

## Relation of Paralumbar Nerves and Conus Medullaris to the Vertebrae of Swamp Buffaloes

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### ABSTRACT

The last thoracic (T13) and the first three lumbar spinal nerves (L1-L3) of the 20 adult swamp buffaloes specimens were dissected and observed the relation of their crossing to the tip of transverse processes of first five lumbar vertebrae (TL1-TL5). Their dorsal and ventral branches crossed obliquely caudolaterally on the dorsal and ventral surface of the lumbar transverse processes, respectively. The T13 crossed the anterior border of TL1 tip (20 specimens). Most of L1 (8 specimens and two of the right side) crossed the posterior border of TL2 tip. The L1 of 6 specimens crossed the anterior border of TL3 tip. Some variations of L1 crossed the anterior border of TL2 tip and the posterior border of TL3 tip. The L2 crossed the anterior (10 specimens and one of the right side) and the posterior (7 specimens) border of the TL4 tip, and a few specimens variably crossed the posterior border of TL3 tip. Most of ventral branch of L3 were lining caudolaterally under psoas muscles. The ventral branch of L3 in some specimens (4 specimens and two of only right and left side) have a branch on the dorsal surface of the psoas muscles and crossed the posterior border of TL5 tip. The conus medullaris of spinal cord of all specimens were taper to filum terminale at the caudal part of the first sacral vertebra.

This study showed the variation in the course of the lumbar spinal nerves. It might be recommended that the effective paravertebral anesthesia nerve blocks in swamp buffaloes will be injected to the tip of the first five lumbar transverse processes, and infiltrated to anterior and posterior of them for the last thoracic and the first three lumbar spinal nerves blocks, respectively. The epidural anesthesia in swamp buffaloes will be safe for the spinal cord by injection at sacrococcygeal foramen since the spinal cord is taper to filum terminale in the first sacral vertebra.

**Key words:** paralumbar nerves, spinal cord end, swamp buffalo

### INTRODUCTION

The local anesthesia of spinal lumbar nerves or epidural anesthesia are the safety anesthesia in large animals for ruminotomy, caesarian sections and exploratory laparotomy. The lumbar paravertebral nerves block in cow has been in clinical practice (Cakala, 1961, de Lahunta and

Habel, 1986). The anesthesia injection points are located by palpation and injection at the tip of lumbar transverse processes which the dorsal and ventral branches of the last thoracic spinal (T13) and the first three lumbar spinal nerves (L1, L2 and L3) are upper and under lining on lumbar transverse processes as follows; the last thoracic spinal nerve crossed the anterior border of the first lumbar

transverse process Tip (TL1), the first lumbar spinal nerve (L1) crossed the posterior border of the second lumbar transverse process tip (TL2), the second lumbar spinal nerve (L2) crossed the posterior border of the fourth lumbar transverse process tip (TL4), and the third lumbar spinal nerve (L3) are running straight caudally along the bodies of vertebrae, under psoas muscles. Therefore, the relationship between lumbar spinal nerves and the lumbar transverse processes are important to locate the injection points for lumbar paravertebral nerve blocks, but those injection points in the swamp buffalo has not yet elucidated.

The end of spinal cord (conus medullaris) in relation to the spinal vertebrae is important to locate the safety point of epidural anesthesia injection. The safety injection points should be posterior to the end of spinal cord and anterior to the end of dura mater. The end of spinal cord and the end of dura mater of the horse, ox, dog and cat have been reported and applied in clinical epidural anesthesia (Seiferle, 1951; de Lahunta and Habel, 1986). The end of spinal cord of the horse, cow, dog and cat terminate at the first or second sacral vertebrae, the first sacral vertebra, the sixth lumbar vertebra and the sixth lumbar to the third sacral vertebrae, respectively. While the end of dura mater of horse, cow, dog and cat locate at the third sacral vertebra, fourth sacral vertebra, first sacral and first coccygeal vertebra, respectively.

