

Influence of BMI and ethnicity on the depth of the epidural space

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Introduction

Correct identification of the epidural space is a vital skill for anaesthetists, often obtained in the first two years of training. Successful placement of an epidural catheter requires thorough patient examination and familiarity with the tactile properties of the tissues of the back.

Often, an increased incidence of complications such as inadvertent dural tap arise for trainees placing epidurals whilst they are acquiring this skill, presenting a challenge for both

trainee and trainer. Experienced anaesthetists can estimate the epidural depth based on patient factors such as body habitus and ethnicity, influencing procedural caution during placement if a loss of resistance is encountered at a depth grossly different to this.

In this project we examine how the depth of the space varies with BMI and ethnicity, to demonstrate the accuracy of using patient characteristics to estimate depth prior to the procedure.

Methods

The Trust IT department assisted in extracting CMIS digital records of epidurals and combined spinal and epidurals at West Middlesex Hospital placed since November 2007.

After removing duplicate and incomplete records, 13,884 complete records were analysed using ANOVA and Multiple Linear Regression tests in GraphPad Prism version 10.2.2 for MacOS.

Figure 1. Epidural depth of space recorded against BMI

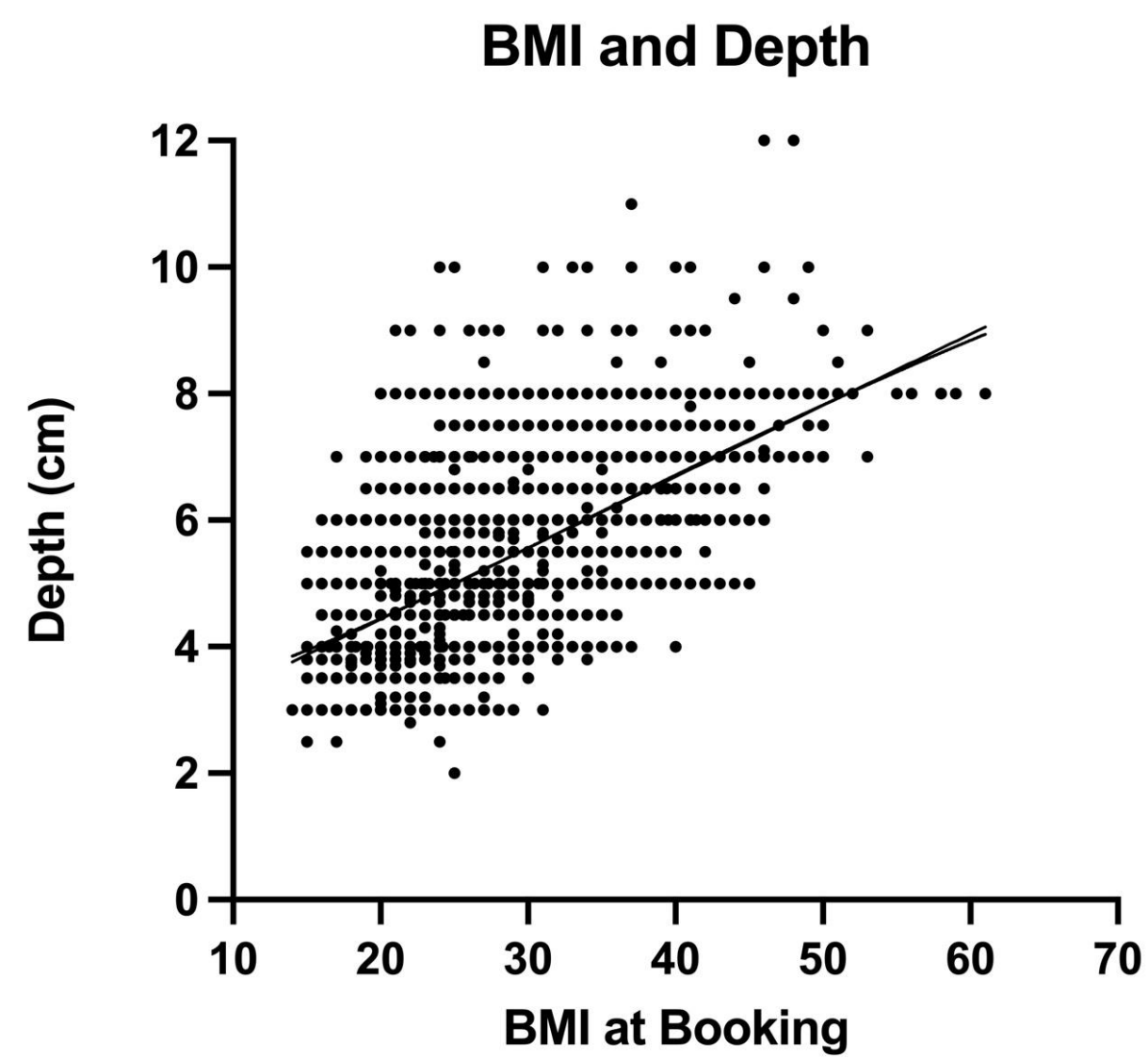
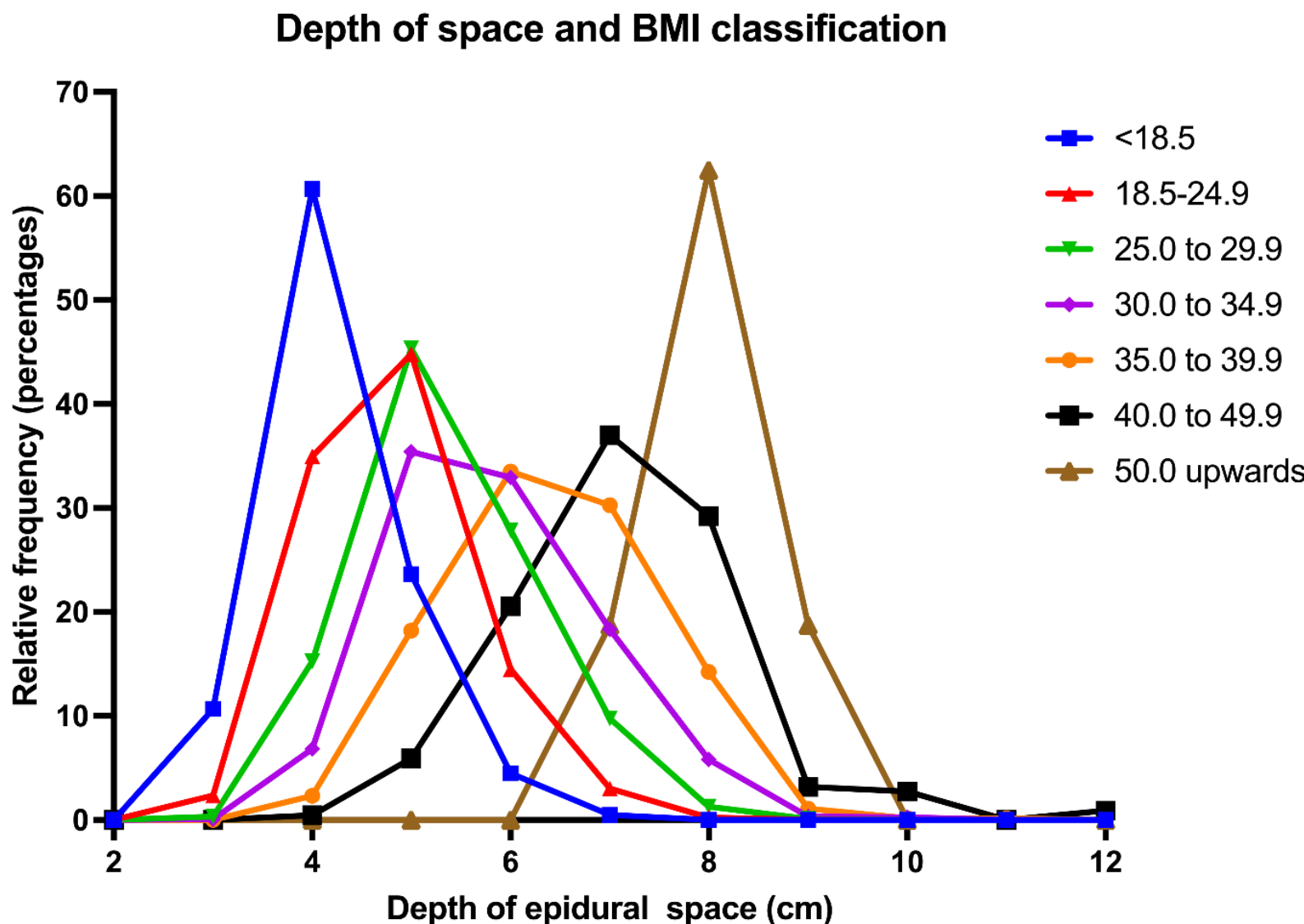


