Original Article

Study of lumbar plexus formation and its variations

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Abstract

Aim: This study was to describe the anatomical variations in the formation of lumbar plexus. Looking to the applied significance of lumbar plexus in the form of its involvement in various injurious and entrapment, it is imperative to have a thorough knowledge about its formation, branching pattern and variations. A recent increase in the retroperitoneal laparoscopic surgeries inspired us tore visit the anatomy of lumbar plexus. **Materials and method:** In the present study 25 embalmed cadavers have been dissected by trans peritoneal approach, lumbar plexus and its branches were identified bilaterally and variations were recorded. **Results:** Left prefixed lumbar plexus due to contribution from T12 was observed in one specimen and right post fixed due to contribution from L5 was observed in another specimen. Absent ilioinguinal nerve was noticed in one specimen on the left side. Four specimens showed the High formation of Lateral Femoral Cutaneous Nerve as there were contribution from L1-L2loop and L2, three specimens showed the Low formation, due to L3 contribution, on the left side respectively. Left third lumbar nerve was furcal nerve in one specimen and Right fifth lumbar nerve was furcal nerve in another specimen. Low formation of Femoral and obturator nerve was observed in one specimen respectively. **Conclusions:** Thus the knowledge of Anatomy of the lumbar plexus and its variations are useful to surgeons, who wish to perform a surgical intervention to this plexus.
Key words: Prefixed, postfixed, high and low formation, nervusfurcalis.

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INTRODUCTION

The lumbar plexus is one of the potential anatomical fields to show variations in many ways. The posterior abdominal wall contains the origin of lumbar plexus, numerous autonomic plexus and ganglia, which lie close to the abdominal aorta and its branches. The lumbar plexus originates from ventral rami of the L1-L3 and greater part of L4 nerve roots, projects laterally and caudally from the intervertebral foramina, in the posterior part of substance of the psoas major muscle. A communicating branch from the T12,also known as the sub costal nerve, often joins the first lumbar nerve. Of the main branches, the iliohypogastricnerve(L1), ilioinguinal nerve(L1), lateral femoral cutaneous nerve(L2,L3-dorsal), and femoral nerve(L2-L4,dorsal) appears, in that order from above downwards at the lateral border of psoas major muscle, the genitofemoral nerve(L1,L2) appears on the anterior surface and the obturator nerve(L2-L4,ventral) appears along the medial border of that muscle. The same is the position of accessory obturator nerve, if present. The pattern of lumbar plexus is altered if the plexus is prefixed or postfixed, that is, the fibre contribution is moved cranially or caudally, respectively (*Deepti Arora et al*).

MATERIALS AND METHODS

This study was conducted on 25 formalin embalmed cadavers (19male and 6female) received at the Institute of Anatomy, Govt, Madurai medical college Madurai. Lumbar plexus was explored by transperitoneal approach. By exposing the iliopsoas fascia branches like iliohypogastric, ilioinguinal nerve, femoral and lateral femoral cutaneous nerves were identified on the lateral border of psoas major muscle. Obturator nerve was

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medial to the muscle while genitofemoral nerve was seen on the surface of the psoas major. Psoas fascia and muscles were removed in piecemeal to study the formation & variations of lumbar plexus (*Cunningham's volume II; 115*)

RESULTS

Variations in the formation of lumbar plexus and its comparative study with the previous authors were tabulated [Philip A. Anloague *et al*]. Two out of 50 specimens, one specimen showed the prefixed type of lumbar plexus as there was a contribution from T12 and another specimen showed the postfixed, due to L5 contribution seen on the right side of the male cadaver.

