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Optimal Dosing of the Rectus Sheath Block: A Cadaveric Dissection Study

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Introduction

The rectus sheath block has been traditionally used to provide analgesia for midline abdominal procedures. It was originally described as a blind needle insertion technique with the operator feeling fascial "pops." The needle end point was described as within the rectus sheath, behind the muscle.1 With the original blind technique, the extent of infraumbilical coverage and local anesthetic spread caudally is thought to be limited due to the presence of the arcuate line. Ultrasound use has changed the rectus sheath block, and it is now performed posterior to the rectus abdominis muscle but anterior to the posterior rectus sheath.2 Apart from a new needle end point with ultrasound, there are limited studies demonstrating the analgesic benefits or correct local anesthetic dosing of this block.3-5

Materials and Methods

Six cadavers were obtained by the Institution's School of Medicine Body Donation Program. All ethical guidelines were followed, and this study was exempt by the Institutional Review Board. Bilateral ultrasound-guided rectus sheath blocks were performed on 6 cadavers, for a total of 12 dissections. For the first 6 blocks, 30 mL of solution (bupivacaine and methylene blue) were injected at the level of the umbilicus. For the remaining blocks, two injections of 15 mL were performed, per side, midway between the xyphoid process and the umbilicus and midway between the umbilicus and the pubis. Spread of solution and location of the arcuate line were assessed with ultrasound and cadaveric dissection.

Results/Case Report

Dissection was successfully performed in 5 out of 6 cadavers. One cadaver had poor tissue quality and was not suitable for evaluation. There was no identifiable arcuate line by ultrasound or dissection in any cadaver. There was significant spread of solution with all injections. A single 30-mL injection showed reliable spread from umbilicus to pubis. Spread to the subcostal margin was inconsistent and was seen in only 2 out of 6 blocks (Figure 1). A double injection of 15 mL showed consistent spread from xyphoid to pubis in 3 out of 4 blocks, with the exception due to the presence of a hernia on the rectus abdominis muscle that impeded cephalad spread (Figure 2). The results of the study are summarized in Table 1.

Table 1: Summary of dissection results. Cadavers 1-3 received a single 30 mL injection per side, for a total of 6 blocks. Cadavers 4 and 5 received two 15 mL injections per side, for a total of 4 blocks. A "+" denotes strong or intense staining, while a "-" denotes scant to no staining. After the 30-mL injection, spread of dye was consistent periumbilically and infraumbilically to the pubic bone in all dissections. Only two dissections, performed in Cadaver 3, demonstrated adequate cephalad spread to the subxyphoid area. After the two 15-mL injections, spread from subxiphoid to suprapubic areas was observed in all dissections except for Cadaver 4 on the right side, where cephalad spread was limited because of a hernia.

Figure 1: Images of the dissection of Cadavers 1 and 2 after a single, 30 mL injection, with RAM reflected off of PRS. A) Cadaver 1, right side: Consistent staining of the PRS can be observed extending caudally. Spread is limited in cephalad direction by the presence of an ostomy. B) Cadaver 1, left side: Consistent dye spread is again observed caudally but is limited in the cephalad direction. Spread is also seen extending laterally to the linea semilunaris. C) Cadaver 2, right side: Dye is seen spreading caudally throughout the dissection but less so in the cephalad direction. As in the other cadaver, dye spread is seen laterally as far as the linea semilunaris. D) Dissection of Cadaver 2 showing the perforating branches of the rectus sheath plexus arising from within the PRS and perforating the RAM.
RAM = rectus abdominis muscle, PRS = posterior rectus sheath.

Figure 2: Dissection of Cadavers 4 and 5 after two 15 mL injections per side, one halfway between the umbilicus and the xyphoid process and the second halfway between the umbilicus and the pubis. A) Cadaver 4: bilateral dissection with RAM reflected off of PRS. The right side displays intense staining in the caudal direction. However, there is a hernia in the right upper quadrant of RAM that appears to limit cephalad spread of dye. The left side displays intense staining from xyphoid to pubis. B) Cadaver 5: Both sides demonstrate significant staining at both sites of injection and in the cephalad and caudad directions. Staining around the level of the umbilicus is less intense but still significant. The left side displays staining that is slightly less intense than the right side overall, but the extent of spread is the same.
RAM = rectus abdominis muscle, PRS = posterior rectus sheath.