However, the relation between the end of spinal cord and spinal vertebrae of the swamp buffalo has not yet reported. Thus this study try to elucidate the relation of the end of spinal cord to the body of sacral vertebrae and the lumbar spinal nerves to the lumbar transverse processes of vertebrae.

## MATERIALS AND METHODS

The posterior part of vertebrae of 20 adult swamp buffaloes were collected from slaughter house, including the last two thoracic with ribs, the

pelvis and coccygeal vertebrae. Thirteen buffalo specimens were 3-4.5 years old. Six specimens were 8-10 years old and 1 year old was one specimen. The dorsal and ventral branches of 13<sup>th</sup> thoracic, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> lumbar spinal nerves were dissected and observed of their crossing to the tip of lumbar transverse processes (TL). Then the specimens were fixed with 10% formalin for dissecting the end of spinal cord and observed the relation of the cord with the sacral vertebrae.

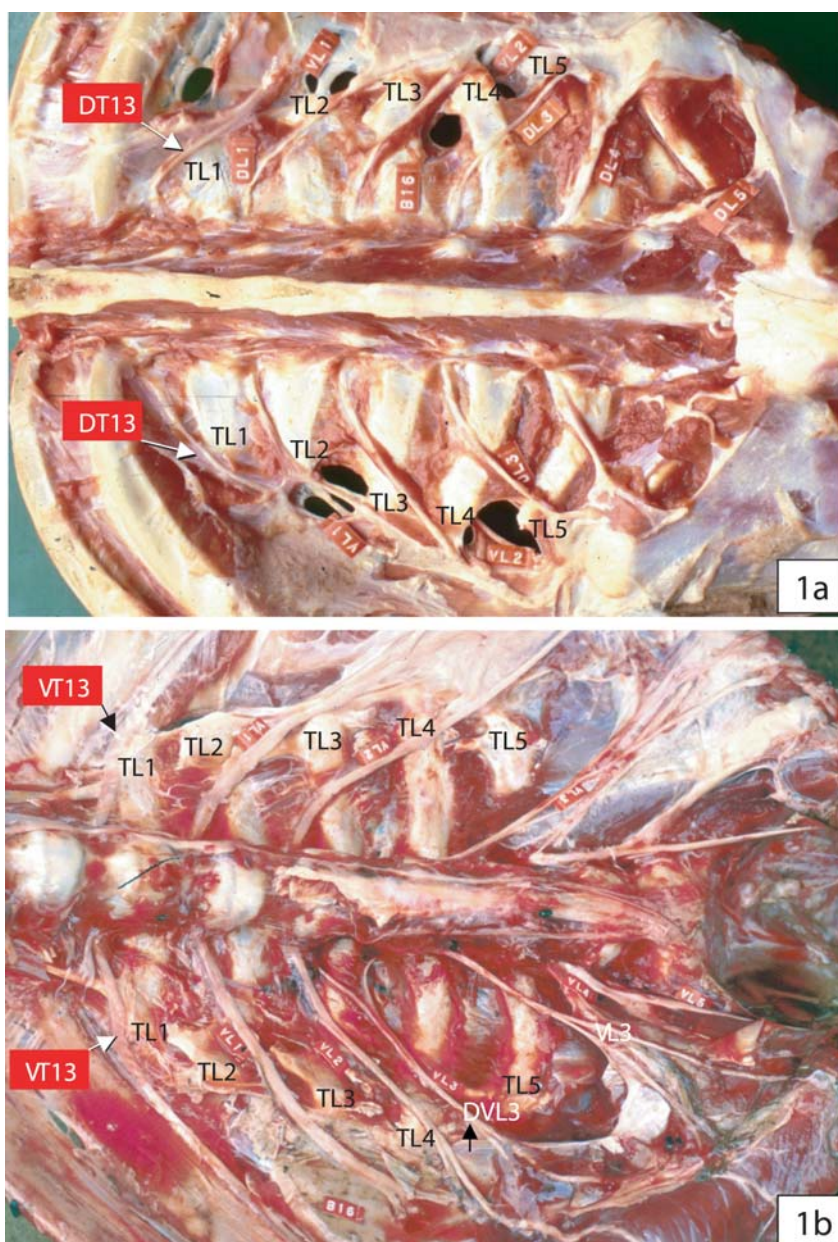
## RESULTS

The dorsal and ventral branches of the 13<sup>th</sup> thoracic, 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> lumbar spinal nerves crossed obliquely caudolaterally on the dorsal and ventral surface of the succeeded lumbar transverse processes, respectively. The dorsal branches perforated the longissimus dorsi muscle to subcutaneous layer at the top of transverse processes tip of succeeded vertebrae. (Figure 1a)