Figure 1

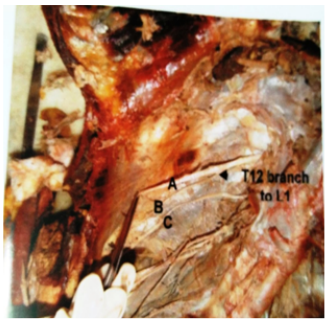

Figure 2

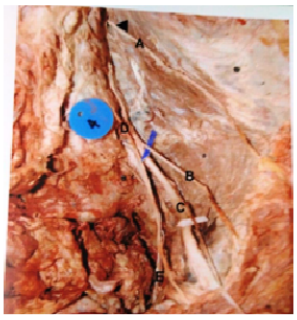

Figure 3

Figure 4

Figure 5

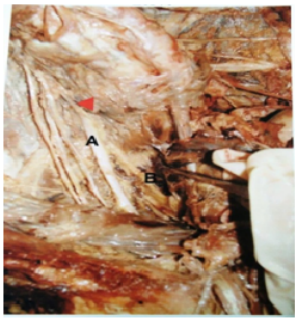

Figure 6

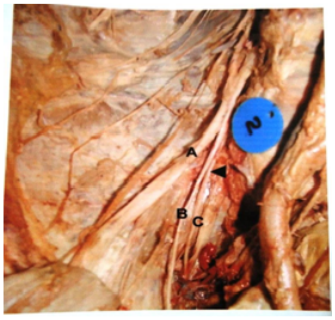

Figure 7

Legend

Figure 1: L3 nerve gives furcal branch (A:Genitofemoral nerve, B:Femoral nerve, C:Obturator nerve, D:Lateral femoral cutaneous nerve)
Figure 2: Iliohypogastric nerve receives a branch from subcostal nerve (A:Sub costal Nerve, B:Iliohypogastric nerve, C:Ilioinguinal nerve)
Figure 3: Ilioinguinal nerve from third lumbar nerve(A:Ilioinguinal Nerve, B:Lateral cutaneous nerve, C:Femoral Nerve, D:Genito femoral Nerve, E:Obturator Nerve)
Figure 4: Higher division of genitofemoral nerve as genital and femoral branch (A:Genitofemoral nerve,A1:Genital branch, A2:Femoral branch, B:Psoas major, C:Ilioinguinal nerve)
Figure 5: Lateral femoral cutaneous nerve from L1,L2-high form (A:Iliohypogastric Nerve,B:Ilioinguinal nerve, C:Lateral femoral cutaneous nerve, D: Femoral Nerve)
Figure 6: Fifth lumbar nerve gives branch to femoral nerve - low form(A:Femoral Nerve, B:Obturator Nerve)
Figure 7: Accessory obturator nerve formed from 3rd & 4th lumbar nerves (A:Femoral Nerve, B:Obturator Nerve, C:Accessory obturator Nerve)

Nervus furcalis

L3 nerve was furcal nerve in 2% (prefixed) and L5 nerve was furcal nerve in 2% (post fixed) of specimens [Gray's Anatomy, Bardeen C.R. and A.W. Elting (1901)] Fig. 1.

Iliohypogastric nerve

Since this nerve receives a branch from T12 (prefixed), seen in 2% on the right side (W. Henry Hollinshed1976, 1906-07 Bardeen CR's observation and J. Symington) Fig. 2.

Ilioinguinal nerve

Variation in theformation of this nerve was 8%, of which2% arose from L1-L2 loop, from L2 alone 2%(RonaldBergman (1988),from L3 alone 2% and absent on the left side in 2% of specimen(Ronald Bergman and Gray's Anatomy (2008) Fig.3.

Genito femoral nerve

8% of the specimen showed the higher division of this nerve at the origin level as genital and femoral branch *(Sim and Webb)* Fig.4.

Lateral femoral cutaneous nerve

Out of 10 variation specimens, in 4% of specimen, this nervearose from both L1,L2 (high formation),from L2 alone (high formation) in 4%,from L3 alone (high form) in 6% (Hollinshed, Griffins and De ridder *et al*), arose from femoral nerve in 4% and as two branch in 2% of

specimens (Erbil KM *et al* Anat. Sci(2002)3.5% and Sim and Webb) Fig. 5.

