



Strong linea alba: Myth or reality?

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ARTICLE INFO

Article history:

Received 15 June 2011

Accepted 8 November 2011

ABSTRACT

The traditional approach of repairing the linea alba, while operating on ventral hernias, is based on the premise that the linea alba is a strong layer and can reinforce the abdominal wall. This deeply entrenched view of most surgeons has resulted in numerous techniques which invariably include the linea alba as a part of the repair. On the contrary, this article proposes a hypothesis that the linea alba is a weak layer and varies widely in individuals with respect to its anatomy. It is especially weak in elderly, obese and multiparous patients in whom ventral hernias are common. The 'white line' – literal translation of 'linea alba' – becomes wide and attenuated in these patients; this 'white area' or 'rus alba' is more susceptible to tissue failure. We termed this the "Sick Linea Alba Complex" (SLAC) and hypothesize that the linea alba should be excluded from rather than included in the repair of ventral hernias in order to minimize recurrence rates.

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Introduction

High recurrence rates following repair of ventral abdominal wall hernias have been a vexing problem for surgeons [1]. This is reflected by the numerous techniques of repair described and hence no universal method satisfactory deals with this problem. The linea alba is traditionally regarded as a strong layer. In fact in many textbooks and several journal articles, much emphasis is placed on obtaining adequate bites of this layer [2–5]. None has placed any emphasis on eliminating the linea alba altogether except the rectus repair which inverts the entire linea alba and brings the recti together in the midline [6]. Ramirez components separation technique attempts medialisation of the recti but does not specifically define elimination of the linea alba as an essential requirement for success [7]. Jenkins initially advocated a suture length to wound length ratio of 4:1 in order to gain a 1 cm bite of rectus sheath with sutures placed 1 cm apart and thereby minimising the occurrence of incisional hernias [8]. This was later revised to a 6:1 ratio when a mathematical model was devised as well as when postoperative tissue swelling and abdominal distension was taken into account [9]. Despite these precautions, hernia rates continue to be high.

Hypothesis

Engaging the rectus abdominis muscle has always been considered to be against good surgical practice and current surgical dogma dictates exclusion of this muscle in abdominal wall closure. The fibroaponeurotic linea alba (LA) is variable in anatomy tending to be wide and thin with multiple defects especially in the elderly, obese and multiparous female. In fact, this white line of the linea alba is transformed to a wide, attenuated layer and could be more appropriately called a white area or rus alba in the obese or multiparous patient. We hypothesize that this layer is a naturally occurring weak layer since most spontaneous hernias, whether umbilical or paraumbilical, involve the linea alba. If this layer spontaneously herniates it should not be surprising that herniation would follow the insults of cutting and suturing. This inherent tissue failure or 'Sick Linea Alba Complex' (SLAC) is doomed to hernia formation and any repair that engages only this layer will be unsuccessful. As a result, if one can eliminate the linea alba or SLAC, there is almost no place for a hernia to occur!

Evaluation of the hypothesis

The anatomy of the LA is variable therefore an all encompassing single ventral repair technique is not practical. Rath et al. studied the mean width of the LA in cadaveric specimens of varying age and sex and found this to be 2.25 cm in the region of the umbilicus and also noted a significant increase in mean LA width in the subset of specimens over age 45 years [10]. The mean LA width as recorded by ultrasonography in nulliparous females between the ages of 20 and 45 years with a body mass index (BMI) of less than 30 kg/m²

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was 3.5 cm [11]. Axer confirmed that the LA was not only wider in females but also thinner [12]. Intuitively, it is reasonable to expect the LA will become wider and thinner with increasing parity and BMI. In addition, studies have confirmed that the tensile strength of the LA is directly proportional to the thickness and density [13].

Even using Jenkins 4:1 rule of suture length, the rectus abdominis will not be engaged in repair of midline incisions with a linea alba width greater than 2 cm. Failure of the ventral repair is attributed to the cutting of the suture through the LA and suture pullout has been directly related to fascial thickness [14]. Postoperative tissue edema, ileus as well as the initial tension placed on the suture during closure will also contribute to suture pullout.

Spontaneous herniation through the rectus abdominis muscle is virtually unknown and paramedian incisions, which do not engage the LA during repair has consistently shown lower incisional hernia rates than midline incisions [15]. Similarly, transverse incisions result in a lower incidence of incisional hernias as compared to the midline incision [16,17]. In addition, port site hernias following laparoscopic surgery is most commonly found at the umbilical port even though there may be other ports of similar size [18] and off-midline has been the extraction site of choice due to the lower port site hernia rate as compared to the midline extraction site [19].

The rectus repair has been described whereby an inverting suture technique is used and involves taking 2–3 cm bites so as to engage the medial edge of the rectus abdominis muscle thereby 'kneeling' the LA into the abdomen. The effect was to bring the muscle bellies of the rectus abdominis together while excluding the potentially weak LA from the repair [6]. This procedure was performed in 85 patients and after an average follow up of 71 months, there was only one recurrence. At reoperation, this was attributed to a technical error whereby the rectus abdominis was not engaged on one side.

Patients with thin, wide LA are prone to developing ventral hernias. However, this hernia tends to be just the clinical manifestation of a larger picture in which the entire LA, due to this inherent weakness, is predisposed to herniation. The authors have termed this clinical entity as Sick Linea Alba Complex (SLAC).

Patients with SLAC exhibit multiple subclinical defects throughout the LA and an effective repair can only be possible following exposure of the entire rectus sheath with subsequent rectus repair as described above, to allow for exclusion of this weak LA. The authors' experience with this repair has resulted in extremely low recurrence rates. This favourable outcome can be explained by the inherent nature of muscle which is dynamic tissue capable of maintaining an isometric state with varying levels of load while the fibroaponeurotic LA loses its elasticity with increasing stress therefore predisposing to herniation.

Transverse repair of the rectus sheath is well described however also with high recurrent rates [20]. During a transverse repair, such as the Mayo repair, the defective linea alba still exists while in vertical repairs, since the recti are pulled together, this defective area is decreased. The use of mesh, unless involving the entire linea alba and extending to the rectus abdominis on each side, will also have weak areas exposed above or below the mesh. Though recurrence following mesh repair of ventral hernias are well published none have reported a recurrence lateral to the LA through the muscle. In the laparoscopic era, multiple defects of the LA are detected intraoperatively, a view that was not previously attained with traditional open repair. Placement of a mesh throughout the entire incision prevents "recurrences" by treating subclinical hernias [21]. In a patient with SLAC, is a recurrent hernia may really be a persistent subclinical hernia which progressively enlarged?

Conclusion

Patients with Sick Linea Alba Complex (SLAC) are suspected clinically by age, sex, BMI and parity and confirmed radiologically by a thin, wide LA. Abdominal closure has traditionally focused on engaging the LA, the distance from the sheath edge and suture material used.

During laparotomy closure, one should study the LA on the CT scan, if previously performed, and if SLAC is present, the LA must be eliminated in closure. In addition, as part of the work up of a patient with a ventral hernia when SLAC is suspected, a CT scan should be performed so as to determine the extent of dissection laterally, superiorly and inferiorly in order to adequately eliminate this layer.

The aim is therefore not to repair the defect in the linea alba but to eliminate the linea alba.

Conflict of interest statement

None.

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