The ventral branch of the 13<sup>th</sup> thoracic spinal nerve (VT13) of all 20 specimens crossed the anterior border of transverse process tip of the first lumbar vertebra (TL1 ). (Figure 1a, 1b, and 2a)

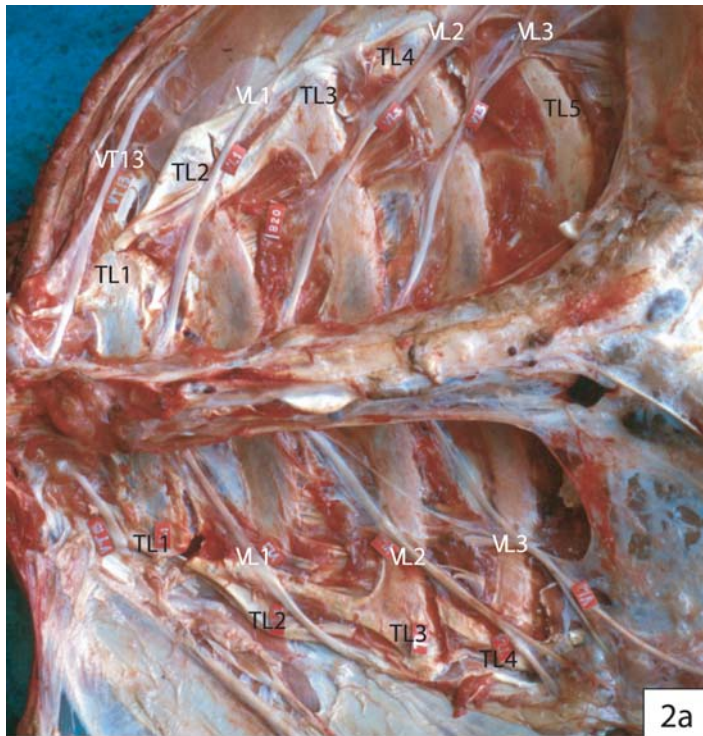
Most of specimens (8 specimens and two of the right side) had ventral branches of the 1<sup>st</sup> lumbar spinal nerve (VL1) crossed the posterior border of transverse process tip of the 2<sup>nd</sup> lumbar vertebra (TL2), while the VL1 of 6 specimens crossed the anterior border of transverse process tip of the 3<sup>rd</sup> lumbar vertebra (TL3 ) (Figure 1a, 1b, and 2a). There were 4 specimens and one of the left side which VL1 crossed the anterior border of transverse process tip of the second lumbar vertebra (TL2). It was one of the left side of specimen which VL1 crossed posterior border of transverse process tip of the third lumbar vertebra (TL3).

The ventral branch of the 2<sup>nd</sup> lumbar spinal nerve (VL2) of 10 specimens and one of the right side crossed the anterior border of the 4<sup>th</sup> transverse process tip (TL4). The other 7 specimens had VL2

