ANATOMICAL CONSIDERATIONS OF THE NEONATAL ILIO-INGUINAL/ILIOHYPOGASTRIC NERVE BLOCK

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Introduction

General anaesthesia, with or without a caudal block, is most commonly used to provide analgesia for surgical procedures in the inguinal region. The ilio-inguinal/ iliohypogastric nerve block is a useful alternative, which may provide more prolonged postoperative analgesia for a range of procedures such as; inguinal hernia repair, orchidopexy and varicocele surgery in children, as well as emergency procedures such as repair of a strangulated hernia with intestinal obstruction [1]. Although this nerve block is not adequate to abolish visceral pain produced from peritoneal traction, exploration and manipulation of the spermatic cord and testes [2], it does provide satisfactory postoperative analgesia [1].

Inguinal hernia repair is one of the most common surgical procedures performed on neonates and premature infants; however the precise anatomical positions of both the ilio-inguinal and the iliohypogastric nerves have not been identified in this age group. Knowledge of the exact anatomical location of these nerves would enhance the success of this block, which carries a relatively high failure rate (between 20-30%) [3].

Aim

This study aimed to determine the anatomical position of the ilio-inguinal and iliohypogastric nerves in relation to an easily identifiable bony landmark, the anterior superior iliac spine (ASIS).

Materials and Methods

The skin covering the anterior abdominal wall was reflected in a sample of 54 neonatal cadavers (51 left and 53 right sides; mean length: 0.43m ± 0.06m; mean weight: 1.64kg ± 0.72kg). The superficial fat layer was carefully removed to expose the superficial muscles and the rectus sheath of the anterior abdominal wall (see Figure 1a & b).

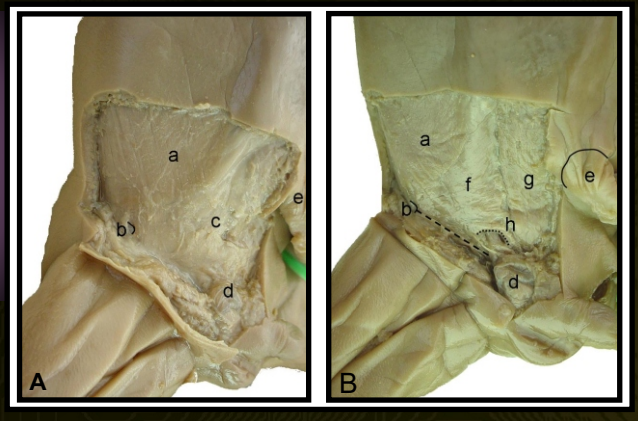

Figure 1a & b: Superficial and deeper dissections of the anterior abdominal wall of a neonatal cadaver with (a) the external oblique muscle, (b) the ASIS, (c) the rectus sheath, (d) testis, (e) the umbilicus, (f) internal oblique muscle, (g) rectus abdominis muscle, and (h) the conjoint tendon (also indicated with the smaller, curved dotted line). The inguinal ligament is indicated with a dashed line.

A midline incision through the external oblique muscle was made and carefully reflected laterally to expose the underlying internal oblique muscle. The ilio-inguinal nerve was then identified as it courses through the deeper layers and travels within the inguinal canal (see Figure 2). The nerve was then followed superiolaterally to the point of its penetration through the internal oblique muscle. This muscle was then carefully removed in sections to expose the course of the ilio-inguinal nerve back to a point superolateral to the ASIS. The iliohypogastric nerve, which ran superior to the ilio-inguinal nerve, was exposed in a similar manner (see Figure 3).

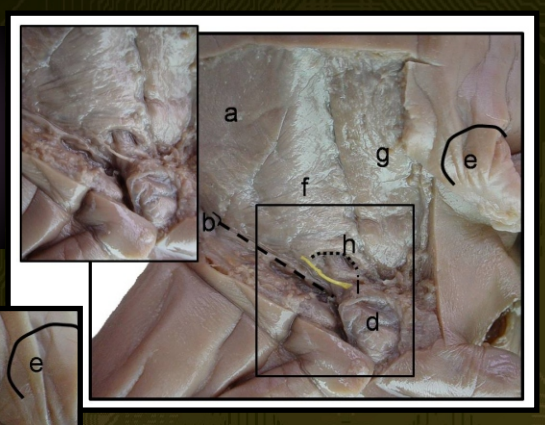

Figure 2: Dissection of (i) the ilio-inguinal nerve (highlighted in yellow). The nerve can be seen piercing (f) the internal oblique muscle running with the spermatic cord towards (d) the testis. Other structures include (a) the external oblique muscle, (b) the ASIS, (e) the umbilicus, (g) rectus abdominis muscle, and (h) the conjoint tendon (also indicated with the smaller, curved dotted line).

