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Optical illusions quintuple during laparoscopic total extraperitoneal preperitoneal (TEPP) hernioplasty: A case report

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Abstract

Optical illusion is a critical factor for bile duct injury during laparoscopic cholecystectomy, but it has never been reported in literature except for a recent report by the author (Ansari MM. Clin Med Imag Int J 2018; xx: xx-xx.(in Press)). A 35-year old man presented with bilateral indirect inguinal hernia. Bilateral laparoscopic total extraperitoneal preperitoneal (TEPP) hernioplasty was performed with 3-midline-port technique through posterior rectus sheath approach. During right hernioplasty, five transient optical illusions were encountered, namely, secondary vs. primary arcuate line, complete vs. incomplete posterior rectus sheath, attenuated lower part of complete posterior rectus sheath vs. transversalis fascia, second layer of double-layered posterior rectus sheath vs. transversalis fascia, and actual vs. virtual junction of secondary arcuate line & Spigelian fascia. Significant technical difficulties were experienced, completing the procedure in 3 hours. Left TEPP repair showed mirror anatomy similar to the right side, and was completed smoothly in 1 hour.

Keywords: Optical illusion, laparoscopic hernioplasty, TEP/ TEPP, arcuate line, posterior rectus sheath, transversalis fascia, preperitoneal fascia

Introduction

Optical illusion is now an established causal human factor for the higher incidence of the bile duct injuries during laparoscopic cholecystectomy as compared to the open cholecystectomy^[1]. However, the phenomenon of the optical illusion during the laparoscopic total extraperitoneal preperitoneal (TEPP) hernioplasty has not yet been reported in literature to the best of our knowledge except for one recent report of triple optical illusions by the author^[2]. Herein, we present a case of five transient optical illusions in an adult patient undergoing simultaneous bilateral TEPP hernioplasty for primary inguinal hernia.

Case Report

A male adult patient aged 35 years (MY #19) with a BMI (body mass index) of 23.0 Kg/m² presented with bilateral indirect inguinal hernia. Pre-anaesthetic check confirmed ASA grade I of American Society of Anesthesiologists. He was taken up under written informed consent for bilateral TEPP hernioplasty under general anesthesia. A 3-midline-port technique through posterior rectus sheath approach was used without a balloon dissector (Fig. 1). Right side was operated first. Immediate direct telescopic dissection within the posterior rectus canal bounded revealed that the posterior rectus canal was bounded anteriorly by a well-defined diaphanous rectus fascia covering the rectus abdominis muscle as reported earlier by the author earlier^[3], and also reflected momentarily the classical textbook description of the posterior rectus sheath (PRS) as taught in the anatomy classroom, i.e., an aponeurotic incomplete posterior rectus sheath with a well-defined arcuate line and in its lower part by the transversalis fascia (Fig. 2A). With a little more telescopic dissection, it was realized that the arcuate line was not really primary (termination of posterior rectus sheath) but secondary in nature (*Illusion 1*) and the posterior rectus sheath continued inferior to the in-transit secondary arcuate line in a grossly attenuated form upto the pubic bone, a clinical situation reported earlier by the author^[4,5].

The upper aponeurotic part of the complete posterior rectus sheath (C-PRS) above the secondary arcuate line was initially misidentified as the classical incomplete posterior rectus sheath (*Illusion 2*), and the grossly attenuated lower part of this C-PRS was misidentified as the transversalis fascia (*Illusion 3*) (Fig. 2A-C).

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These three misperceptions were rectified by the application of the ‘methods of error reduction’, i.e., the tendinous fibres and bands (Henle’s band) which were present in the grossly attenuated lower part of the C-PRS (Fig. 2B-C) are never present in the transversalis fascia.

Middle working port was placed at the previously marked site (Fig. 1) and the C-PRS was opened at the level of this port (approximately corresponding to the midpoint of the umbilico-pubic distance) to achieve an ergonomic working, i.e., an artificial secondary arcuate line was created at the level of the middle working port (Fig. 2D-G) as described earlier by the author [6-8]. On wide opening the C-PRS transversely, two fascial layers were visible (Fig. 2E) and the deeper layer was considered as the transversalis fascia but soon it was realized on a little more gentle dissection that the complete posterior rectus sheath was itself double-layered in nature and the transversalis fascia proper was really present further deep (Fig. 2G).

