



The Italian national consensus conference on the diagnosis and treatment of Rectus Abdominis diastasis in Post-gravidic Women

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Abstract

Purpose Rectus Abdominis diastasis (RAD) is a prevalent condition, particularly in post-gravidic women, with functional and esthetic impact. This Delphi consensus, led by general surgeons, aimed to establish evidence-based recommendations for the diagnosis and management of RAD in post-gravidic women.

Methods A Delphi process was conducted under the auspices of the Italian Society of Hernia and Abdominal Wall Surgery (ISHAWS), the national chapter of the European Hernia Society (EHS). A steering committee supervised systematic literature reviews to evaluate the quality of evidence and formulate recommendations. Iterative rounds of voting involving 105 expert panellists were conducted, with Consensus defined as $\geq 70\%$ agreement. Non-consensual recommendations were revised and discussed in a plenary session during the Italian Society of Surgery (SIC) Congress, 2024.

Results Consensus was achieved on 12 recommendations covering RAD diagnosis, classification, and treatment. Key findings included the endorsement of radiological methods for accurate RAD assessment, the establishment of surgical thresholds (> 2.5 cm inter-recti distance for symptom improvement), and the recommendation of minimally invasive linea alba plication for surgical management. Non-operative treatments, such as targeted exercise programs, were emphasized as first-line approaches. For RAD with concomitant hernias of the linea alba with defects > 1 cm, mesh reinforcement was strongly recommended, with extraperitoneal placement preferred. The importance of tailoring approaches based on patient-specific factors and fostering shared decision-making was highlighted.

Conclusion This consensus provides a structured framework for RAD management, emphasizing accurate diagnosis, tailored treatments, and patient-centered care. Future multicenter studies are required to address remaining evidence gaps and refine these recommendations.

Keywords Rectus Abdominis Diastasis · Abdominal rectus diastasis · Diastasis recti · Post-gravidic · Consensus conference · Diagnosis · Treatment

Introduction

Rectus Abdominis Diastasis (RAD) is a clinical condition characterized by a separation of rectus abdominis muscles along the linea alba, with or without the concurrent presence of midline hernias [1]. Although commonly perceived as an esthetic issue, in several reports, RAD was

related to substantial functional repercussions, such as a reduction in muscular strength and impaired core stability, with an overall reduced quality of life [2, 3]. This condition shows an increased incidence in the post-gravidic course, but it can also be detected in men and individuals with other risk factors, such as visceral obesity, ageing, and connective tissue disorders. Despite its clinical relevance, management strategies for RAD remain heterogeneous and are frequently supported by low-quality

Extended author information available on the last page of the article

evidence, resulting in a lack of standardized protocols. Several studies have highlighted the impact of RAD on both physical and psychological well-being, hypothesizing potential associations with chronic back pain, pelvic floor dysfunction, and decreased core muscle strength [4–6]. Nonetheless, clinical management of RAD remains inconsistent. Diagnostic approaches are highly variable as well as therapeutic strategies, which include conservative approaches (e.g., targeted exercise programs) and surgical repair. This variability is due to the lack of Consensus on fundamental aspects such as diagnostic criteria, classification systems, and treatment thresholds, which creates a critical gap in evidence-based care. This Consensus paper aims to establish evidence-based recommendations for the management of RAD specifically in post-gravidic women, without significant skin redundancy requiring abdominoplasty *and also in patients who do not voluntarily request abdominoplasty*, through a systematic synthesis of available literature and expert consensus. Other patient groups, such as obese men with upper abdominal RAD, were not the focus of this study. It reflects a general surgery perspective and does not include input from plastic surgeons. The recommendations are particularly relevant to cases where a functional approach to the abdominal wall is prioritized and may not be directly applicable to patients requiring combined esthetic procedures, such as skin resection.

Methods

Development of the Delphi consensus

This Delphi Consensus was conducted under the auspices of the Italian Society of Hernia and Abdominal Wall Surgery (ISHAWS), the national chapter of the European Hernia Society (EHS), to develop recommendations on the treatment of RAD. A steering committee comprising four general surgeons, experts in abdominal wall surgery (UB, GC, CS, and MP), oversaw the development and execution of the consensus methodology.

Steering committee and expert brainstorming

The process began with the steering committee inviting 27 Italian general surgeons, recognized for their expertise in hernia and abdominal wall surgery, to participate in a brainstorming session. This session aimed to identify and

refine the key topics and questions to be addressed during the Delphi process. Participants were selected based on their extensive clinical experience and contributions to the field.

Evidence review team and literature review

An Evidence Review Team (ERT) of 10 members conducted systematic reviews of the literature for each of the selected topics. The literature reviews were carried out between February 1, 2024, and July 30, 2024. The results of the literature reviews guided the formulation of the initial set of statements and recommendations to be evaluated in the Delphi process. The Certainty of Evidence (CoE) was categorized into four levels: high, moderate, low, and very low, based on the study design and risk of bias. The RAND/UCLA method was implemented to systematically and quantitatively combine expert opinion and evidence by asking panellists to rate, discuss, and then re-rate recommendations [7].

Delphi process

The Delphi process comprised iterative rounds of voting to achieve Consensus among experts, following the Guidance on Conducting and REporting Delphi Studies (CREDES) checklist [8]. The first round of the Delphi was conducted online from September 20, 2024, to October 5, 2024. Panel members were asked to vote on the recommendations derived from the systematic reviews and brainstorming sessions. A Likert scale was used for voting, ranging from 1 (strong disagreement) to 5 (strong agreement). Recommendations that achieved $\geq 70\%$ agreement, defined as the sum of scores 4 (agreement) or 5 (strong agreement), were adopted as final and shared recommendations. Recommendations that did not achieve Consensus in the first round were revised based on feedback from the panel of experts and subsequently re-submitted for discussion. The revised recommendations were also presented to all members of ISHAWS, facilitated by the society's secretary, for further voting.

Plenary session and final consensus

Recommendations that failed to reach Consensus during the online Delphi rounds were re-discussed during a plenary session held during the 126th Congress of the Italian Society of Surgery (SIC, Società Italiana di Chirurgia) in Rome, from October 13 to 16, 2024. The plenary session allowed the panel of experts to modify the recommendations based on collective input. The revised recommendations were then re-voted by the ISHAWS members until a Consensus was reached.

Results

1 st Delphi round participation and demographics

In the 1 st Delphi round, 12 statements and 12 recommendations were presented for evaluation. A total of 105 members of the ISHAWs participated in the voting process. Of the respondents, 95.2% were consultant general surgeons, while the remaining 4.8% were junior doctors. Most participants (85.7%) reported familiarity with surgical techniques for RAD repair. Regarding the annual volume of RAD surgeries performed by the respondents, 62.9% reported performing fewer than 30 cases per year, 20% performed more than 30 cases annually, and 17.1% indicated that they did not perform surgical repairs for RAD.

