

Over Threading Epidural Catheter Leads to Increased Caudal Rather Than Cephalad Migration: Prospective Study in Obstetric Patients

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Introduction

- Threading an epidural catheter 5 cm into the epidural space is recognized as standard procedure due to the previously observed increase in failure rate when threading beyond 7 cm¹
- Intravenous migration and migration to a different spinal level are potential causes of epidural failure, but the exact underlying process is still not well understood
- The Electrical Stimulation Test (EST) can confirm appropriate epidural placement
- This presents an opportunity to categorize the catheter’s precise location at varying depths^{2,3} and could be used to determine the direction of catheter migration in the epidural space
- We hypothesize that excessive insertion of the epidural catheter results in migration away from the intended spinal level toward the sacrum rather than cephalad toward the thoracic vertebrae

Methods

- IRB approval (NCT06055686) was obtained for this study, and informed consent was acquired before epidural placement
- Participants were English-speaking females aged 18 years old or older, at full-term pregnancy
- Immediately after epidural placement, the catheter was threaded to a depth of 20cm at the skin
- A Peripheral Nerve Stimulator was connected to the epidural catheter via an electrocardiography (ECG) adapter and grounded to the patient via an ECG lead
- The epidural catheter was flushed with 2-5cc of sterile saline, current was slowly increased until muscle twitching was observed
- The initial stimulation test took place at a catheter depth of 20cm. Subsequently the epidural catheter was withdrawn to 15cm, 10cm at the skin and 5cm past LOR, and the stimulation was repeated at each of these intervals
- The interpretation of stimulation was categorized as negative when there was no objective visual-motor response
- Positive stimulation was characterized as a visual motor response of either low abdominal contraction (thoracic), lumbar (hamstring or quadriceps), or sacral (foot flexion) movement