Thus, the second layer of the attenuated C-PRS was misidentified for a moment as the transversalis fascia (*Illusion 4*) but presence of tendinous fibres in it dispelled the misconception.

During the lateral extension of the artificial secondary arcuate line (Fig. 2H), the junction of the Spigelian fascia and the lateral end of the artificially created secondary arcuate line was misjudged due to the angle being splayed out under the twin effects of the CO₂ insufflation pressure and pulling-down pressure by the instrument over the lower end of the posterior rectus sheath (*Illusion 5*), leading to excessive division with resultant peritoneal injury and pneumoperitoneum which was vented by putting a Veress needle at the Palmer point of the abdomen. This patient also had a double-layered preperitoneal fascia which was timely recognized for the avascular dissection in the proper surgical preperitoneal space between the transversalis fascia proper and the double-layered preperitoneal fascia as reported earlier by the author [9-10]. Right hernioplasty was completed in 3 hours with significant technical difficulties secondary to the anatomic variations and optical illusions.

Left TEPP repair was also performed in the same sitting, which showed presence of two anatomical variations, namely, presence of complete posterior rectus sheath of grossly attenuated nature and a double-layered preperitoneal fascia. Left hernioplasty was completed in 1 hour with ease and rapidly as compared to the right side.

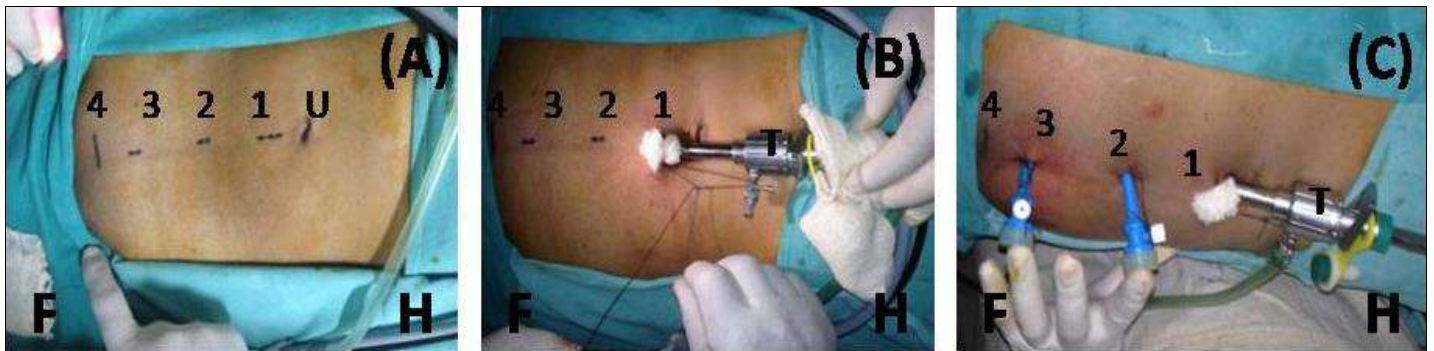
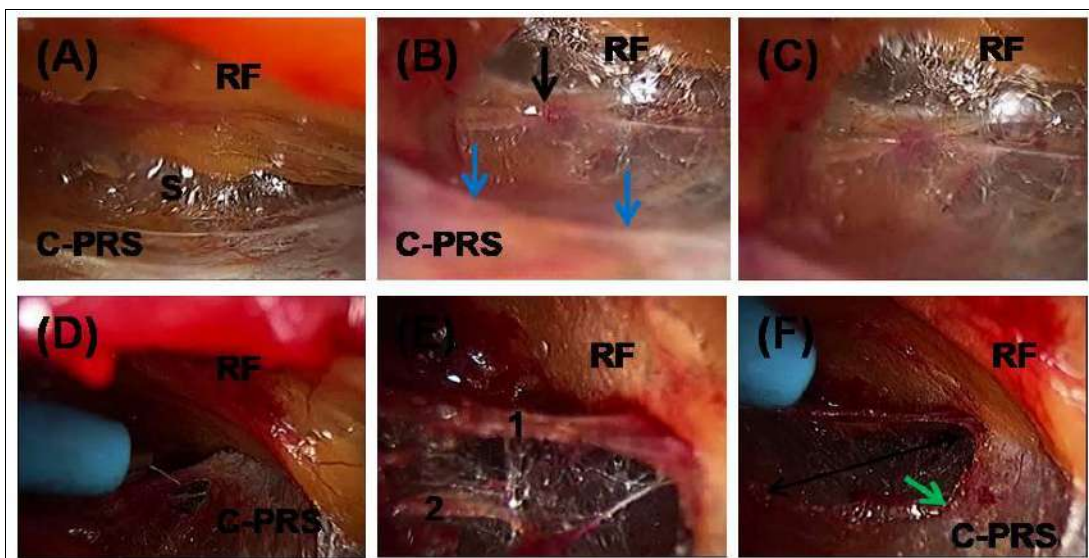