Femoral nerve

Low formation of femoral nerve from dorsal division of L3,L4, L5 was found in 2% and forms lateral femoral cutaneous nerve in 4% of specimens. [Bardeen C.R.A.W. Elting (1901)]Fig.6.

Obturator nerve

Low formation of obturator nerve from ventral division of L3, L4, and L5 was observed in 2% of specimen. [Bardeen C.R.A.W. Elting (1901)].

Accessory obturator nerve

Presence of accessory obturator nerve with root value of L3 &L4 was noticed in 8% of specimens.[Bardeen(1906), Kaiser (1949)]Fig. 7.

Table 1: Observation of variations in the formation of Lumbar plexus[Bardeen C.R]

Plexus formation	Variations	Frequency in %
Iliohypogastric nerve	From T12(Prefixed)	2%
	From L1-L2 loop	2%
Ilioinguinal nerve	From L2	2%
	From L3	2%
	Absent	2%
Genitofemoral nerve	Higher division	8%
	From L1,L2(High form)	4%
	From L2 (High form)	4%
Lateral femoral cutaneous nerve	From L3 (Low form)	6%
	From L2 as a two branch	2%
	As a branch of Femoral nerve	4%
Femoral nerve	Forms Lateral femoral cutaneous nerve	4%
	From dorsal division of L3,L4,L5(Low formation of plexus)	2%
Obturator nerve	From ventral division of L3,L4,L5(Low formation of plexus)	2%
Accessory Obturator nerve	From L3,L4 lumbar nerves	8%
Nervusfurcalis	L3 Furcal nerve (high form)	2%
	L5 furcal nerve(low form)	2%

DISCUSSION

In the present study iliohypogastric nerve receives a branch from 12th thoracic nerve in one specimen (2%), while Deepti Arora *et al* was observed in 3.3%. This also coincides with W. Henry Hollinshed 1976 and 1906-07 Bardeen CR's observation. J. Symington states that 12th thoracic nerve gives a branch to first lumbar nerve which in turn gives iliohypogastric and ilioinguinal nerves Quain's Anatomy 11th edition 1909. According to E.A. Schafer and J. Symington in Quain's Elements of Anatomy, ilioinguinal nerve may arise from a loop between first and second lumbar nerve or from L2 alone. Ronald Bergman (1988) study confirms the formation of ilioinguinal nerve from two spinal nerve roots (L1,L2 or L2,L3)in 11%. Absent ilioinguinal nerve and formation of this nerve from L3 was observed in 2% of specimen respectively, which coincides with Ronald Bergman and Gray's Anatomy(2008). This knowledge of ilioinguinal nerve is very useful to avoid injury to this nerve during surgeries like routine and laproscopicherniorrhaphy. Genito femoral nerve divides close to its origin as genital and femoral branch was observed in 8% of present study, also coincides with Sim and Webb study(8.3%).Thus the study of genito femoral nerve is useful to avoid injury to it during Vasectomy and Varicocoelectomy. Most common variations were found with Lateral Femoral Cutaneous Nerve cutaneous formation. In the present work, formation of lateral femoral cutaneous nerve from L1, L2 (high form) was 4% from L2 alone (high form) was 4% from L3 alone (low form) was 6%, while De ridder *et al* observed 12% for each variations. Presents study also showed the formation of lateral femoral cutaneous nerve as two branch in 2% and as a branch of femoral nerve in 4% of specimens, supported by Erbil KM *et al* Anat. Sci(2002)3.5%andSim and Webb 10% respectively correlated with Hollinshed and Griffins statement. Carai *et al*[18]. Lateral Femoral nerve from L3 can be correlated with Hollinshed and Griffins statement. Carai *et al*[18] reported absent lateral femoral cutaneous nerve in 8.8% of specimen. Knowledge about lateral femoral cutaneous nerve helps to avoid meralgiaparaesthetica caused by injury to this nerve during iliac crest bone graft. Bardeen C.R and A.W. Elting (1901) found that in the low form of plexus,the femoral nerve arose from dorsal division of L3-L5 and low form of obturator nerve arose from ventral division of L3-L5.This variation was observed in 2% of specimens respectively. Bardeen(1906), Kaiser (1949) found the accessory obturator nerve in 8.4 specimens which

coincides with the present study of 8%. Low formation of nervusfurcalis found in 2 % of the specimen which coincides with the Bardeen C.R. and Gray's anatomy.

