



Original Research Article

Low lying pubic tubercle: A predictor of development of inguinal hernia

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ABSTRACT

Background: All the inguinal hernias begin within a single weak area called myopectoneal orifice, the natural mechanisms in our body which support this area are oblique direction of the inguinal canal in abdominal wall, the tension mechanism of transversalis fascia and presence of aponeurotic extensions from the transverse abdominis aponeurotic arch in the posterior wall of the inguinal canal. As the distance from pubic tubercle to the horizontal line joining two anterior-superior iliac spine increases, the inguinal canal becomes less oblique that leads to increased risk of development of inguinal hernia. The present project was planned to study the role of low-lying pubic tubercle in development of inguinal hernia.

Materials and Methods: The present case control study was conducted in our institute from June 2018 to April 2019 taking 100 cases and 100 control meeting inclusion criteria. In all patients, following parameters SS line, ST line, height, weight was recorded and evaluated.

Results: The mean value of ST line in our study group is 7.3476 ± 0.16354 cm significantly greater ($p=0.05$) than the controls the mean value being 6.9242 ± 0.12620 cm.

Conclusions: Group of people with low-lying pubic tubercle are at high risk of developing inguinal hernia.

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1. Introduction

An inguinal hernia is a protrusion of abdominal-cavity contents through the inguinal canal or fascia transversalis. Inguinal hernias always contain a portion of peritoneal sac and may contain viscera, usually small bowel and omentum. Risk factors for the development of a hernia include: smoking, chronic obstructive pulmonary diseases, obesity, collagen vascular diseases, bladder outlet obstruction and previous open appendectomy, among others.^{1,2} Inguinal hernia is a common problem in men aged more than 50 years.

The lifetime prevalence rate of inguinal hernia in men aged more than 45 years ranges between 28.0 and 39.7%.³ Inguinal hernia repair is the most frequently performed

operation in general surgery. The incidence of subclinical inguinal hernia was reported between 10 and 33%, whereas it was found to be 20% in autopsy studies.^{4,5} The chance that a man will undergo an inguinal hernia repair during his life is 27%.⁶

There are two types of inguinal hernia; direct and indirect, which are defined by their relationship to the inferior epigastric vessels. One common feature in all types of hernias is a zone of weakness through which herniation occurs. All the inguinal hernias begin within a single weak area called myopectoneal orifice.⁷ As the mankind evolved from Neanderthal man to homoerectus/homosapiens (upright man) there is thought to be apparent lack of the evolutionary development of a strong posterior rectus sheath and transversalis fascia in lower abdomen which is thought to represent a significant specific anatomic

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defect.⁸

There are natural mechanisms in our body which support the area of myopectoneal orifice. Factors preventing inguinal hernia are the oblique direction of the inguinal canal in the abdominal wall; the tension mechanism of transversal fascia; the sphincter mechanism of Lytle; the tamponade function of cremaster muscle; the mechanisms for the constricting the internals femoral ring and presence of aponeurotic extensions from the transverse abdominis aponeurotic arch in the posterior wall of the inguinal canal. Lateral and cephalad displacement of the internal ring beneath the transversus abdominis muscle and approximation of crura results in shutter mechanism at inguinal canal.⁸

As the distance from pubic tubercle to the horizontal line (The line joining two anterior-superior iliac spine) increases, the inguinal canal becomes less oblique. A low-lying pubic tubercle results in less obliquity of inguinal canal and narrow arching of conjoint tendon with wide origin of internal oblique muscle and transverses abdominis muscle. It leads to ineffective shutter mechanism of inguinal canal. Thus increasing the risk of future development of inguinal hernia.⁹

Hernia presents as bulge in the groin area that becomes more prominent while coughing, straining, or standing up. Mild discomfort can develop over time. As the hernia progresses, contents of the abdominal cavity, such as the intestines and omentum, can descend into the hernia causing an intestinal obstruction. If the blood supply of the portion of the intestine caught in the hernia is compromised, the hernia is deemed "strangulated" and gut ischemia and gangrene can result, with potentially fatal consequences. The timing of complications is not predictable. Emergency surgery for incarceration and strangulation carries much higher risk than planned, "elective" procedures.

These complications can be avoided if the hernia is diagnosed early. Further, the burden of hernia will decrease if such patients having high risk of development of inguinal hernia can be identified. They can be advised to avoid strenuous activities because they are at risk of developing inguinal hernia. Hence, the present project is to study the role of low lying pubic tubercle in development of inguinal hernia.

2. Materials and Methods

This case control study was conducted in 100 patients of inguinal hernia admitted in our institute and 100 healthy individuals as controls.

2.1. Inclusion criteria

1. For cases — All patients diagnosed as case of inguinal hernia.

2. For controls — All normal attendants accompanying inguinal hernia patients who were comparable to respective patients with respect to age, height and weight.