Consensus achievement

Following the 1 st Delphi round, four of the original statements and recommendations (numbers 3, 6, 11, and 12) did not reach the predefined $\geq 70\%$ agreement threshold. These statements and recommendations were subsequently rediscussed during the in-person meeting in Rome on October 17, 2024. The Panel engaged in an open discussion, and modifications were made based on the feedback received. The revised statements were then re-voted upon, ultimately leading to consensus. In the plenary session, structured moderation facilitated balanced discussions, allowing all participants to express their views before the final vote. The revised recommendations were re-voted upon by 90 members of the ISHAWs. To minimize potential bias from dominant voices, the Delphi method was conducted anonymously during the online voting rounds, ensuring that each expert's opinion carried equal weight. This second vote resulted in a Consensus on all 12 recommendations, as reported in this paper (Table 1). The management algorithm suggested by the Italian national consensus conference on the diagnosis and treatment of RAD in post-gravidic women is reported in Fig. 1.

KQ1. Definition. What is the definition of Rectus Abdominis Diastasis (RAD)?

Speaker in Rome: Giuseppa Procida.

Statement 1

RAD is an acquired defect characterized by an increased distance between the two rectus muscles of the abdomen > 2 cm, primarily affecting multiparous women and negatively impacting their physical perception and psychophysical well-being. (CoE: Moderate ●●●○).

RAD is an acquired defect characterized by abnormal separation of the two rectus muscles of the abdomen along their insertion on the linea alba in the absence of midline hernias [9].

The physiological width of the linea alba is up to 2 cm [9], with variations of ± 5 mm depending on whether the measurement is taken [10–12]. A distance between the rectus muscles greater than 2 cm can be considered pathological [1, 13].

RAD is caused by conditions that lead to gradual thinning and widening of the linea alba, combined with the laxity of abdominal wall muscles, resulting in a protrusion of the midline following increases in intra-abdominal pressure [14].

RAD can affect both men and women. The exact prevalence is not known due to variability in diagnostic criteria, measurement locations (above, at, or below the navel), measurement methods (single vs. multiple measurements using finger width, callipers, ultrasound scan, computed tomography), measurement conditions (during activity, at rest), and patient categories (men, nulliparous, primiparous, and multiparous women).

The prevalence of RAD 3 cm above the navel between the ages of 18 and 90 in both sexes is 57% [15], but when stratified by gender, this defect is more common in women.

RAD occurs more frequently during pregnancy and tends to regress after childbirth spontaneously. Prevalence in the third trimester is estimated to range from 46–100%. In 39% of women, however, RAD can still be present six months postpartum [16] and in 33% of women twelve months postpartum [3]. In multiparous women, the prevalence ranges from 66 to 90% [17], suggesting that RAD is directly related to the amount of parity. Data from nulliparous women are scarce and contradictory, with prevalence ranging from 0% [17] to 35% [18].

Pregnancy is a significant risk factor for RAD, mainly due to hormonal changes in connective tissue, the mechanical strain on the abdominal wall from the growing fetus, weight gain, and displacement of abdominal organs, conditions that together cause skin and tissue laxity [19].

Other known risk factors include a second caesarean section [17, 20], increased body mass index (BMI), ageing, diabetes [21], connective tissue weakness and anatomical variability of the linea semilunaris [20].

There are no consistent data on RAD prevalence in males: one study describes RAD in men aged 30 to 40 with a history of weightlifting, or intensive exercise-related trauma, chronic or intermittent abdominal distension, weight fluctuations, advancing age, or structural differences in collagen composition [22].

KQ2. Definition. Should RAD be considered a functional or esthetic disorder?

Speaker in Rome: Giulia Montori.

Table 1 Summary of the statements and recommendations of the Italian National consensus conference on the diagnosis and treatment of rectus abdominis diastasis in Post-gravidic Women**KQ1. Definition. What is the definition of Rectus Abdominis Diastasis (RAD)?****Statement 1**

RAD is an acquired defect characterized by an increased distance between the two rectus muscles of the abdomen > 2 cm, primarily affecting multiparous women and negatively impacting their physical perception and psychophysical well-being. (CoE: Moderate ●●●○)

KQ2. Definition. Should RAD be considered a functional or esthetic disorder?**Statement 2**

Functional muscular disorders seem to be associated with RAD, which negatively affects abdominal wall muscle strength and core stability. (CoE: Moderate ●●●○)

Recommendation 1

The experts' panel suggests excluding other reasons beyond RAD that could determine functional deficits. **Agreement 37.1%, Strong agreement 37.1%**

KQ3. Classification. What are the classification systems for RAD? Is there a most reliable classification for RAD?**Statement 3**

There are several anatomical classifications of RAD: the German Hernia Society (DHG) working group classification, the International EndoHernia Society (IEHS) classification, and the European Hernia Society (EHS) classification. The EHS classification introduced the width of muscle separation, post-pregnancy status, and presence of hernia, but it did not mention the skin condition. (CoE: Moderate ●●●○)

Recommendation 2

The experts' panel suggests implementing the criteria proposed by the EHS, adding skin conditions and previous abdominal surgery as treatment modifiers. **Agreement 32.4%, Strong agreement 47.6%**

KQ4. Disease-related symptoms. What symptoms could be associated with RAD?**Statement 4**

Patients with RAD could report symptoms such as chronic pain (lower/upper back, abdominal, pelvic), incontinence (urinary, fecal), muscle weakness, gastrointestinal issues (bloating, constipation), sexual and pelvic health problems, and postural difficulties. (CoE: Moderate ●●●○)

Recommendation 3

The experts' panel suggests excluding any other possible reason beyond RAD that could determine functional deficits and informing patients that there is no certainty that RAD repair may improve symptoms beyond a better physical perception. **Agreement 36.2%, Strong agreement 53.3%**

KQ5. Diagnosis. Which modalities are most suitable for the diagnosis and assessment of RAD? Are clinical examinations and ultrasound scans (US) adequate for diagnosing RAD? Is a Computed Tomography (CT) scan suitable for diagnosing and assessing RAD?**Statement 5**

Clinical assessment through palpation (fingerbreadth) or callipers 3 cm above the umbilicus may be appropriate for diagnosing RAD. Optimal diagnosis involves having the individual lie supine and engaging core muscles with a half sit-up or leg-raise maneuver. In cases of obesity or concurrent hernia, a US or CT scan is necessary for a more accurate assessment. (CoE: Low ●●○○)

Recommendation 4

The experts' panel suggests that the initial clinical examination should involve palpation (fingerbreadth method), calipers, and ultrasound (US) scanning. A US scan (with length and width measurement) is suggested for preoperative planning. In cases where clinical assessment is challenging (such as in obese patients) or where concomitant hernias are suspected, CT scans could be used to ensure accurate diagnosis and assessment. The use of a dynamic CT scan with the Valsalva maneuver is advisable for a more detailed evaluation of the abdominal wall. This approach is particularly useful in cases where a midline hernia is associated. **Agreement 40.0%, Strong agreement 48.6%**

KQ6. Surgical treatment of RAD without a hernia of the linea alba. What is the minimum size of RAD that justifies a surgical treatment for symptom improvement? Is there a referral surgical treatment for RAD without a hernia of the linea alba?**Statement 6**

The minimum size of RAD that justifies a surgical treatment for symptom improvement widely varies in the literature, with studies reporting preoperative RAD sizes ranging from 1.1 to 11 cm. However, no clear consensus exists on an exact minimum size. (CoE: Low ●●○○)