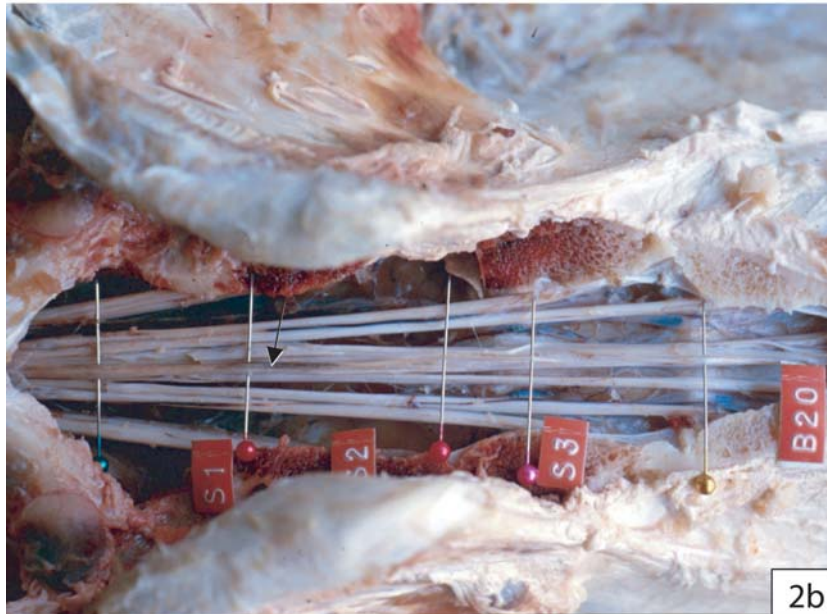


**Figure 1a and 1b.** The dorsal and ventral views of lumbar region of swamp buffalo specimen No. 16 (B16) show the course of last thoracic (T13) and first three lumbar spinal nerves (L1-L3). The dorsal (DT13) and ventral (VT13) branches of T13 cross the anterior tip of first lumbar transverse process (TL1). The dorsal (DL1) and ventral (VL1) branches of L1 cross the anterior part of TL3 tip. The dorsal (DL2) and ventral (VL2) branches of L2 cross the posterior part of TL4 tip. The dorsal (DL3) and the right ventral (DVL3, dorsally psoas muscle branch) branches of L3 cross the posterior part of TL5 tip. The dorsal (DL4 and DL5) and ventral (VL4 and VL5) branches of L4 and L5 run caudolaterally on the dorsal and ventral surface of pelvic girdle, respectively.





**Figure 2a.** The ventral view of lumbar region of swamp buffalo specimen No. 20 (B20) shows the course of the ventral branches of the last thoracic (VT13) and the first three lumbar spinal nerves (VL1-VL3). The VT13 crosses the anterior part of the first lumbar transverse process (TL1) tip. The VL1 crosses the anterior part of TL3 tip. The VL2 crosses the posterior part of TL4 tip. The dorsally psoas muscle branch of left VL3 crosses the posterior part of TL5 tip.



**Figure 2b.** The dorsal view of opened sacral region of buffalo specimen No. 20 (B20) shows the filum terminale of spinal cord (arrow) at the caudal part of the first sacral vertebra (S1), and the end of dura mater at the third sacral vertebra (S3). S2; the second sacral vertebra.

crossing the posterior border of the TL4 tip (Figure 1a, 1b, and 2a). The VL2 of a few specimens (2 specimens and one of the left side) showed variably crossed the posterior border of TL3 tip.

The ventral branch of the 3<sup>rd</sup> lumbar spinal nerve (VL3) of the most specimens (14 specimens and two of only left and right sides) were lining caudolaterally under psoas muscles to the inguinal region. The VL3 in some specimens (4 specimens and one of the left side) have a branch on the dorsal surface of the psoas muscles (DVL3) which it crosses the posterior border of transverse process tip of the fifth lumbar vertebra (TL5) (Figure 1b, right side and 2a, left side).

The ventral branch of the 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> lumbar spinal nerves were lining caudally along the body of vertebrae to the dorsolateral wall of pelvic cavity (Figure 1b). These nerves lied far from the median plane about 3.5-4.5 cm.

The conus medullaris of spinal cord of all specimens were tapered to filum terminale at the caudal part of the first sacral vertebra (Figure 2b). The end of dura mater of all specimens were located caudal part of the third sacral vertebrae (Figure 2b).

## DISCUSSION

The location of ventral branch of 13<sup>th</sup> thoracic spinal nerve of swamp buffalo was at the same point as of the cattle (Cakala, 1961, de Lahunta and Habel, 1986) since the ventral branch of buffalo also crossed the anterior border of transverse process tip of the first lumbar vertebra.