2.2. Exclusion criteria

1. Hernias associated with hydrocele / undescended testis / Irreducible / Strangulated / Obstruction.
2. Patients less than 18 years of age.
3. History of pelvic fracture / Anomaly / Hip surgery
4. BMI >29.9

2.3. Clinical analysis

The informed consent was taken from all patients who will participate in the study. All patients assessed with a detailed history and clinical examination. All the patients were subjected to ultrasonography of inguino-scrotal region, kidney, urinary bladder, prostate and any abdominal lump.

2.4. Measurements

The study subjects were asked to lie in supine relaxed position on hard bed. Keeping both their lower limbs straight, so that both the anterior superior iliac spine were at the same level. A line drawn on the anterior abdominal wall connecting both anterior superior iliac spines which will be given the name SS and the length of SS line in cm were noted; next the pubic tubercle on the side of hernia was marked by the palpation. Then vertical distance between this point and the SS line was measured in centimeters and this line was designated as ST line. Similar measurements were done on controls as well. At the end of the study, the data was collected and analyzed statistically by using Student t-test and Chi square test. A value of $p < 0.05$ was considered as significant.

3. Results

This case control study was conducted in 100 patients of inguinal hernia admitted in our institute. The attendants (100) accompanying the patients were taken as controls. The two groups (case and control) were statistically comparable with respect to age, height and weight. The level of pubic tubercle was measured in centimeters as vertical distance (ST line) from the horizontal level (SS line — the line joining the two anterior superior iliac spine). The ST lines were measured in all cases as well as controls and the results were analyzed. In our study, all the patients were males. Majority (74%) of inguinal hernia patients were in age group 31-70 years. Indirect inguinal hernia was more common than direct inguinal hernia (65% Vs 32%). Inguinal hernia was slightly more common in right side (49%) as compared to left side (48%). Majority of patients (64%) were over-weight with BMI 25 – 29.9. The results were as

under:

Mean value of ST line were 7.3476 ± 0.16354 cm and 6.9242 ± 0.12620 cm in cases and controls respectively. ST line was longer in cases ($p < 0.05$). This implies that the level of pubic tubercle was lower in hernia patients. Most of the hernia patients had ST line > 7.1 cm (statistically significant). Height/ST line as a parameter was selected in order to minimize any bearing that the height of the patients might had on their ST length. It was found that majority of cases had lower Height/ST length value ($p < 0.05$). Majority (83%) of the hernia patients had Height/ST line < 23.5 (statistically significant). Weight/ST line as a parameter was selected in order to minimize any bearing that the weight of the patients might had on their ST length. It was found that majority of cases had lower Weight/ST length value ($p < 0.05$). Majority (63%) of the hernia patients had Weight/ST line < 10 (statistically significant).

| | Case | Control | p value |
|----------------|-----------------------|-----------------------|------------|
| ST Line | 7.3476 ± 0.16354 | 6.9242 ± 0.12620 | $p < 0.05$ |
| Height/ST Line | 22.5085 ± 1.02353 | 23.7759 ± 0.92047 | $p < 0.05$ |
| Weight/ST Line | 9.5642 ± 1.17395 | 9.2784 ± 0.49547 | $p < 0.05$ |

4. Discussion

All sites of herniation possess one common feature i.e. the zone of weakness where structures pass from or to the abdominal cavity. In case of inguinal hernia, as the testis descends from the abdominal cavity to the scrotum in male it first passes through a defect called the deep inguinal ring in the transversalis fascia, just deep to abdominal muscles. Muscle fibres of the innermost two layers of the lateral abdominal wall, the transversus abdominis and the internal oblique muscle, arch over the deep inguinal ring from lateral to medial before descending to become attached to the pubic tubercle. These two muscles fuse and become tendinous, hence the arch is referred to as the conjoint tendon. Below this arch there is no muscle but only transversalis fascia and external oblique aponeurosis resulting in a zone of weakness, and the lowness of the pubic tubercle is associated with narrow origin of internal oblique muscle from lateral inguinal ligament. This narrow origin fails to protect the deep ring and consequently predisposes the individual to develop inguinal hernia.