Recommendation 5

The experts' panel suggests minimally invasive plication of the linea alba in patients with RAD without concomitant hernia, unless significant skin changes necessitate abdominoplasty. The experts' panel also suggests a tailored approach considering age and expected outcomes (functional and cosmetic), which aligns with the principles of abdominal wall surgery. **Agreement 40.0%, Strong agreement 41.9%**

Statement 7

Several surgical treatments are used for RAD for post-gravidic women without a hernia of the linea alba. However, no single referral technique is universally recommended due to the high heterogeneity of procedures and low quality of studies. (CoE: Low ●●○○)

Recommendation 6

The experts' panel suggests considering > 2.5 cm as the minimum size of RAD that justifies surgical treatment for symptom improvement when any other causes have been ruled out and after the failure of the conservative treatment. **Agreement 52.3%, Strong agreement 32.2%**

Table 1 (continued)

	Recommendation 7 The experts' panel suggests considering mesh reinforcement strategies for patients with large diastasis (> 5 cm) and/or unfavorable factors, including obesity. The decision to use mesh reinforcement should be individualized, taking into account patient-specific factors such as diastasis width, comorbidities, and expectations. Agreement 35.2%, Strong agreement 43.8%
KQ7. Conservative treatment of RAD. Are there non-operative treatment options for RAD? Is non-operative treatment effective in improving symptoms of RAD?	
Statement 8 Non-operative treatment options for RAD include various abdominal exercise programs, postural training, mobility, lifting techniques, and methods for strengthening the transversus abdominis muscles. Techniques such as Pilates, Tupler's, Noble's, manual therapy, abdominal bracing, and taping are commonly applied. Although several studies indicate the effectiveness of these exercises in reducing the inter-recti distance, no standardized protocols exist (CoE: Low ●●○○)	Recommendation 8 The experts' panel suggests implementing non-operative treatment before surgery. Agreement 23.8%, Strong agreement 61.9%
KQ8. Surgical treatment of RAD with a hernia of the linea alba. Is there a most effective surgical treatment for RAD with a concomitant hernia of the linea alba > 1 cm?	
Statement 9 Mesh reinforcement strategy is supported by evidence in the case of RAD with a concomitant hernia of the linea alba > 1 cm. This evidence is extrapolated from high level studies on primary umbilical and epigastric hernias [104, 105], and no direct data currently exist regarding recurrence rates after full linea alba plication without mesh in this specific context. (CoE: Moderate ●●●○)	Recommendation 9 The experts' panel suggests the use of a mesh when considering surgical treatment for RAD with an associated hernia of the linea alba > 1 cm. Considering the patient's specific features (young age and long-life expectancies), the panel suggests in favor of extraperitoneal mesh placement. Agreement 23.8%, Strong agreement 65.7%
Statement 10 In the case of RAD with concomitant hernia of the linea alba > 1 cm, different surgical approaches (open, laparoscopic, endoscopic and robotic) can be used. Minimally invasive surgery offers well-known benefits and is associated with good cosmetic results. In case of associated skin excess, the open approach is more reasonable. (CoE: Low ●●○○)	Recommendation 10 The experts' panel suggests tailoring the surgical approach for RAD associated with a hernia of the linea alba > 1 cm based on surgical expertise and patient expectations. Agreement 37.1%, Strong agreement 51.4%
KQ9. Surgical treatment of RAD with a hernia of the linea alba. Is there a most effective surgical treatment for RAD with a concomitant hernia of the linea alba ≤ 1 cm?	
Statement 11 Suture plication of the linea alba contributes additive strength to umbilical hernia repair by correcting the lateral displacement of the rectus muscles, thereby restoring abdominal wall tension and structural support. The EHS guidelines suggest that plication of the anterior rectus sheath may be sufficient to repair RAD with the smallest (less than 1 cm) umbilical or epigastric hernias. (CoE: Moderate ●●●○)	Recommendation 11 The experts' panel recommends that surgeons and patients make shared decisions about all aspects regarding the use of mesh and type of approach in cases of RAD with an associated hernia of the linea alba ≤ 1 cm. Agreement 35.2%, Strong agreement 49.5%
KQ 10 Mesh reinforcement strategy. Is using absorbable or biosynthetic meshes worth it in case of RAD repair?	
Statement 12 Some authors have proposed the use of biosynthetic meshes in case of RAD repair (both with or without a concomitant hernia of the linea alba), reporting promising results even if no evidence deriving from comparative studies has been published to date. (CoE: Low ●○○○)	Recommendation 12 Currently, there is insufficient evidence to favor biosynthetic mesh over synthetic mesh for RAD repair. Biosynthetic meshes may be considered in select cases, such as young patients or those with a very low BMI. Their use should be guided by individualized patient discussions, weighing potential benefits, costs, and long-term outcomes. Even this, the discussion among general surgeons experts in hernia repair showed general satisfaction for the preliminary results. Agreement 54.5%, Strong agreement 35.6%
Statement 2 Functional muscular disorders seem to be associated with RAD, which negatively affects abdominal wall muscle strength and core stability. (CoE: Moderate ●●●○).	Recommendation 1 The experts' panel suggests excluding other reasons beyond RAD that could determine functional deficits. Agreement 37.1%, Strong agreement 37.1%.