Figure 2. Recorded depth of space in different BMI groups



Results

A positive correlation exists between BMI at Booking and Epidural Space Depth (Pearson r test R² = 0.304, p<0.0001). Figure 2 illustrates the range of depths for each BMI category. Ethnicity also influences depth (table 2); and despite overlapping intervals, significant racial differences

were demonstrated using a Kruskal Wallis test. Asian women generally have shallower depths compared to white and black women. Black women exhibit a skewed interquartile range towards deeper spaces. Increased BMI

also correlates with greater depth variation across all ethnicities.

Multiple linear regression identified BMI, height, age, and specific ethnic groups as significant contributors to epidural space depth.

	Median depth of epidural space (interquartile range) in cm		
BMI category	White	Asian (all)	Black (all)
18–25	5 [4 – 5]	4.5 [4 – 5]	5 [4.5 – 5.5]
25–35	5.5 [5 – 6]	5 [4.8 – 6]	5.5 [5 – 6.5]
35+	7 [6 – 7.5]	6.5 [5.75 – 7]	7 [6 – 7.5]

Table 1. Median and interquartile range of epidural depth of space in different BMI categories, subdivided by ethnicity.

Dunn's multiple comparisons test	Mean rank diff.	Significant?	Adjusted P Value
White vs. Asian	655.1	Yes	<0.0001
White vs. Black	-1,116	Yes	<0.0001
655.1vs. Black	-1,771	Yes	<0.0001

Table 2. Significance of the difference between racial groups in epidural depth of space irrespective of BMI

Discussion

Trainee anaesthetists face challenges in both mastering the practical skill of placing epidurals and understanding how depth varies with patient characteristics. Trainers must guide novices without access to the tactile feedback they usually rely on. Pre-procedural depth estimation can assist

trainers. While depth varies predictably with patient traits, there remains significant uncertainty. This uncertainty may be reduced by using additional tools such as ultrasound. Ultrasound is useful for identifying lumbar levels (Balki et al., 2009) and reducing procedural pain (Darrieutort-Laffite et

al., 2015) and it can aid in estimating the depth of the epidural space accurately. Future projects will explore if novice anaesthetists can readily acquire ultrasound skills, if ultrasound reduces depth estimation uncertainty, and if this improves success.

References

- Balki, M., Lee, Y., Halpern, S., & Carvalho, J. C. A. (2009). Ultrasound Imaging of the Lumbar Spine in the Transverse Plane: The Correlation Between Estimated and Actual Depth to the Epidural Space in Obese Parturients. *Anesthesia & Analgesia*, 108(6), 1876–1881.
- Darrieutort-Laffite, C., Bart, G., Planche, L., Glemarec, J., Maugars, Y., & Le Goff, B. (2015). Usefulness of a pre-procedure ultrasound scanning of the lumbar spine before epidural injection in patients with a presumed difficult puncture: A randomized controlled trial. *Joint Bone Spine*, 82(5), 356–361.