The age-distributed prevalence rates shows that inguinal hernia prevalence was peaking at adult age group of 50-70 years which constituted almost 38% and 31-49 years which accounted for 36% of inguinal hernias in this study, whereas Indranil Basu et al. study showed that the peak incidence of inguinal hernia was 42 to 57 years.¹⁰ It is relatively less common in adolescent age groups. Some studies have shown that age distribution is bimodal peaking

at early childhood and old age. This can be explained on the basis that most patients especially of the lower socioeconomic group do not present to the hospital during the initial presentation of the disease, instead opting for surgery only when the disease becomes a hindrance to their occupation or day to day activities. Novarro et al. (1992) undertook study in 156 cases of inguinal hernia; they measured distance of pubic tubercle from a horizontal line joining both the anterior superior iliac spines and compared the result with twenty healthy volunteers. The distance of the pubic tubercle from bi-crestal horizontal line was more than 7.0 cm in patients having inguinal hernia as compared to the volunteers, who had less distance.¹¹ Chand Sehgal et al. (2000) in their study have classified the subjects as (Group 1) “high lying pubic tubercle” i.e. those with ST line more than 7.5 cm and (Group II) “low-lying pubic tubercle” i.e. those with ST line more than 7.5 cm. they observed that in 73.6% of cases and only in 16% of controls belonged to Group II and concluded that the low-lying pubic tubercle was a predisposing factor for inguinal hernia.¹² Lopez- Cano et al. (2005) have stated that the low pubic arch group showed a significantly longer inguinal ligament at its medial insertion. The lower the pubic tubercles are located, the more often morphological alterations are found in the external oblique, internal oblique, transversus, cremasteric muscles and fascia transversalis. The shutter-like mechanism at the internal inguinal ring is provided by contraction of the arching fibres of the internal oblique muscle, which, when shortened, approximate themselves to the inguinal ligament and compress the spermatic cord. The unusual origin and insertion of internal oblique and transversus abdominis muscle, results in an ineffective shutter mechanism of the inguinal canal.¹³ Agrawat M et al. (2014) undertook study of 135 cases of inguinal hernia to evaluate the role of low-lying pubic tubercle in development of inguinal hernia and concluded that abnormal origin and insertion of internal oblique and transversus abdominis muscle and thus resulting in an ineffective shutter mechanism of inguinal canal leading to increased risk of inguinal hernia development, especially in the presence of other risk factors.¹⁴

In the present study the mean value of ST Line was 7.3476 in the cases which was much above mean value of ST Line of controls (6.9242). All the patients who had ST Length > 7.1 cm (both cases and controls) 91% of them had inguinal hernia while 11% of them did not have an inguinal hernia. Radojevic calculated the angle created between the interspinal line and Malgaigne’s line and concluded that a large angle increases the risk of development of inguinal hernia.¹⁵ Radojevic and Ami independently studied the pubic height.^{15,16} Both arrived at the same conclusion that greater the pubic height, more likely are the chances of developing hernia due to a larger Fruchaud’s area, a theory that was postulated by Georges Chavannaz, a French

professor. Ajmani and Ajmani studied the musculature of the lower abdominal wall muscles and noticed that in inguinal hernia patients, the internal oblique muscle origin from the inguinal ligament was away from the pubic tubercle and its lower fibers did not cover the deep inguinal ring. As a result the deep inguinal ring is left unprotected thus predisposing to hernia formation.¹⁷

Harris and White found an association between the length of inguinal ligament and a tendency to develop inguinal hernia and found that they are directly proportional.¹⁸

According to Stoppa, pelvimetry is a simple clinical examination which should be routinely considered.¹⁹ these findings help us determine whether the functional significance of the inguinal region is modified by anatomic variations be it bony, muscular or ligamentous. Configuration of bony pelvis seems to be a major contributing factor in determining the risk of development of inguinal hernia as evidenced by our study. Other parameters such as Weight/ST line, SS line/ST line and Height/ST line also showed statistically significant variations. Early identification of said risk factors in early adulthood could help in the prevention of hernia.

The inguinal canal, in the study group with low lying pubic tubercle being more longer and more oblique so the hernia sac will push out easier through the canal as the more gravitational effect than when the canal is more or less horizontal or oblique in normal group. So we can state that the functional significance of the inguinal region is modified by bony, ligament and muscular variations and therefore the identification of the structural characteristics enables the surgeon to perform the surgical technique appropriately, be it classical hernia repair or laparoscopic approach for prosthetic mesh implantation. Pelvimetry with radiograph correlation is a simple and non-invasive method that could help in identification of the risk factors as well as adequately plan preoperatively the kind of hernia repair to be undertaken for individual patients. On the other hand those patients with low-lying pubic tubercle developed inguinal hernia preferably to make hernioraphy for the posterior wall and do reinforcement for the deep ring by mesh for example since they have unprotected deep ring and weak shutter mechanism.

5. Conclusion

We concluded that low-lying pubic tubercle makes the inguinal canal more vertical rather than being more or less horizontally placed, making it easier for the hernial sac to be pushed out through the canal due to gravitational effect. It is also associated with narrow origin of internal oblique leading to unprotected deep ring and weak shutter mechanism. As a result these individuals become more prone for the development of inguinal hernia. Thus, the individuals having low-lying pubic tubercle can be given

precautionary advice to avoid strenuous activities because they are at risk of developing inguinal hernia.

6. Source of Funding

None.

7. Conflict of Interest

None.

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