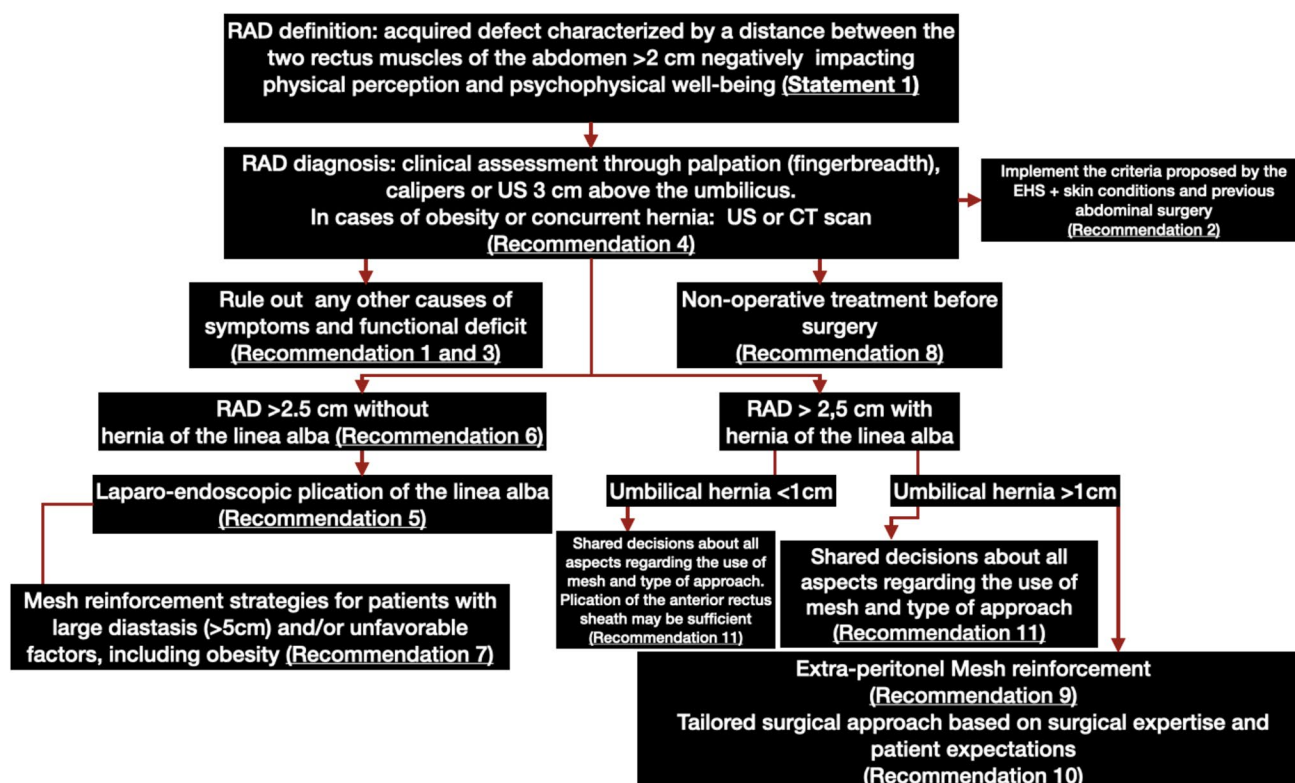


Fig. 1 Management algorithm suggested by the Italian national consensus conference on the diagnosis and treatment of Rectus Abdominis Diastasis (RAD) in post-gravidic women

RAD is not solely an esthetic problem. Functional disorders, particularly muscular ones, have been identified that negatively affect abdominal wall muscle strength and core stability [1].

Most studies confirm that RAD has a negative impact on life quality and health, especially in women. Women with RAD experience body image distortion, feelings of neglect by healthcare institutions, shame, sadness, powerlessness, low self-esteem, resignation, and social pressure [23].

Regarding functional deficits, a possible association has been found between RAD and urinary or fecal incontinence, pelvic organ prolapses and pelvic floor dysfunctions [24–26]. However, in contrast with data in favor of a positive association, many studies refute the existence of a correlation between RAD and back or pelvic girdle pain [3, 27].

Functional outcomes after surgical correction of RAD show an improvement in back pain and posture, as reported in several articles [28–32], suggesting that RAD may be implicated in this functional disorder. Women with RAD have dysfunction of trunk muscles, whether they are primiparous [33] or multiparous [27]. Women with RAD tend to have lower abdominal muscle strength and, consequently, a higher prevalence of abdominal pain because RAD alters the spatial arrangement of abdominal muscles and fascia,

modifies their optimal line of action, and consequently reduces their ability to generate force [27].

KQ3. Classification. What are the classification systems for RAD? Is there a most reliable classification for RAD?

Speaker in Rome: Salvatore Tramontano.

Statement 3

There are several anatomical classifications of RAD: the German Hernia Society (DHG) working group classification, the International EndoHernia Society (IEHS) classification, and the European Hernia Society (EHS) classification. The EHS classification introduced the width of muscle separation, post-pregnancy status, and presence of hernia, but it did not mention the skin condition. (CoE: Moderate ●●●○).

Recommendation 2

The experts' panel suggests implementing the criteria proposed by the EHS, adding skin conditions and previous abdominal surgery as treatment modifiers. Agreement 32.4%, Strong agreement 47.6%.

Abdominal palpation, tape measures, callipers, and ultrasound scans are the most common methods used in clinical practice to diagnose RAD. Several classification systems exist to define the spectrum of RAD. Currently, the

classification by Rath et al. is the most accepted. It is based on the attenuation level relative to the umbilicus and the patient's age [10]. Conversely, the classification by Beer et al. is based on the standard width of the linea alba [12]. Nahas et al. proposed an esthetic classification based on myoaponeurotic deformities, with four types corresponding to specific characters [34]. Clinical symptoms and findings of physical examination are rarely discussed in the classification of RAD. In 2019, the International Endohernia Society (IEHS) proposed a classification of RAD with concomitant hernias based on its location and width [13]. In 2021, the European Hernia Society (EHS) developed a clinical practice guideline on managing RAD, with specific topics on the standardization of the classification [1]. The group suggested a new classification system based on the width of muscle separation, post-pregnancy status and whether or not there is a concomitant hernia. A new classification may be helpful for staging and taking anatomical differences among different types of RAD. It should also relate clinical staging with surgical choice. We identified **two** clinically relevant aspects that were not included in the EHS classification: skin condition and previous abdominal surgeries. Skin condition is a critical factor when deciding between minimally invasive or open surgical approaches, as significant skin laxity may necessitate an abdominoplasty. Previous abdominal surgeries can influence the choice of surgical technique, affecting dissection planes, risk of adhesions, and feasibility of certain techniques. Recently, a working group of the German Hernia Society (DHG) and the IEHS set the task of devising such a classification of RAD, starting from a systematic search [13]. The proposed classification defines RAD based on the diastasis length, diastasis width, concomitant hernias, previous operations, number of pregnancies and multiple births, skin condition and severity and localization of preoperative pain. Keramidas et al. propose a RAD classification and treatment algorithm that plastic surgeons could quickly adapt to a prospective evaluation. A four-type (A: mild 2–3 cm, B: moderate 3–5 cm, C: severe 5–7 cm, and D: very severe 7–9 cm) classification was described, with a different treatment method performed in each category using continuous and interrupted absorbable sutures [35]. Complex abdominal evaluation may determine subgroups of RAD classification. A recent study conducted by Qu et al. established an ultrasound diagnostic criterion for RAD: RAD of > 2 cm measured 3 cm below the umbilicus; RAD of > 2 cm at the umbilicus; RAD of > 14 mm evaluated 3 cm above the umbilicus [36]. Corvino et al. proposed the different anatomical variations of RAD by using an ultrasound scan to categorize RAD according to its location (open only above the navel, only below the navel, at the navel level, open completely but wider above the navel, and open entirely but wider below the navel) [37]. While imaging is not required to diagnose RAD, it is often used to classify the severity of this condition

and aid in surgical planning, as evidenced by Tung et al. in a recent review [38].

KQ4. Disease-related symptoms. What symptoms could be associated with RAD?

Speaker in Rome: Andrea Balla.

Statement 4

Patients with RAD could report symptoms such as chronic pain (lower/upper back, abdominal, pelvic), incontinence (urinary, fecal), muscle weakness, gastrointestinal issues (bloating, constipation), sexual and pelvic health problems, and postural difficulties.

(CoE: Moderate ●●●○).

Recommendation 3

The experts' panel suggests excluding any other possible reason beyond RAD that could determine functional deficits and informing patients that there is no certainty that RAD repair may improve symptoms beyond a better physical perception. Agreement 36.2%, Strong agreement 53.3%.

The most common symptoms reported by patients with RAD are cosmetics (shape of the abdomen, skin excess), chronic high and lower back pain, abdominal pain, pelvic girdle pain, urine and fecal incontinence, anorectal symptoms, pelvic organ prolapse, muscle weakness, repetitive musculoskeletal stemming from pelvic instability, poor posture, sexual matters, gastrointestinal disturbances like bloating and constipation, but also dissatisfaction with the body image [13, 31, 39–42].

These symptoms are attributable to an impairment of the fascial tissue integrity and to a reduction in the stability of the abdominal wall [13, 31, 39].