Fig 1: Port Placement for Laparoscopic Total Extraperitoneal Preperitoneal (TEPP) Hernioplasty for Inguinal Hernia; F, foot end of patient; H, head end of patient; U, umbilicus; 1, infraumbilical site for camera port (11 mm); 2 & 3, sites for working ports (5 mm); 4, upper border of pubic symphysis; T, 11-mm metallic trocar with 10-mm 0° telescope in-situ; Blue trocars, 5-mm plastic trocars; (Reproduced with permission from Ansari MM. A Study of Laparoscopic Surgical Anatomy of Infraumbilical Posterior Rectus Sheath, Fascia Transversalis & Pre-Peritoneal Fat/Fascia during TEPP Mesh Hernioplasty for Inguinal Hernia.-Doctoral Thesis for PhD (Surgery), Aligarh Muslim University, Aligarh, India, 2016)



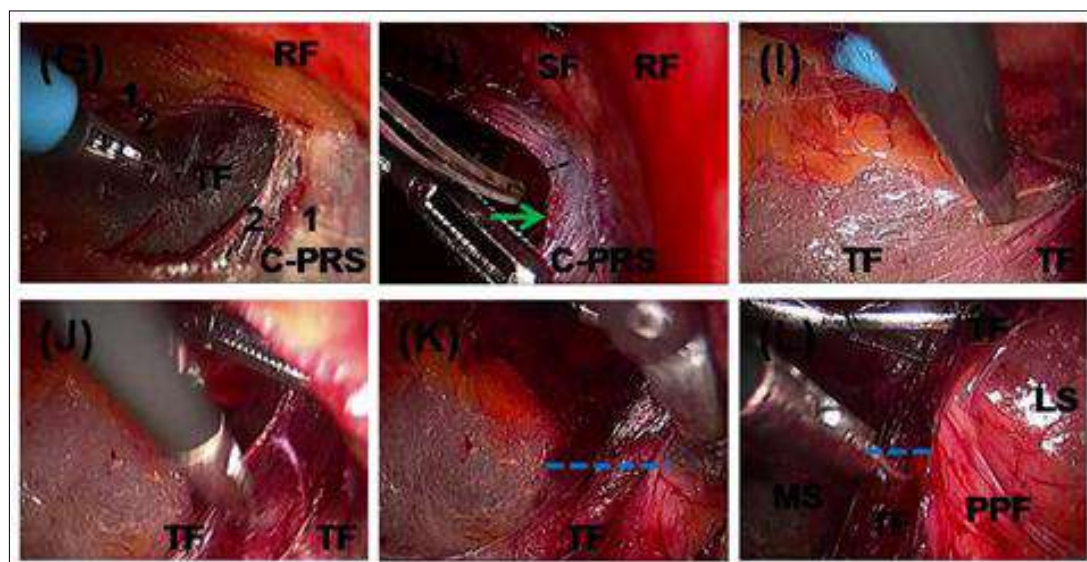


Fig 2: Five Anatomic Illusions during Right Laparoscopic Total Extraperitoneal Preperitoneal (TEPP) Hernioplasty: (A-C) Telescopic dissection in true posterior rectus canal bounded anteriorly by diaphanous Ansari's rectus fascia (RF) and posteriorly by grossly attenuated complete posterior rectus sheath (PRS) continuing upto pubic bone (Absent primary arcuate line) but containing a well-defined secondary arcuate line (Blue Arrow) and a tendinous band called Henle's Band (Black Arrow); secondary arcuate line as the primary arcuate line (Illusion 1), upper tendinous part of complete PRS was initially misidentified as the classical incomplete PRS (Illusion 2), and lower grossly attenuated part of complete PRS as the transversalis fascia (Illusion 3); (D-F) creation of an artificial arcuate line (Green Arrow) at about the level of middle working port (P) by making a transverse opening (Double-headed Black Arrow) in complete PRS; (D) Two layers (1 and 2) of double-layered C-PRS clearly visible through opening in C-PRS; second PRS layer (2) was initially misperceived as transversalis fascia (Illusion 4); (H) Lateral extension (Black dotted line) of artificial arcuate line (Green Arrow) and misjudgement of its junction with Spigelian fascia (Illusion 5), resulting in small peritoneal injury; (G-H) Dissection underneath C-PRS; (I-K) Making an opening in transversalis fascia (TF) to enter lateral preperitoneal space; (L) Division of transversalis fascia fibres (Blue dotted line) to freely communicate the medial (pre-transversalis) space (LS) and the lateral (retro-transversalis) space (LS); S, sign of lighthouse faintly visible in the depth; PPF, preperitoneal fascia covering indirect hernial sac; SF, Spigelian fascia; (Reproduced with permission from Ansari MM. A Study of Laparoscopic Surgical Anatomy of Infraumbilical Posterior Rectus Sheath, Fascia Transversalis & Pre-Peritoneal Fat during TEPP Mesh Hernioplasty for Inguinal Hernia.-Doctoral Thesis for PhD (Surgery), Aligarh Muslim University, Aligarh, India, 2016)

Discussion

