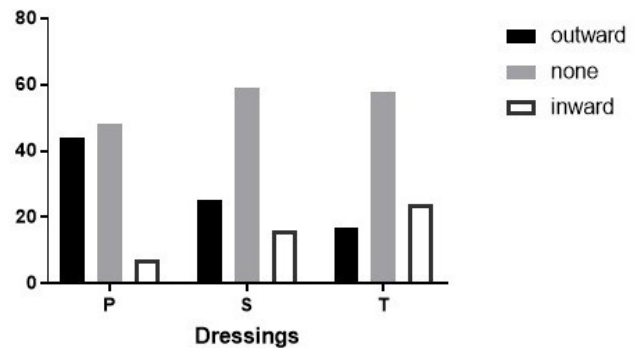
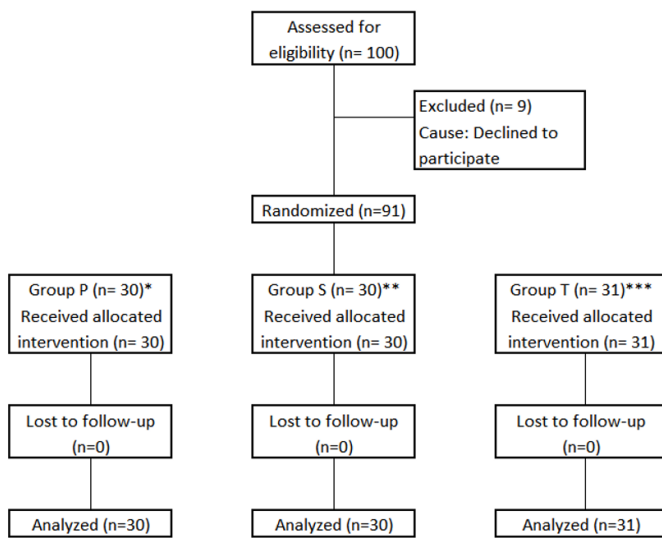


Figure 5. Direction of epidural catheter migration with three dressing methods. P, Tegaderm™ with sticky pad. S, Tegaderm™ with Steri-Strip. T, Tegaderm™ alone.



\* P, adjunct skin pad. \*\* S, adjunct Steri-Strip. \*\*\* Tegaderm only

Chart 1. CONSORT flow chart with enrollment, allocation, follow-up and analysis.

Discussion

The success rate and quality of labor neuraxial analgesia depends from multiple factors, including adequate position of the catheter within the epidural space throughout labor. Dressing application is the most commonly used technique to secure the epidural catheter to the skin after placement. Our study shows that the use of Tegaderm™ in combination with a pad with groove for the epidural catheter to sit, or with Steri-Strip™ are superior to the sole use of Tegaderm™ as a dressing to secure the epidural catheter to skin in the context of labor analgesia.

Reported factors influencing catheter migration include weight, body mass index, depth of the epidural space and patient positioning (9, 10). Some authors have evaluated the influence of different dressing methods on epidural catheter migration. Burns *et al.* compared Tegaderm™ dressing, Tegaderm™ plus filter-shoulder fixation and Niko Epi-Fix dressing in 113 patients in labor(2), finding that

Tegaderm™ plus filter-shoulder was superior in terms of minimization of epidural catheter displacement. Their study does not mention the weight or BMI of patients included in the study. Odor *et al* evaluated the efficacy of Epi-Fix™, Lockit Plus® and Tegaderm™ for dressing of intrapartum catheters, finding superiority of the Lockit Plus® system to decrease catheter migration and epidural analgesic failure<sup>(11)</sup>. Even though the authors did not find differences between the groups in terms of BMI, they did not evaluate the effect of BMI on the outcomes, and even excluded patients with BMI >50 kg/m<sup>2</sup>. Clark *et al* reported similar results in a cohort of 102 patients having epidural catheters for major non-obstetric procedures<sup>(12)</sup>. Although counterintuitive, our results show that BMI is not associated with an increased catheter migration. This finding might be the result of our strategy of requesting the patients to sit up straight before applying the dressing<sup>(4)</sup>. Hamza *et al.* found that the distance to the epidural space was larger when the blocks were performed in the lateral position<sup>(13)</sup>. In our study, we used the sitting position, eliminating this factor as a possible culprit for catheter migration.

Motamed *et al.* showed that 45% of epidural failures in major abdominal surgery could be attributable to catheter migration<sup>(6)</sup>. Phillips *et al.* studied epidural catheter migration in labor finding an incidence of 54%<sup>(7)</sup>. Migration was 2 cm on average and tended to be directed inward. Crosby *et al* found a similar incidence of catheter migration but in an outward direction<sup>(8)</sup>. In our study, we found that migration in all groups was directed predominantly outward. Inward migration of the epidural catheter could potentially lead to unilateral blocks. Uchino *et al* recognized lateral deviation of the epidural catheter into the intervertebral foramen with contrast radiography in eight of thirty-three patients having lumbar epidurals<sup>(14)</sup>.

Bishton *et al* documented inward migration in 13% and outward displacement of one or more centimeters in 22% of patients in a cohort of 153 laboring patients<sup>(10)</sup>. They also found that all cases of failed epidural occurred in patients with outward migration greater than 2.5 cm<sup>(10)</sup>. Hamilton *et al.* showed an association between patient position change and movement of epidural catheters, when the patient is sitting with a straight back and when placed on lateral decubitus position<sup>(4)</sup>. The authors found that the magnitude of epidural catheter movement was more pronounced in patients with BMI >30 kg/m<sup>2</sup>. It has been hypothesized that the epidural catheter might be fixed to the ligamentum flavum after it is threaded, as the maximum pressure found during catheter placement corresponds to this anatomical structure<sup>(15)</sup>. When the patient changes position after taping the catheter, especially in the case of a parturient with high BMI, the new anchor point theoretically moves to the skin, facilitating outward migration of the epidural catheter<sup>(9)</sup>.

In conclusion, our study shows that taping the lumbar epidural catheter used for labor analgesia with Tegaderm™ is inferior to Tegaderm™ with sticky pad or with Steri-Strip™ in terms of catheter migration. There is no association of catheter migration and BMI. We discourage the use of Tegaderm™ as the only dressing method for labor epidural. There is no association of catheter migration and BMI.

#### Sponsoring and Responsible Institution:

Department of Anesthesiology and Perioperative Medicine. Medical College of Georgia at Augusta University

#### Conflicts of interest

There are no conflicts of interest.

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