The ventral branches of the 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> lumbar spinal nerves of swamp buffaloes were greater variable distribution than those of the cattle (Cakala, 1961, de Lahunta and Habel, 1986). It might be the cause of the small number of the specimens (only 20 specimens) and the transverse process tips of swamp buffaloes are more lateral or far from the emerging point (intervertebral foramen) of each lumbar spinal nerves. Thus the

distribution of nerves are more variable lining. However, the transverse process tips are the easiest clinical palpation for locating anesthesia injection points in buffaloes. As the results, it might be recommended that the local anesthesia infiltration points of 1<sup>st</sup> lumbar spinal nerve (L1) in buffaloes are at the tips of both second and third transverse process of lumbar vertebra (TL2 and TL3), but the infiltration anesthesia point of L1 in the cattle is only the posterior border of TL2 tip (Cakala, 1961). However, the tip of TL2 of buffaloes was the main infiltration point for L1, since the percentage of ventral branches of L1 (VL1) crossed posterior border of TL2 tip were 45% (8 specimens and two of the right side in 20 specimens) and the crossing of the anterior border of TL2 tip were 20% (4 specimens and one of the left side in 20 specimens). The VL1 of the others specimens (30% or 6 specimens in 20 specimens) and 5% (one specimen) crossed the anterior border and posterior border of TL3 tip, respectively.

The ventral branch of L2 (VL2) crossed the anterior border and posterior border of TL4 52.5% (10 specimens and one of the right side) and 35% (7 specimens), respectively. It suggested that the main anesthesia infiltration point for the 2<sup>nd</sup> lumbar spinal nerve (L2) in the buffalo might be the tip of the 4<sup>th</sup> transverse process tip (TL4). It was similar to the recommended point in cattle (Cakala, 1961), but in buffaloes might be need the minor anesthesia infiltration point for L2 at the tip of TL3 since the VL2 crossed the posterior border of TL3 12.5% (2 specimens and one of the left side). This infiltration point will also anesthetize the more caudal lining of L1 as mentioned above.

The ventral branch of the 3<sup>rd</sup> lumbar spinal nerve (VL3) of the most specimens (75% or 14 specimens and two of only left and right sides) were similar to cattle by lining caudal and slightly lateral under psoas muscles to the inguinal region (de Lahunta and Habel, 1986). Some specimens (or 4 specimens and two of only right and left sides) having a branch of VL3 on the dorsal

surface of the psoas muscles and crossed the posterior border of transverse process tip of the fifth lumbar vertebra (TL5). Therefore, the infiltration anesthesia of the udder will be injection 3.5-4.5 cm from the median plane to the L3 at emergence point. This injection point was a little shorter than the original method of paravertebral anesthesia in cattle, 5 cm from the median plane (Farquharson, 1940). However, the width of vertebral bodies are variable on the body size of animals.

The ventral branch of the forth lumbar spinal nerve (VL4) for the udder might also be anesthetize by injection at emergence point from intervertebral foramen since it straight caudally along the bodies of vertebrae to the dorsolateral wall of pelvic cavity.

The conus medullaris of spinal cord and the end of dura mater of all specimens were similar with the cattle (Seiferle, 1951) because they terminated at the caudal part of the first and third sacral vertebrae, respectively. This might be recommended that the lumbosacral epidural anesthesia can be done in adult buffaloes as similar procedure as in adult cows (de Lahunta and Habel, 1986).

### CONCLUSION

The branch of the lumbar spinal nerves in swamp buffaloes were greater distribution than in

the cattle. It is recommended to inject at the tip of the first five lumbar transverse processes and infiltration to both anterior and posterior part of them for local anesthesia the last thoracic and first three lumbar spinal nerves. The epidural anesthesia in swamp buffaloes will be applied at sacrococcygeal foramen as similar as in cattle because of the conus medullaris of spinal cord is in the first sacral vertebra, and the end of dura mater is located caudal part of the third sacral vertebra.

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