Morphological variations in the fascial abdomino-inguinal anatomy are known since but has been re-emphasized recently for their surgical significance during newer surgical approaches of modern laparoscopy^[3-10], where even the thinnest fascial layers and tissues are visualized very clearly under the excellent lighting, high magnification and internal perspective, and all the same, projected in real time on to the video monitors for the collective wisdom of not only the whole surgical team but also the audience far from the operation theatre. Multilaminated fascial layers are potentially prone to optical illusion, especially for the young surgeon not well-versed with the older literature outside the traditional textbooks of surgery and anatomy.

In recent years, the laparoscopic surgeons became wiser about the optical illusion as a critical causal factor for the higher incidence of laparoscopic bile duct injuries through the work of Way *et al*^[1]. However, the optical illusion has not yet been explored for their significance during non-biliary surgery. For the first time, the author analysed his own experience of optical illusion during a prospective doctoral research study, and reported a case of triple optical illusions earlier^[2]. Present case of five different optical illusions during TEPP hernioplasty in a patient warrants due cognizance for their potential occurrence by the laparoscopic hernia surgeons to safeguard against the injudicious dissection and technical difficulty for seamless execution of the procedure with ease, rapidity and safety.

Experience of laparoscopic TEPP hernioplasty on one side benefitted the author for the contralateral side because of the mirror anatomy on the two sides of the body in this patient, and the contralateral repair was performed smoothly and rapidly without any anatomical illusion. However, this may not be

necessarily true for all cases because non-mirror anatomy has been reported in the posterior rectus sheath extent (50%), posterior rectus sheath morphology (37.5%), posterior rectus sheath extent & morphology both (75%)^[4]; and similarly non-mirror anatomy has been also documented in the arcuate line position (50%), arcuate line morphology (37.5%), and arcuate line position and morphology both (62.5%)^[5].

Conclusion

Five different transient optical illusions were documented in a patient undergoing laparoscopic TEPP hernioplasty for primary inguinal hernia, with significant increase in technical difficulty and operation time. Laparoscopic hernia surgeons are strongly advised to take cognizance of the potential optical illusion during TEPP hernioplasty in order to safeguard against the injudicious dissection and technical difficulty for seamless execution of the procedure with ease, rapidity and safety.

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