

ORIGINAL RESEARCH ARTICLE

Anatomical Studies with Clinical Importance of Unusual Patterns of Abdominal Muscles in North Indian Population.

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Abstract:

Introduction: Abdominal wall supports and protect abdominal organs during twisting and flexing movement of the trunk. To get surgical approach to the abdominal cavity, and intimate knowledge of the arrangement of the muscles is important.

Aim : Abdominal wall is anatomically layered structure to support and protect abdominal organs. For surgeries and autologous tissue breast reconstruction knowledge of arrangement of muscle is important .The present work was done for anatomical studies of unusual pattern of abdominal muscle.

Material and Method: The study was conducted on 32 cadaver of North Indian origin allotted for Anatomy dissection classes. Manual dissection was done to separate flat muscles of the abdomen.

Result: In the present study length and width of rectus abdominis muscle were symmetrical ,frequency of pattern of tendinous intersection were Transverse line (85.85%),Angulated line(7.57%) and oblique line(6.56%).In 78.12% intersection were bilaterally symmetrical , 15.62%were bilaterally asymmetrical and 6.25% intersection were incomplete.

Conclusion: The present study of unusual pattern of abdominal muscles is important as myocutaneous flap of rectus abdominis muscle is used for autologous tissue breast reconstruction.

Key words: Rectus abdominis muscle, External oblique muscle, Internal oblique muscle, Transversus abdominis muscle, TRAM Flaps, Breast reconstruction.

Introduction:

Abdominal wall supports and protect abdominal organs during twisting and flexing movement of the trunk. To get surgical approach to the abdominal cavity, and intimate knowledge of the arrangement of the muscles is important. The abdominal wall is anatomically complex layered structure with segmentally derived blood supply and innervations [1].

The right and left rectus abdominis muscle meet in mid line of anterior abdominal wall. The muscle fiber of the rectus abdominis are arranged vertically and are enclosed within an a poneurotic sheath , the anterior and posterior layer of sheath are fused in mid line at

the line alba. The rectus abdominis muscle has insertion on pubic bone and origin on fifth, six and seventh costal cartilage and xiphoid process. The lateral border gives the surface landmark, the lineas emilunaris. There are usually three intersection , one at the level of xiphoid process ,one at the level of umbilicus and one halfway between the xiphoid process and the umbilicus [2].

Lateral to the rectus sheath there are three muscles in layers, external oblique muscle, internal oblique muscle and transverses abdominis. The external oblique muscle run infer medially.

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It arise from lowest eight rib and costal cartilage. Medially it forms tendinou saponeurosis, which is continuous with the anterior rectus sheath. Inferior most edge of external oblique aponeurosis forms inguinal ligament [1].

The internal oblique muscle lies immediately deep to the external oblique muscle .It runs superomedially. It arise from lateral aspect of the inguinal ligament, iliac crest and thoraco lumber fascia. Medially it forms tendinous aponeurosis, which is continuous to the anterior and posterior rectus sheath. Inferior most edge of internal oblique muscle is contiguous with the cremasteric muscle [1].

The transverses abdominal muscle is the deepest of the three lateral muscles. It runs transversely from the bilateral lower six rib, the lumbosacral fascia and the iliac crest the lateral border of the rectus abdominis. Which is contiguous with the posterior rectus sheath [1].

The muscle of the hypomeres give rise to the lateral and ventral flexor musculature. The ventral flexor musculature splits into three layers .In the abdominal wall these three muscle layer consist of the external oblique muscle, internal oblique muscle and transverses abdominis muscle.In the abdominal wall the muscles of the various segments fuse to form large sheath of muscle tissue [3].

Innervation of the anterior abdominal wall is segmentally related to specific spinal levels. The motor nerves to the rectus muscles the internal oblique muscles and the transversus abdominis muscles run from the anterior rami of spinal nerves at the T6 to T12 level. The overlying skin is innervated by afferent branches of the T4 to L1 nerve roots, with the nerve roots of T10 sub serving sensation of the skin around the umbilicus [1].

The muscles must be split in the direction of their fibres, rather than cut across. The incisions must not divide nerves. The rectus muscles may be cut transversely without seriously weakening the abdominal wall, as such a cut passes between two adjacent nerves without injuring them. The rectus has a segmental nerve supply, so that there is no risk of a transverse incision cutting off the distal part of the muscle from its nerve supply [4].

The rectus abdominis is supplied by the deep superior and inferior epigastric vessels that run in the undersurface of the muscle and anastomose with the segmentally arranged intercostal vessels to form the epigastric arcade. These vessels send perforating branches throughout the length of the muscle, perforating the anterior rectus sheath and supplying the overlying skin. The Transverse Rectus Abdominis Myocutaneous (TRAM) flap, when based on the

superior epigastric vessel and including the infra umbilical skin, has become a workhorse for autologous tissue breast reconstruction [5].