Several conditions may mimic or contribute to symptoms attributed to RAD, including pelvic floor dysfunction (e.g., stress urinary incontinence, pelvic organ prolapse, or fecal incontinence), which can coexist with RAD and should be assessed via pelvic floor ultrasound, urodynamic studies, or clinical examination; musculoskeletal disorders (e.g., lumbar hyperlordosis, sacroiliac joint dysfunction, or myofascial pain syndromes), which can contribute to lower back pain and should be evaluated using clinical examination and, if needed, MRI of the lumbar spine; gastrointestinal conditions (e.g., functional bloating, irritable bowel syndrome, or gastroparesis), which may contribute to abdominal distension and discomfort and should be assessed with gastroenterology consultation; connective tissue disorders (e.g., Ehlers-Danlos syndrome), which may predispose to poor fascial integrity and exaggerated diastasis and can be suspected based on clinical history and genetic consultation. Multidisciplinary evaluation (e.g., by physiotherapists, urogynecologists, or gastroenterologists) may be necessary in patients with persistent symptoms not clearly attributable to RAD alone.

Increased inter-recti distance (IRD) is correlated with decreased trunk flexor strength: a significant moderate negative correlation between the presence of RAD and the strength and endurance of the trunk flexors and rotators has been found in postpartum women [39]. In the case of RAD, the transversus abdominis and internal oblique complex are displaced and shortened, thus not exerting tension on the lumbodorsal fascia and destabilizing the lumbar spine. Another important aspect is the lordosis of the spine since this is the most important parameter controlling the distribution of forces between the fascia and muscles, influencing pelvic stability. In the case of RAD, the interposition of the pelvis leads to the head and shoulders retro positioning [31]. Moreover, RAD causes a decrease in intra-abdominal pressure, further contributing to the loss of stability of the lumbar spine [31]. These conditions are responsible for low back pain and a lack of "core strength", causing patients difficulty standing on one leg or getting up from a supine position on the floor [31].

Another proposed mechanism for the relationship between RAD and back pain is the excess skin after extensive weight loss following bariatric surgery and/or diet or after pregnancy [42]. Such skin redundancy and fascial laxity in the abdominal area have been shown to cause back strain and pain [42].

Apart from back pain, RAD could be responsible for urinary incontinence and other support-related pelvic floor dysfunction as a result of weaker pelvic floor muscles [31, 42]. In this regard, pelvic floor muscles have important sphincter and support functions but also act as critical postural stabilizers [42]. Coordination among lumbopelvic and abdominal muscles and fascia plays a significant role in continence, respiration and musculoskeletal function, including postural stabilization [42]. The mechanism of urinary continence is still debated. However, it seems to range from a reduction of anterior abdominal weight to increased strength of the anterior abdominal wall, leading to more complete bladder emptying [31]. Moreover, it seems likely that tensioning in the elevation of the pubis and Scarpa's fascia, contiguous with the Colles' fascia of the urogenital triangle, acts to lengthen the urethra and improve continence. This concept of tension distributed throughout the fascial network to effect change at a distant point is central to the tensegrity theory of biomechanics [31]. The severity of symptoms tends to correlate with increasing IRD, but defining a strict threshold remains challenging due to variability in patient-reported outcomes. Some studies indicate that symptoms such as core instability, back pain, and pelvic floor dysfunction are more frequently reported when IRD exceeds 5 cm [32].

KQ5. Diagnosis. Which modalities are most suitable for the diagnosis and assessment of RAD? Are clinical examinations and ultrasound scans (US)

adequate for diagnosing RAD? Is a Computed Tomography (CT) scan suitable for diagnosing and assessing RAD?

Speaker in Rome: Alberto Aiolfi

Statement 5

Clinical assessment through palpation (fingerbreadth) or callipers 3 cm above the umbilicus may be appropriate for diagnosing RAD. Optimal diagnosis involves having the individual lie supine and engaging core muscles with a half sit-up or leg-raise maneuver. In cases of obesity or concurrent hernia, a US or CT scan is necessary for a more accurate assessment. (CoE: Low ●●○○).

Recommendation 4

The experts' panel suggests that the initial clinical examination should involve palpation (fingerbreadth method), calipers, and ultrasound (US) scanning. A US scan (with length and width measurement) is suggested for preoperative planning. In cases where clinical assessment is challenging (such as in obese patients) or where concomitant hernias are suspected, CT scans could be used to ensure accurate diagnosis and assessment. The use of a dynamic CT scan with the Valsalva maneuver is advisable for a more detailed evaluation of the abdominal wall. This approach is particularly useful in cases where a midline hernia is associated. Agreement 40.0%, Strong agreement 48.6%.

The existing literature presents a complex picture, with limited, diverse, and primarily retrospective studies using various methods to measure RAD. Additionally, there is an inconsistency in how RAD should be assessed, with different measurement points, including above (from 3 cm to 4.5 cm), at, and below the umbilicus (from 3 cm to 4.5 cm) [3, 12, 18]. Furthermore, most studies focus on data from healthy female patients. Callipers, tape measures, US scans, and the traditional 'finger width' method (palpation) are commonly employed in clinical settings, as indicated in numerous studies. Clinically, the width of RAD can be estimated by counting the number of finger widths that cover the gap during palpation or by using callipers to measure the distance between their tips across the width of the RAD.

Additionally, methods involving US scans, CT scans, and Magnetic Resonance Imaging (MRI) have been documented. Some have argued that the 'finger width' method is unreliable, while others consider measurements from CT or MRI scans as the gold standard. However, these claims need more evidence on measurement accuracy or are based on flawed statistical analysis, potentially leading to unreliable conclusions [13].

The goal of assessment may involve screening/diagnosing, monitoring, or categorizing the severity of RAD. The selection of the measurement method should be guided by the intended purpose of measurement, its properties, and the

clinical context (e.g., obesity, presence of concurrent hernia, or concomitant symptoms). For screening/diagnosing RAD, clinical assessment through palpation (fingerbreadth) or calipers may be appropriate. Clinical assessment could potentially reveal a protruding abdomen. The optimal method for diagnosing RAD is to have the individual lie supine and engage the core muscles with a half sit-up or leg-raise maneuver. This assessment can be accomplished 3 cm above the umbilicus [11]. Clinical scenarios can pose specific challenges, as clinical assessment alone might underestimate the condition. Obese patients, for example, often require radiological investigations to precisely characterize the condition [21, 43] and exclude a concomitant abdominal wall defect. Advanced diagnostic modalities such as US, CT, or MRI may be recommended, contingent upon resource availability, the desired level of precision, and radiation protection considerations. When utilizing US measurements, it is essential to consider factors such as measurement properties (e.g., linear transducer type and frequency, typically in the range of 5–7.5 MHz) and patient positioning (e.g., lying supine with arms crossed over the chest) [44]. US scan has proven to be a dependable technique for monitoring patients over time and assessing the severity of the condition [38, 45]. While there is limited data available on CT scan measurements, it may be beneficial in cases where a concurrent umbilical hernia is suspected or in case of concomitant suspicious symptoms (i.e. pelvic floor dysfunction symptoms), aiding in hernia measurement, surgical planning, and differential diagnosis.

KQ6. Surgical treatment of RAD without hernia of the linea alba. What is the minimum size of RAD that justifies a surgical treatment for symptom improvement? Is there a referral surgical treatment for RAD without a hernia of the linea alba?