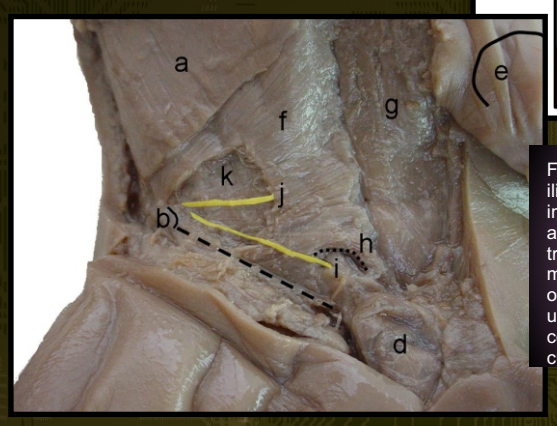

Figure 3: Dissection of (i) the ilio-inguinal and (j) iliohypogastric nerves. As the nerves courses inferiomedially past (b) the ASIS, these two nerves are still running in the plane between (k) the transverse abdominis and (f) the internal oblique muscles. Other structures include (a) the external oblique muscle, (b) the ASIS, (d) the testis (e) the umbilicus, (g) rectus abdominis muscle, and (h) the conjoint tendon (also indicated with the smaller, curved dotted line).

The ASIS was identified on both sides and distance of both nerves from the ASIS, on a line connecting the ASIS to the umbilicus, was measured with a mechanical dial sliding calliper (accuracy of 0.01mm). The ideal point of needle insertion, defined as the point between the ilio-inguinal and iliohypogastric nerve on the line connecting the ASIS to the umbilicus (see Figure 4).

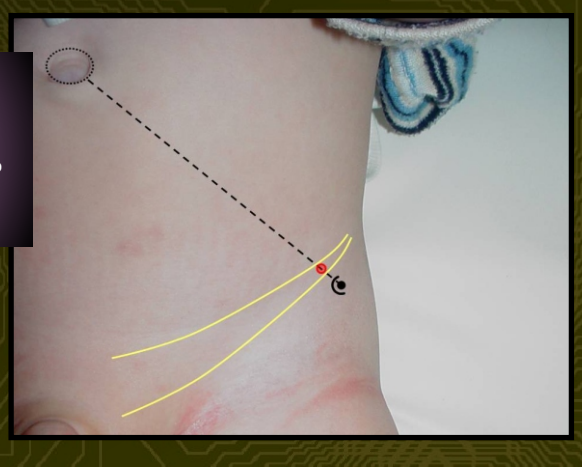

Figure 4: Graphic representation of the ideal point of needle insertion (red circle) on a neonate. This point can be found between the ilio-inguinal and iliohypogastric nerve (indicated by the two yellow lines) on the line connecting the ASIS to the umbilicus (dashed line).

Results

A paired *t*-test revealed that there is no significant difference between the distance from the ASIS to the left and right ilio-inguinal (p = 0.3938), iliohypogastric nerves (p = 0.2109) or needle insertion site (p = 0.1636). There were also no significant difference between the distance between the ilio-inguinal and iliohypogastric nerves, on both sides (p = 0.9758). Because there were no significant differences between the two sides, all the data was pooled together for both the right and left sides (total n = 104) (see Table 1).

Table 1: Distances (in mm) of the ilio-inguinal and iliohypogastric nerves from the ASIS for the total neonatal sample

	Ilio-inguinal nerve	Iliohypogastric nerve	II - IH
n	104	103	103
Mean	2.20	3.81	1.60
SD	1.17	1.32	0.58
CI 95%	0.22	0.25	0.11
Lower range*	1.98	3.56	1.49
Upper range*	2.43	4.07	1.71
Ideal insertion site (mm)		3.00	

Key:
II IH: Distance between the ilio-inguinal and iliohypogastric nerves
SD: Standard deviation
CI: Confidence interval
* Lower and upper ranges are obtained by subtracting and adding the CI 95% value from/ to the Mean, respectively.

On average the ilio-inguinal can be found 2.20mm ± 1.17mm from the ASIS, on a line connecting the ASIS to the umbilicus. More specifically, it is with a 95% confidence level that the nerve can be found between 1.98mm and 2.43mm from the ASIS in a neonatal sample. The iliohypogastric nerve can be found 3.81mm ± 1.32mm or between 3.56mm and 4.07mm from the ASIS (95% confidence level). The optimal needle insertion site for the sample is 3.00mm from the ASIS.