The superior epigastric artery travels deep to the rectus muscle but enters it before the first inscription. It is a branch of the internal mammary artery, which itself is a branch of the subclavian artery. The deep inferior epigastric artery is a branch of the external iliac and enters the posterior sheath near the level of the arcuate line. The most important perforators from the superior and deep inferior epigastric arteries to supply the pedicle TRAM are immediately lateral and superior to the umbilicus [6].

A paramedian incision is made vertical, parallel to the midline, and about 2.5 cm away from it to one or other side. It may be made of any length, and even if extended from costal margin to pubis, the scar does not greatly weaken the abdominal wall [7].

In this incision there are different ways of dealing with the rectus, the muscle may be displaced outwards intact without any further interference with it. When the wound is closed the muscle returns to its bed and forms the most efficient protection possible to the line of the incision, which it directly covers. This is a sound incision extensively used on the right or left of the midline. When used to deal with the terminal part of the pelvic colon or for excision of the rectum, the incision extends low down so that the rectus may be mobilized down to its insertion to the pubis. The muscle may be divided in the line of the incision. The nerves to the rectus enter it from the side or back about its middle. If the incision through the rectus be made too far laterally, the nerves will be divided and the muscle paralyzed .In addition, since the blood supply enters with the nerve, an extensive split, combined with a tight closure, and may result in ischemia to the medial part of the muscle enclosed within the incision [7].

The present anatomical study was conducted on cadavers to report unusual patterns of abdominal muscle.

Material and Method:

The study was conducted on formalin fixed thirty two cadaver (21 male and 11 female) from dissection room of Anatomy Department of three Medical Colleges , Katihar Medical college, Katihar; DMCH Darbhanga and SRMS IMS Bareilly were included in this study during 2008-2014. All the cadavers were North Indian origin allotted to undergraduate medical student for dissection purpose.

In each case manual dissection was done following Cunningham's manual. To expose rectus abdominis muscle rectus sheath was opened by bilateral vertical incision. Lateral to the rectus sheath three flat muscles are separated layer by layer. These flat muscles are the

external oblique muscle, internal oblique muscle and transverses abdominis muscle. Number, location and pattern of tendinous intersection were studied. These intersection pass transversely or obliquely across the muscle in zig zag manner. Pattern of tendinous intersection were Transverse lines, Angulated lines and Oblique lines.

Length and width of the rectus abdominis muscle were measured by measuring total length of muscle from xiphisternum to pubic symphysis and width of the muscle at the level of its origin, insertion, costal margin, umbilicus and interval between the umbilicus and pubic symphysis.

The present study was conducted to identify variation in pattern and dimension of abdominal muscle. The result did not show any sexual dominance and bilateral variation exists. In this study we do not found variation in pattern of the external oblique muscle, internal oblique muscle and transverses abdominis muscle. We found unusual pattern and dimension in rectus abdominis muscle because number of tendinous intersection varied from two to five.

Observation and Results:

Table 1: Intersection In Each Rectus

No. of recti (64)	No. of intersection in each rectus	Percentage
In 2 recti	5 intersection	3.12%
In 4 recti	4 intersection	6.25%
In 36 recti	3 intersection	87.5%
In 2 recti	2 intersection	3.12%

The tendinous intersection were found to be zigzag in course, present only on anterior half of the muscle and adherent to the anterior wall of the rectus sheath. The posterior wall of rectus sheath was free.

The frequency of occurrence in 64 recti were five tendinous intersection in two recti (3.12%), four tendinous intersection in four recti (6.25%), three tendinous intersection in 56 recti (87.5%), two tendinous intersection in two recti (3.12%).

Table-2. Patterns of Tendinous Intersection

Pattern	No. of intersection (total no. 198)	Percentage
Type A (Transverse line)	170	85.85%
Type B & C (Angulated line)	15	7.57%
Type D (Oblique line)	13	6.56%

Type A (Transverse line), 170 tendinous intersection (85.85%). Type B & C (Angulated line apices directed superiorly or inferiorly), 15 tendinous intersection (7.57%). Type D (Oblique line) 13 tendinous intersection (6.56%).

Table 3: Tendinous intersection with no. of Cadaver

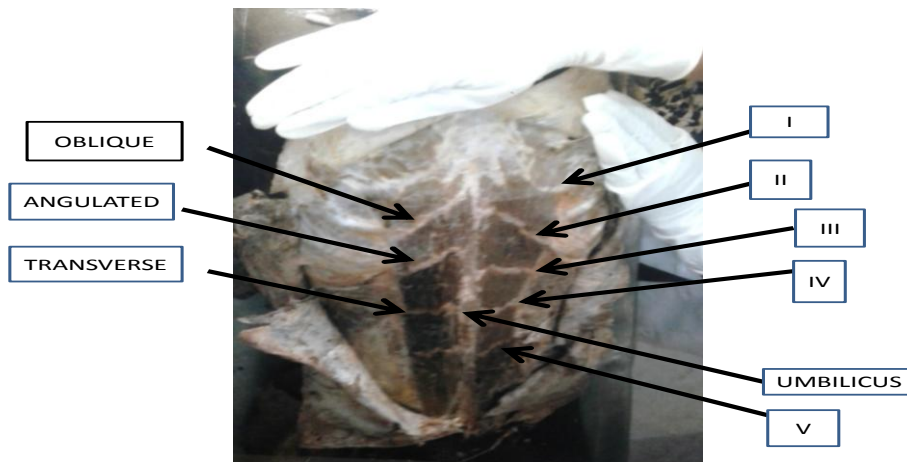
Tendinous intersection	No. of cadaver (total no. 32)	Percentage
Bilateral symmetrical in pattern	25	78.12%
Bilateral Asymmetrical in pattern	5	15.62%
Incomplete intersection	2	6.25%