Speaker in Rome: Sara Capoccia Giovannini

Statement 6

The minimum size of RAD that justifies a surgical treatment for symptom improvement widely varies in the literature, with studies reporting preoperative RAD sizes ranging from 1.1 to 11 cm. However, no clear consensus exists on an exact minimum size. (CoE: Low ●●○○).

Statement 7

Several surgical treatments are used for RAD for post-gravidic women without a hernia of the linea alba. However, no single referral technique is universally recommended due to the high heterogeneity of procedures and low quality of studies. (CoE: Low ●●○○).

Recommendation 5

The experts' panel suggests minimally invasive plication of the linea alba in patients with RAD without concomitant hernia, unless significant skin changes necessitate abdominoplasty. The experts' panel also

suggests a tailored approach considering age and expected outcomes (functional and cosmetic), which aligns with the principles of abdominal wall surgery. Agreement 40.0%, Strong agreement 41.9%.

Recommendation 6

The experts' panel suggests considering > 2.5 cm as the minimum size of RAD that justifies surgical treatment for symptom improvement when any other causes have been ruled out and after the failure of the conservative treatment. Agreement 52.3%, Strong agreement 32.2%.

Recommendation 7

The experts' panel suggests considering mesh reinforcement strategies for patients with large diastasis (> 5 cm) and/or unfavorable factors, including obesity. The decision to use mesh reinforcement should be individualized, taking into account patient-specific factors such as diastasis width, comorbidities, and expectations. Agreement 35.2%, Strong agreement 43.8%.

The literature search retrieved four non-randomized studies and three randomized controlled trials. Regarding the minimum RAD size that justifies a surgical treatment to improve symptoms, six studies reported the RAD dimension preoperatively and postoperatively, measured with preoperative radiological investigations and intra-operative measurements. One study [46] included only patients with preoperative RAD ≥ 3 cm, but no measurement of the RAD was reported. In contrast, the other two studies [47, 48] did not report RAD size as a criterion for inclusion, but the mean RAD preoperatively was 2.5 cm and 1.1–3.2 cm.

Only one study reported the RAD size as > 6 cm in the criteria for selecting patients. Further, four studies preoperatively reported the mean RAD size, with a mean range between 1.4 and 11 cm. Booth et al. found that RAD is linked to an increased incidence of incisional hernias following midline abdominal surgery, reinforcing the concept that a wider inter-recti gap may predispose to midline structural weaknesses [49]. In this study, 36 of 85 patients (42.4%) with RAD > 25 mm developed incisional hernia, compared to 9 of 71 (12.7%) without RAD. Symptoms reported by patients were the main indication for surgery among the analyzed studies. In systematic reviews, there was no consensus on the minimum size of RAD for surgery [14, 50–53].

Regarding the referral surgical treatment for RAD without hernia, six studies reported an open approach with abdominoplasty with several modalities of plication of the linea alba and different suture materials used. One study analyzed the results of a laparoscopic approach with plication of the linea alba and the position of an intraperitoneal mesh [54]. One study compared the open to laparoscopic approach for plication of the linea alba.

Four studies reported using mesh: one onlay polypropylene lightweight, one autologous dermal mesh positioned in the retromuscular plane, one retromuscular polypropylene lightweight, and one composite intraperitoneal mesh. Techniques for the linea alba plication, including running suture, interrupted stitches, single or double layer, not absorbable or absorbable sutures (both short or long term), quilted or not, were described without any differences in the recurrence of RAD in comparative studies.

Four studies reported the analysis of the changes in quality of life (QoL) in patients who underwent surgery for RAD correction. Several scores (SF36, VHPQ, satisfaction questionnaires) were used, and an overall improvement in QoL measures after surgery was reported.

Postoperative complications were reported in three studies, including seroma, pain and pneumonia in 9–30% of cases.

In the systematic reviews by Van Kerkoven et al. [53], Mommers et al. [14], and in the scoping review by Jessen et al. [52], the extracted evidence concluded that it is not possible to establish if any treatment of RAD is better than others due to the high heterogeneity of procedures proposed and the low quality of studies.

Nahas et al. [51] focused on the approaches and materials reported for the plication of the linea alba, recommending a running 0 PDS suture in a single layer, although the included studies' quality was not high and with heterogeneity in techniques. Hickey et al. [50] focused on postoperative complication analysis, pointing out that the RAD correction is not different from a hernia repair in terms of complications, even though the rate of severe complications is low.

KQ7. Conservative treatment of RAD. Are there non-operative treatment options for RAD? Is non-operative treatment effective in improving symptoms of RAD?

Speakers in Rome: Biancamaria Iacone

Statement 8

Non-operative treatment options for RAD include various abdominal exercise programs, postural training, mobility, lifting techniques, and methods for strengthening the transversus abdominis muscles. Techniques such as Pilates, Tupler's, Noble's, manual therapy, abdominal bracing, and taping are commonly applied. Although several studies indicate the effectiveness of these exercises in reducing the inter-recti distance, no standardized protocols exist (CoE: Low ●●○○).

Recommendation 8

The experts' panel suggests implementing non-operative treatment before surgery. Agreement 23.8%, Strong agreement 61.9%.

Several conservative approaches for managing postpartum RAD have been proposed and documented, although the most effective method remains unclear.

In the majority of postpartum women, RAD resolves spontaneously. However, persistent RAD often leads to the implementation of conservative treatments, particularly among younger patients [2, 3].

Abdominal exercise programs have demonstrated general effectiveness in addressing RAD at various postpartum stages. Despite the supportive evidence for the positive impact of exercise on reducing RAD, a universally accepted therapeutic exercise protocol specifying the most effective exercises has not yet been established [55]. Therefore, patient selection for conservative treatment remains an open question due to the variability in study outcomes and the absence of standardized protocols.

Common interventions include abdominal exercise programs targeting the transversus abdominis or rectus abdominis muscles, postural training, education on proper mobility and lifting techniques, and specific strengthening methods for the transversus abdominis, such as Pilates, functional training, or Tupler's technique (with or without abdominal splinting). Additional techniques include Noble's technique (manual approximation of the rectus abdominis during partial sit-ups), manual therapies such as soft tissue mobilization and myofascial release, abdominal bracing and taping, and the use of a tubigrip or a corset.

The literature search retrieved 477 articles, which were screened for relevance. After full-text review, nine randomized controlled trials (RCTs) were included in a pooled data analysis [4, 5, 56–61], along with four additional RCTs from the meta-analysis conducted by Weingerl et al. [6, 55, 62–64]. Two RCTs were excluded due to the inability to extract data [45, 61], resulting in 16 studies (11 RCTs) in the final analysis [5, 56–60, 62–71].

In RCTs, the intervention arm involved conservative management with exercise programs for postpartum RAD, while the control arm received no treatment or standard advice. The primary outcome across all studies was the variation in IRD before and after treatment. Secondary outcomes included patient-reported outcome measures (PROMs), though these were reported sparsely and heterogeneously using various scales (e.g., SF-36, Oswestry Disability Index, Pelvic Floor Disorders Inventory, VAS, low back pain, and girdle pain). The mean follow-up period across the studies was 1.8 months (range 0–3 months). The trials compared postpartum female populations, which were homogeneous in terms of baseline characteristics and sample size. However, significant heterogeneity was observed in the methods used to measure the IRD. Some studies assessed the IRD distance using a US scan [6, 56, 58, 59, 63], while others used finger-width measurement. Furthermore, some studies measured the IRD at rest or during contraction or did not

specify whether measurements were taken above or below the umbilicus.