A Pearson's correlation coefficient test (this test determines the strength of the linear relationship between two variables, with a value more than 0.7 indicating a strong correlation) revealed that there exists a strong correlation between the distance of the ideal point of needle insertion (R = 0.7707) to the ASIS and the weight of the sample.
Because of this strong correlation, a linear regression formula was developed for the sample with the distance to the point of needle insertion from the ASIS (dependent variable) and the weight of the sample (independent variable) (see Figure 5).

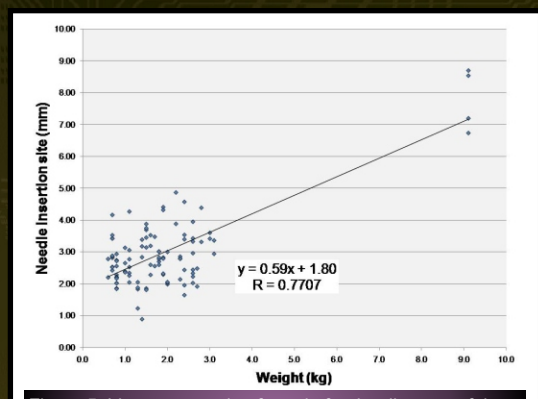

Figure 5: Linear regression formula for the distance of the point of needle insertion from the ASIS as the dependent variable, and the weight of the sample as the independent.

Discussion

Evaluation of current techniques for blocking the ilio-inguinal and iliohypogastric nerve shows that they differ somewhat in respect of the needle placement. When comparing the site of placement described by these techniques, the needle is placed a substantial distance from the nerves (see Figure 6).

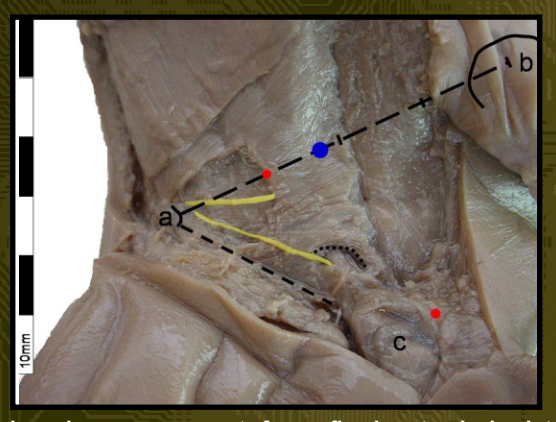

Figure 6: Classic technique described by Von Bahr 4. A line is drawn between (a) the ASIS and (b) the umbilicus and subsequently divided into quarters. The first point of needle insertion (red circle) is on this line at the junction of the medial quarter and lateral three quarters, while the second insertion site is slightly proximal to the pubic tubercle. The ilio-inguinal and iliohypogastric nerves are highlighted in yellow. The blue circle indicates the technique described by Jagannathan and Suresh (2007) 1. The dashed line represents the inguinal ligament, while the curved, dotted line is the conjoint tendon; (c) is the testis.

Accurate placement of the needle in close proximity to the nerve is essential for a successful block, and correct placement requires a familiarity with regional anatomy and landmarks [5]. Difficulty arises when there is anatomical variation as seen in the growing child and when landmarks are difficult to identify. Techniques based on measurements from a fixed anatomical point clearly have limitations when applied to all age groups. For the ilio-inguinal/ iliohypogastric nerve block it has been estimated that complete failure could occur in about 10% of all procedures, while partial failure may be even more frequent in the order of 10 and 25% [6]. A failure rate as high as between 20% 30% has even been reported for the classic ilio-inguinal/ iliohypogastric nerve block technique [3].
The findings in this study may explain the high rate of failure of the block particularly if the blocks are based on incorrect measurements or understanding of the anatomy in this age group. The results show that in neonates the needle should be placed much closer to the ASIS in neonates than previously described in the literature, approximately 3mm from the ASIS on a line drawn between the ASIS and the umbilicus. The linear regression formula could also be used with infants as the distance of the insertion point showed to have a strong correlation with the weight of the patient. Where ultrasound is unavailable, a short bevel needle is considered essential to identify the "give" or "pop" as the needle penetrates the external oblique aponeurosis. This give may be very subtle particularly in small infants.

Conclusion

Armed with this knowledge it is suggested that smaller volumes of local anaesthetic placed closer to the ASIS would improve the success rate of ilio-inguinal/ iliohypogastric nerve blocks in this age group and in the process improve patient safety.

References

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