Table 2: Comparison of present study with other authors [Philip A. Anloague]

Plexus formation	Present study (%)	Deepti Arora *et al*	Ronald Bergman	Sim and Webb	De ridder	Erbil *et al*
Iliohypogastric nerve(prefixed): T12,L1	2%	3.3%				
Ilioinguinal nerve: L1,L2						
Absent	2%		5%			
	2%		2.5%			
Genitofemoral Nerve:						
Higher division	8%			8.3%		
Lateral Femoral nerve:						
L1,L2	4%	1.67%		36.7%	12%	
L2	4%			1.7%	12%	
L3	6%				12%	
L2(two branch)	2%					
From femoral nerve	4%			10%		3.5%
Femoral nerve:						
Give raise to Lateral femoral nerve	4%			10%		
Accessory obturator nerve	8%			11.6%		

CONCLUSION

Of all the specimens (50), one showed the pre fixed type and one showed the post fixed type of lumbar plexus. Variations for iliohypogasrtic, obturator and femoral nerve were observed in one specimen and for ilioinguinal, genitofemoral, and accessory obturator nerve was observed in four specimens. Variations in the formation of lateral femoral cutaneous nerve was observed in ten specimens, of which five were low form and five were high form. Thus the knowledge of lumbar plexus formation and it's variations are useful forsurgeons, not only in surgical procedures, but also in diagnosing various clinical conditions associated with it, like referred pain, psoas abscess and hip joint diseases etc.

REFERENCES

1. Bardeen, CR and Elting,AW.1901.A statistical study of the variations in the position of the lumbo-sacral plexus in man. Anat. Anz, 19, pp.124, 209.
2. Bardeen, CR [1906-07] Development and variation of thenerves and the musculature of the inferior extremity and of the neighbouring regions of the trunk in man. Am.J.Anat.6:259-390.
3. Bergman, RA, Afifi, AK, Miyauchi, R. 2006. Genitofemoralnerve. http://www.anatomyatlases.org/Anatomic variants/Nervous system/Text/Genito femoral Nerve.shtml.
4. Carai A, Fenu G, SechiE,Crotti FM, Montella A. Anatomical variability of the lateral femoral cutaneous nerve:Findings from a surgical series.Clin Anat. 2009; 22; 365-370.
5. Cunningham's Practical Manualvolume II; 115
6. De Ridder, VA., De Lange, S., Popta, J.1999. Anatomical variations of the lateral femoral cutaneous nerve and the consequences for surgery. J Orthop Trauma, 13, pp.207-11.
7. Erbil, KM., Onderoglu, S., Basar, R.1999. Unusual branching in lumbar plexus:case report. Okajimas Folio Anat Jpn,76(1),pp.55-59.
8. Gray's Anatomy 2008(40th) Edition. Articles in Chinese. Zhonghuawai Kezazhi et al 2008 May 46(9): 647-9.Clinical anatomy of lumbar plexus in lumbar-anterolaterally.
9. Henry Hollinshedw.Text Book of Anatomy 1976 3rd Edition.
10. Horwitz, MT.1939. The anatomy of the lumbosacral nerve plexus- its relation to variations of vertebral segmentation. Anat. Rec, 74,pp 91.
11. Kaiser, RA. 1949 Obturator and Accessory obturatornerves. J. Bone Jt. Surg., 31A:815-819.
12. Philip A. Anloague et al; J Man Manip Ther.2009;17(4):e107-e114.
13. Schaefer, E.A. Symington, J. and T.H. Bryce, Eds.(1915) Quain's Anatomy, Longmans, Green and Co., London.

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