Analysis of the primary outcome data revealed that the mean change in IRD in the intervention group was 8.83 mm (± 9.85), with a mean pre-treatment distance of 28.81 mm (± 6.52) and post-treatment distance of 19.98 mm (± 7.38). The 95% confidence interval (CI) was [4.91, 12.75], with a p -value < 0.001 , indicating a statistically significant reduction.

In the control group of patients who received standard advice only, the mean change was 3.86 mm (± 10.12), with a mean pre-treatment distance of 25.88 mm (± 6.93) and a post-treatment distance of 22.02 mm (± 7.38). The 95% CI was $[-0.20, 7.92]$, and the p -value was 0.07, indicating no statistically significant change.

A two-sample t -test comparing pre- and post-treatment variations between the intervention and control groups yielded a t -statistic of -1.91 and a p -value of 0.069.

Data on PROMs were extractable from only six RCTs [4–6, 56, 62, 63], which overall indicated positive changes with improvements in quality of life and reduction in reported symptoms in the experimental groups.

However, a direct comparison of the Oswestry Disability Index across 3 studies revealed mean differences ranging from -1 to 5 in the intervention group and from -1 to 4 in the control group. The independent t -test for these variations showed no statistically significant difference.

Abdominal exercises are leading protocols for reducing IRD and may be an effective option for managing RAD. However, standardized protocols are needed to make results more comparable.

KQ8. Surgical treatment of RAD with a hernia of the linea alba. Is there a most effective surgical treatment for RAD with concomitant umbilical hernia > 1 cm?

Speaker in Rome: Francesca Pecchini

Statement 9

Mesh reinforcement strategy is supported by evidence in the case of RAD with a concomitant hernia of the linea alba > 1 cm. This evidence is extrapolated from high level studies on primary umbilical and epigastric hernias [104, 105], and no direct data currently exist regarding recurrence rates after full linea alba plication without mesh in this specific context. (CoE: Moderate ●●●○).

Statement 10

In the case of RAD with concomitant hernia of the linea alba > 1 cm, different surgical approaches (open, laparoscopic, endoscopic and robotic) can be used. Minimally invasive surgery offers well-known benefits and is associated with good cosmetic results. In case of associated skin excess, the open approach is more reasonable. (CoE: Low ●●○○).

Recommendation 9

Recommendation 9. The experts' panel suggests the use of a mesh when considering surgical treatment for RAD with an associated hernia of the linea alba > 1 cm. Considering the patient's specific features (young age and long-life expectancies), the panel suggests in favor of extraperitoneal mesh placement. Agreement 23.8%, Strong agreement 65.7%.

Recommendation 10

The experts' panel suggests tailoring the surgical approach for RAD associated with a hernia of the linea alba > 1 cm based on surgical expertise and patient expectations. Agreement 37.1%, Strong agreement 51.4%.

The repair of RAD, when associated with a ventral hernia, presents a challenging topic for general surgeons. A consensus on the preferred surgical management of RAD associated with ventral hernia is lacking, as most of the reported studies are small case series [29, 30, 72–95], whereas RCTs comparing different techniques are scarce [14, 96–98].

In recent years, we assisted in developing and implementing several new reconstructive techniques with a progressive increase in the overall complexity of evidence related to RAD. Thanks to the advent of minimally invasive surgery applied today in this field, traditional open techniques have been joined by several novel endoscopic, laparoscopic, hybrid and robot-assisted procedures, which seem to offer optimal results [99].

Previous studies have demonstrated the effectiveness of both open and endoscopic techniques in treating RAD, resulting feasible, safe, and effective [14, 96–98]. ElHawary et al. analyzed outcomes and complications of surgical RAD repair by comparing open and laparoscopic approaches among 56 studies, of which 10 of the 39 (25.6%) open RAD repair techniques and 22 of the 28 (78.6%) laparoscopic RAD repair techniques described a concomitant abdominal wall hernia repair [96]. The authors reported no significant difference in recurrence rates between the two approaches (open = 0.86%, laparoscopic = 1.6%, $p > 0.05$). Furthermore, no significant difference in total complication rates between open repair (13.3%) and laparoscopic repair (14.5%) ($p > 0.05$) was found. The review stated that both approaches were practical, with reduced postoperative pain and shorter hospital duration in favor of minimally invasive surgery. The same research group, in a previous systematic review, registered a higher rate of wound dehiscence and hematoma/bleeding in the open approach ($p < 0.001$), whereas the laparoscopic approach was associated with a significantly higher rate of postoperative seroma ($p < 0.001$) [97].

The IEHS guidelines have questioned which mini-invasive technique is the best treatment option in patients presenting with a ventral hernia in combination with an RAD.

However, the absence of comparative data prevented the superiority of any given technique from being established [100].

Similarly, the Swedish Guidelines in 2020 [101] and the EHS guidelines in 2021 [1] failed to make a strong recommendation for the repair of RAD with associated ventral hernia due to the absence in the scientific panorama of comparative studies and long-term results, describing the endoscopic subcutaneous dissection followed by linea alba plication with an onlay mesh application as the most reported technique. Recently, several new procedures of RAD concomitant to ventral hernia repair have emerged [29, 30, 72–95]. In all cases, Authors reported their initial experiences with limited series. Moreover, comparative groups are scarce, and follow-up is often short-term. Furthermore, there is a profound lack of homogeneity of data presented for these techniques in terms of patient selection, types of defects (primary hernia or incisional hernia), location (epigastric or umbilical), width of both hernia orifice and diastasis. For example, Claus et al. treated both primary and incisional hernia with concomitant RAD [80], while Carrara et al. selected patients presenting with at least one midline defect M1-M3/W1-2 [102] associated with a RAD of maximum width between 4 and 8 cm [29, 84]. Most cases concern minimally invasive procedures, demonstrating an increasingly common desire within the scientific community to shift towards endoscopic or robotic procedures. In particular, the emerging field of robotics has gained increasing success, leading to the advantage of performing complex procedures with the potential of minimizing tissue dissection and reducing morbidity [73, 74, 77–79]. Cuccurullo et al. described their initial experience with the r-TARRD technique, reporting promising results [79], with the possibility of restoration of the abdominal wall integrity by plicating the linea alba along its entire length and combined with the TAR procedure as needed.

There are different types of access and working space (preaponeurotic, retromuscular, preperitoneal); for example, REPA technique provides a preaponeurotic repair [75, 82, 89], while Manetti et al. [30] and Carrara et al. [29, 84] described techniques with retromuscular space development for mesh positioning.

According to the recommendations by previous guidelines [100, 101], most of the techniques described to date have in common the ideal restoration of abdominal wall integrity through the linea alba plication with the closure of the hernia defect. Discrepancies regarding the type of suture used for the repair emerge among the authors. Moga et al., in their series, used non-absorbable running sutures for plication [81], while other Authors preferred absorbable sutures [28, 30]. Conventionally, non-absorbable sutures might provide a stronger and more permanent repair. However, previous studies have shown similar efficacy in the

repairs' strength between non-absorbable and absorbable sutures [34, 48, 51, 103].