Results

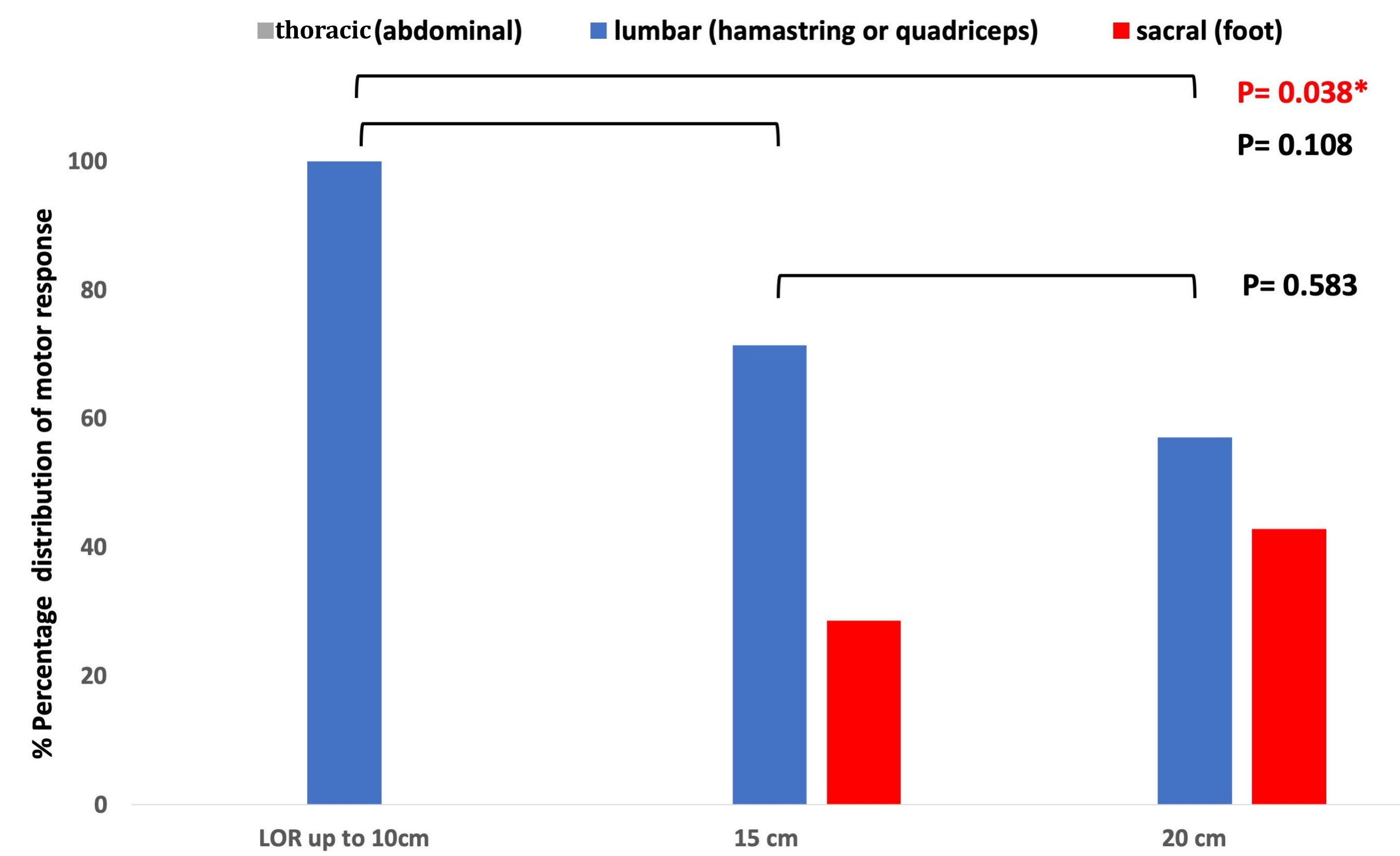


Figure 1: Myotome stimulus at varying catheter depths (past loss of resistance)

Age (years)	Weight (kg)	BMI (kg/m2)	# Prior Pregnancies	Length of Pregnancy	LOR Depth (cm)	First Myotome Stimulated (20cm)	Second Myotome Stimulated (15cm0	Third Myotome Stimulated (10cm vs. LOR + 5cm)	Complications	3h failure?	Ease of Threading Catheter	LOR Status
20	74.4	30.99	0	40w1d	6	Negative	Negative	Negative	Failed epidural	Y	Resistance	Questionable
28	104.8	35.1	2	40w	7.5	R quadriceps	R quadriceps	R quadriceps	None	N	Easy	Crisp
33	88.9	32.6	1	40w	7	R quadriceps	R quadriceps	R quadriceps	None	N	Easy	Crisp
34	81.6	30.9	0	37w5d	5	R dorsiflexion	L hamstring	L hamstring	None	N	Easy	Crisp
43	100.7	36.9	2	39w1d	8	R dorsiflexion	R dorsiflexion	R hamstring	None	N	Easy	Crisp
29	68	29.3	0	39w5d	5	N/A	N/A	R quadriceps	Unable to thread > 10cm	N	Resistance	Questionable
25	81.6	35.5	1	37w5d	5	L dorsiflexion	L dorsiflexion	L quadriceps	none	N	Easy	Crisp
28	99.1	38	0	40w4d	7	R quadriceps	R quadriceps	R quadriceps	none	N	Easy	Crisp
34	120.2	41.5	0	38w2d	6.5	R quadriceps	R quadriceps	R quadriceps	none	N	Easy	Crisp

Table 1: Basic demographic data and myotome stimulus details

Results

- Nine (9) English-speaking patients in active labor are currently enrolled
- One (1) patient did not exhibit any stimulation at the time of block placement nor any level to ice after standard dosing of local anesthetic and went on to require epidural removal and a spinal for C-section
- Positive EST was seen in the remaining eight (8) patients. All these patients had a confirmed block at 3 hours. None required epidural replacement
- Over-threading the epidural catheter resulted in downward migration of the epidural catheter in 42.8% (20cm) and 28.6% (15cm)
- No patient had sacral stimulation when inserted to a depth of 10cm at the skin or less
- We were unable to thread the catheter past 10cm in one patient due to increased resistance, resulting in only one electrical stimulation measurement

Discussion

- EST confirms the proper placement of catheters within the epidural space
- Lumbar Epidural catheters tend to move in the sacral direction when threaded 10cm or more beyond the loss of resistance
- Over-threading of epidural catheters to 20cm at the skin resulted in a significantly (P= 0.038) increased incidence of caudal advancement compared to those inserted less than 10cm past LOR
- Clinicians can utilize EST to monitor and optimize the exact spinal level of epidural catheters of women during labor
- Clinicians can potentially use EST to troubleshoot and optimize the catheter location
- Our findings suggest that over-threaded lumbar epidurals cannot be reliably substituted for thoracic epidural analgesia, especially due to the risk of catheter tip misplacement in the sacral region

References

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