In 25 cadavers (78.12%) the intersection were bilaterally symmetrical where on in 5 cadavers (15.62%) it was bilaterally asymmetrical in pattern. In 2 cadavers (6.25%) the intersection were incomplete i.e. they failed to reach either medial or lateral borders of the recti.

Table 4: Length and width of rectus abdominis muscle: [In cm]

Length	Minimum	Maximum	Mean
From Xiphisternum to Pubic Symphysis	34.4	37.1	35.4
Width at Different Level			
At Origin	1.8	2.5	2.1
At Insertion	4.4	6.8	5.4
At Costal Margin	5.5	7.5	6.3
At Umbilical	4.2	5.1	4.8
Below Umbilicus	4.5	5.1	4.7

The mean length of rectus abdominis muscle from xiphisternum to pubic symphysis was 35.4 cm. The mean width at origin-2.1cm, at insertion 5.4 cm, at costal margin-6.3cm, at umbilicus-4.8 and below umbilicus-4.7cm



Caption for the figure 1- Location Of Tendinous Intersections

I At the Xiphisternum
II At the costal margin.
III In between Xiphisternum and umbilicus
IV At the Umbilicus
V In between Umbilicus & pubic symphysis

Discussion:

Normal anatomical pattern of abdominal muscle are illustrated in medical books but other variation in pattern are reported in research works.

Z. AshAktan]kiz, Hulya Ucerler presented a case report in the dissection of a 65 year old man both right and left rectus muscle were symmetrical but there were no tendinous intersection on them. The total length of the muscle was 30 cm bilaterally. The width at the umbilicus level was 5.7cm on the right side and 5.4cm on the left side. The thickness of the muscle at the umbilical level was 0.5cm for both side [8].

The measurements of the recti in the present study were bilaterally symmetrical and there was no correlation between the length or width of the muscle with the number of inscriptions. The mean length of the rectus abdominis muscle was 35.4cm bilaterally. The mean width at the umbilicus level was 4.8cm. Milloy, Anson and McAfee also found in their study the recti to be of equal length on both sides and measured between 34 to 38 cm [9].

Das SI, Suri RK, Kapur V. studied 46 human cadavers to note the different patterns of tendinous intersection of rectus abdominis muscle. They found two unusual pattern of intersection ,one with tendinous intersection arched and the other with the intersection at different level on the right and left side of the same cadaver[10].

The pattern of tendinous intersection in present study were transverse line in 85.85% ,angulated in 7.57%, oblique in 6.56% and incomplete intersection in 6.25%.The intersection at different level on the right

side and left side in the same cadaver was 15.62% and the intersection at same level on the right side and left side (bilateral symmetrical in pattern) in 78.12%.

Ribeiro ,DMc., Cerqueira, PC et al was found a male cadaver in 106 dissection, who did not have inferior venter of rectus abdominis muscle bilaterally. Instead of this there was a tendon on left side measuring 5.5cm laterally and 12cm medially. At the right side there was the same variation with 15.5 cm long tendon arising from pubis [11].

In present study we found tendinous intersection in all cadaver which varied in number from two to five. Two intersection in one cadaver (3.12%), three intersection in twenty eight cadaver (87.5%), four intersection in two cadaver and five intersection in one cadaver (3.12%).

Yan LI ,Zhong S. dissected twenty two embalmed cadaver. They found cutaneous nerve distribution in TRAM flap coming mainly from T11,T12. They run obliquely between transverse abdominis and internal oblique muscle. At the lateral edge of rectus abdominis ,they pierce the anterior rectus sheath in to the muscle and to supply the overlying skin[12].

Mori HI, Akita K, Hata Y dissected twenty cadaver. They investigated anterior cutaneous branches of the 10,11 and 12 inter costal nerves innervating the transverses, rectus abdominals musculocutaneous and deep inferior epigastric perforator flaps [13].

Ali QM studied sonographic anatomy of the rectus sheath in 8 subjects. Identical segments and intersections were found to have characteristic

sonographic features in all subjects. The intersection below the umbilicus was observed in one out of eight. Preoperative ultrasonic definition of rectus flaps may provide basis of reconstructive surgery [14].

Conclusion:

The present study of unusual pattern of abdominal muscles is important as myocutaneous flap of rectus abdominis muscle is used for autologous tissue breast reconstruction.

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