Discussion

The rectus sheath block is commonly included among abdominal fascial plane blocks that can be utilized to achieve analgesia for abdominal procedures. However, as often as they are mentioned in the literature, the evidence for appropriate dosing and benefits is lacking. This study shows that rectus sheath blocks may provide adequate coverage of periumbilical as well as lower abdominal incisions. Interestingly, the arcuate line was not identified either by ultrasound or dissection and there was no evidence that spread of solution was limited by this structure. Two injections with a combined volume of at least 30 mL per side are likely to achieve complete coverage of the anterior abdomen in the absence of previous abdominal abnormalities such as ostomies, hernias or surgical scarring. Further studies are needed to corroborate these findings and better define the dosing for this block in clinical practice.

References

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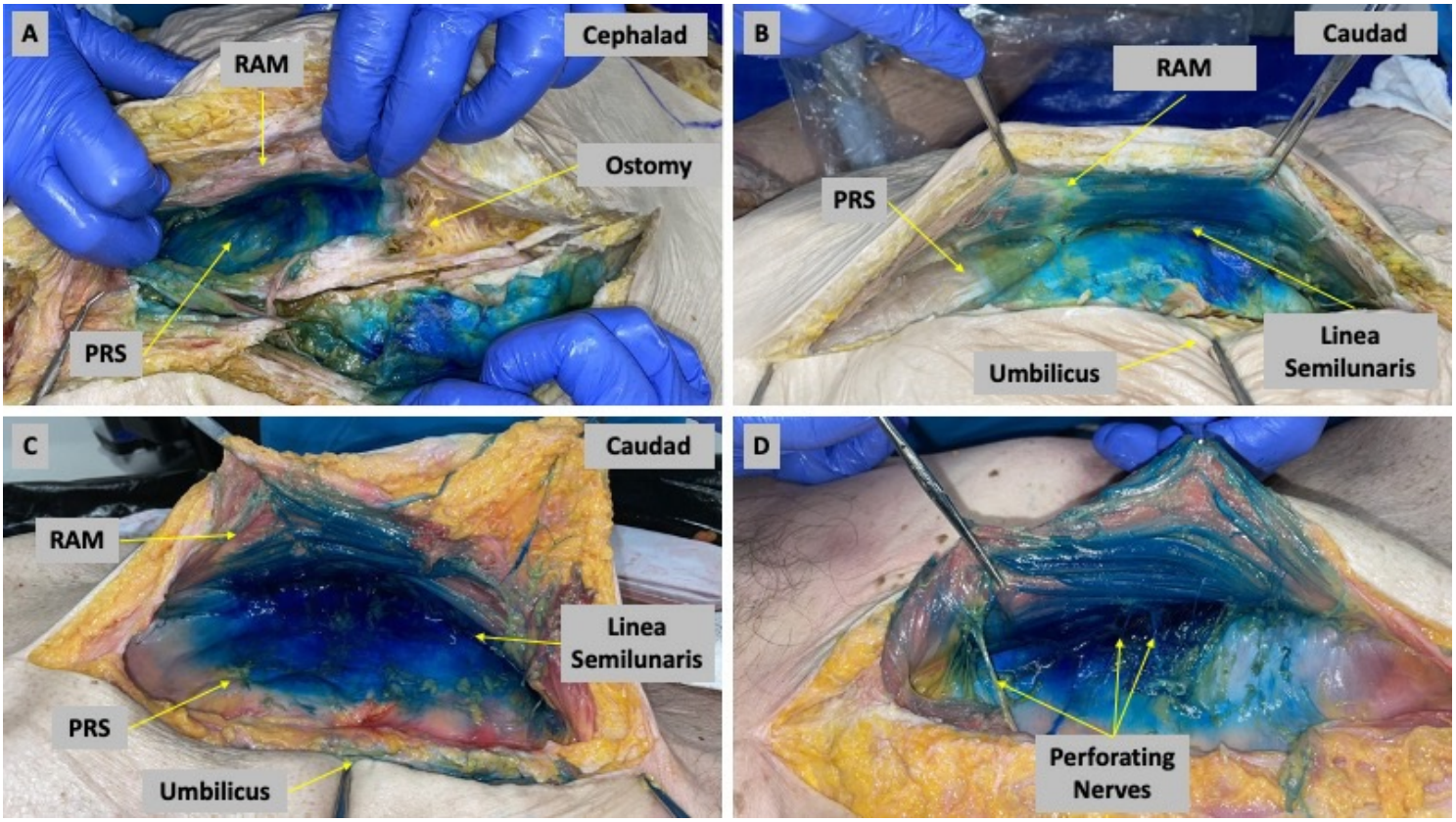
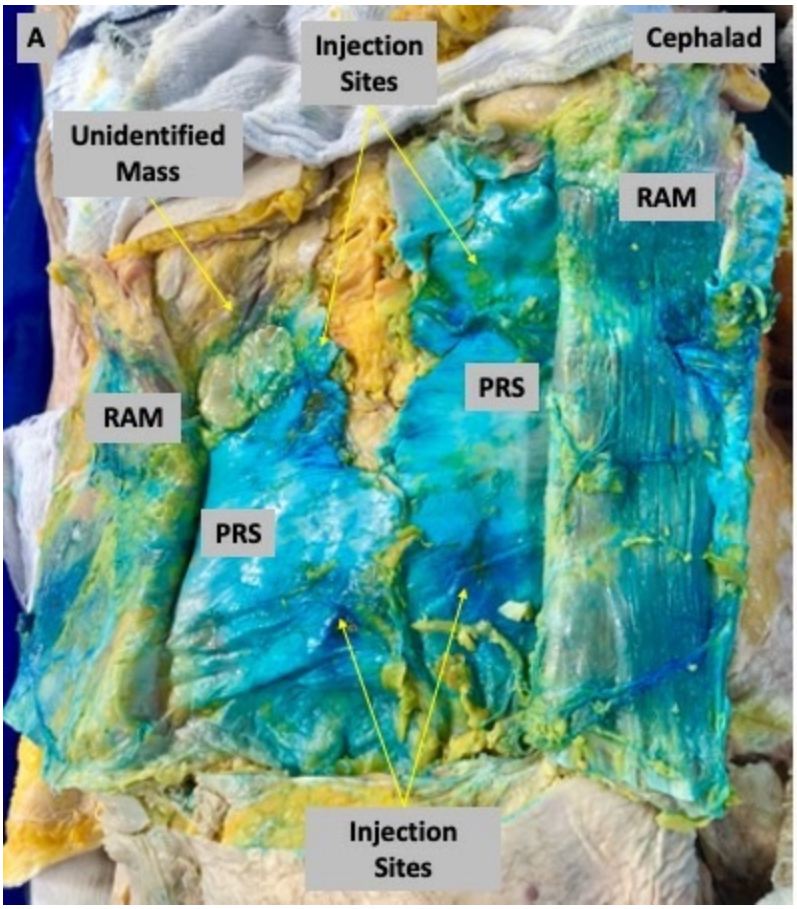
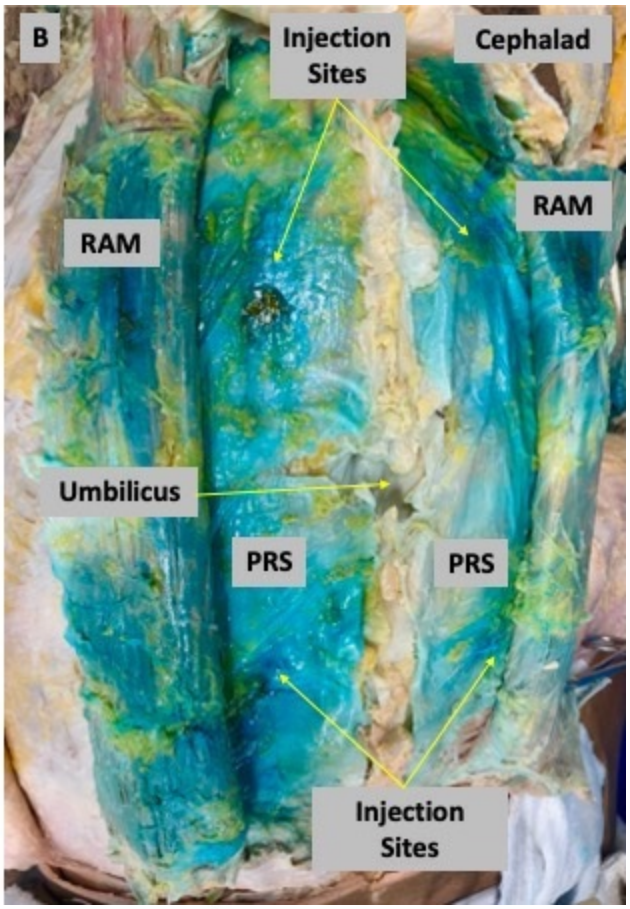
Disclosures

No

Tables / Images







	Single Injection (30 mL)						Double Injection (15 mL x 2)			
	Cadaver 1		Cadaver 2		Cadaver 3		Cadaver 4		Cadaver 5	
	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left
	-	-	-	-	+	+	-	+	+	+
	+	+	+	+	+	+	+	+	+	+
	+	+	+	+	+	+	+	+	+	+