Using a mesh is another technical aspect that varies from one technique to another. EHS guidelines suggested a mesh-based repair of RAD with concomitant midline hernias with a weak strength of recommendation [1].

A systematic review and meta-analysis on elective repair of umbilical hernia found that mesh repair reduced the risk of recurrence compared with suture closure without altering the risk of chronic pain [104]. While direct evidence specific to RAD with concomitant hernias is limited, these findings from primary umbilical hernia repairs suggest that mesh reinforcement may offer a similar benefit in reducing recurrence rates in RAD patients with hernias larger than 1 cm. Similarly, a study by Shankar et al. reported recurrence rates of 2.4% for mesh repair versus 9.8% for suture repair in umbilical hernias, underscoring the efficacy of mesh reinforcement in reducing recurrence [105].

Nowadays mesh augmentation seems to be commonly used in the setting of mini-invasive repair [29, 30, 74–92]; polypropylene material resulted the most frequently applied material, with a single reported experience of biosynthetic mesh [29].

In consideration of postoperative outcomes, we found that postoperative morbidity and recurrence rates are similar among different mini-invasive experiences described [29, 30, 72–95].

Lastly, results concerning the minimum size of RAD eligible for surgical treatment in the presence of a ventral hernia are heterogeneous. Swedish guidelines reported that the presence of an associated ventral hernia may be an indication for surgery, regardless of the size of a concomitant RAD, and that in the case of pronounced abdominal bulging or when performing trials, surgery on patients with a diastasis exceeding 3 cm may be considered [77]. ElHawary et al. and Mommers et al. demonstrated discrepancy in RAD width surgically treated when associated with a ventral hernia, with different indications by single Authors [14, 96]. Even when focusing on novel endoscopic approaches, we did not find a standard RAD width, or even within certain limits, to justify a surgical treatment. Some Authors proposed surgery for RAD smaller than 4 cm when associated with ventral hernia [30, 74, 75, 83], while others do not give information on the widths of the treated RAD.

In conclusion, a multiplicity of techniques for treating RAD combined with ventral hernia are described, with a majority of minimally invasive approaches. The different repairs seem safe, feasible, and effective regarding postoperative complications, hospital stay, recurrence rates, and patient satisfaction, but follow-ups are still short. Further studies, including clear indications of treatment, comparative data and long-term observation periods, are mandatory

to standardize the treatment and guarantee the optimal care option for patients.

KQ9. Surgical treatment of RAD with umbilical hernia. Is there a most effective surgical treatment for RAD with a concomitant hernia of the linea alba ≤ 1 cm?

Speaker in Rome: Francesca Pecchini

Statement 11

Statement 11. Suture plication of the linea alba contributes additive strength to umbilical hernia repair by correcting the lateral displacement of the rectus muscles, thereby restoring abdominal wall tension and structural support. The EHS guidelines suggest that plication of the anterior rectus sheath may be sufficient to repair RAD with the smallest (less than 1 cm) umbilical or epigastric hernias. (CoE: Moderate ●●●○).

Recommendation 11

The experts' panel recommends that surgeons and patients make shared decisions about all aspects regarding the use of mesh and type of approach in cases of RAD with an associated hernia of the linea alba ≤ 1 cm. Agreement 35.2%, Strong agreement 49.5%.

Umbilical and epigastric hernias with concomitant RAD represent a treatment challenge in the field of abdominal wall reconstruction. Despite the lack of standardization of surgical techniques, a large consensus indicates the need for concomitant repair of ventral and/or incisional midline hernias associated with RAD [98]. If, on the one hand, RAD is a risk factor for hernia development [106], the concomitant presence of RAD is acknowledged as the main predictor of recurrence after midline hernia repair [107]. Nevertheless, RAD might not be diagnosed preoperatively in patients undergoing umbilical hernia repair since the diagnosis is usually based upon clinical examination, while abdominal wall US scans or CTs are not routinely performed. Also, not all surgeons recognize the fact that the concomitant presence of RAD and umbilical hernia increases the risk of recurrence. When RAD is present, the recurrence risk increases because of the poor quality of the fascial tissue surrounding the hernia [108].

According to the European Hernia Society (EHS) guidelines on the management of RAD [1], though plication of the linea alba might be sufficient in case of RAD associated with a hernia ≤ 1 cm, an increasing number of studies indicate the need for a mesh augmentation when the hernia defect is > 1 cm. Although the quality of this evidence is low, and the strength of recommendation is weak, it has been confirmed and reported in the European and American Hernia Societies Guidelines (EHS and AHS) [109]. In patients with RAD and umbilical/epigastric hernia, both open and minimally invasive techniques with mesh reinforcement

are effective, with preperitoneal or retromuscular placement of the mesh as the treatment of choice [110]. Several minimally invasive techniques (laparoscopic or robotic) have been introduced to reduce invasiveness and preserve efficacy. Unfortunately, the available studies often report single center or even single surgeon experience, usually described in retrospective analyses [81, 86, 98, 111, 112]. Despite the surgical approach employed, the treatment of RAD with a midline hernia seems to be a safe procedure, with seroma reported as the main complication. Hematomas and wound infections are instead less commonly described [72, 76, 83, 113]. The recurrence rate has been reported as high as 12% [108]. However, this evidence might be affected by the high variability among the studies, the lack of standardized procedures, the length of follow-up, and bias in data collection.

In conclusion, in the presence of a midline hernia, abdominal wall evaluation in order to diagnose concomitant RAD must be performed. Surgical repair of both the hernia and RAD with mesh augmentation through open or minimally invasive approaches according to patients' general conditions, hernia and RAD features and surgeon expertise is the treatment of choice. Large prospective and multicentric cohort studies are needed to establish the surgical approach to choose according to RAD and hernia characteristics, then standardize the technique to achieve easily reproducible interventions, thus increasing the quality of evidence and strength of recommendations.

KQ10. Mesh reinforcement strategy. Is using absorbable or biosynthetic meshes worth it in case of RAD repair?

Speaker in Rome: Gerardo Sarno

Statement 12

Some authors have proposed the use of biosynthetic meshes in case of RAD repair (both with or without a concomitant hernia of the linea alba), reporting promising results even if no evidence deriving from comparative studies has been published to date. (CoE: Low ●○○○).

Recommendation 12

Currently, there is insufficient evidence to favor biosynthetic mesh over synthetic mesh for RAD repair. Biosynthetic meshes may be considered in select cases, such as young patients or those with a very low BMI. Their use should be guided by individualized patient discussions, weighing potential benefits, costs, and long-term outcomes. Even this, the discussion among general surgeons experts in hernia repair showed general satisfaction for the preliminary results. Agreement 54.5%, Strong agreement 35.6%.

Evidence on using biosynthetic mesh in the surgical repair of RAD is lacking, and available data mainly derive from studies focused on ventral hernia repair in different grades of contaminated fields. Therefore, the recommendation

was based on the clinical experience and observations of the expert panel members who participated in the Delphi process.

Modern abdominal wall reconstruction necessitates a combination of mesh reinforcement and tissue-based repairs to successfully achieve a hernia free-condition. The need for mesh augmentation in RAD repair is still not completely defined. Moreover, the use of biosynthetic meshes for this condition has only seldom been described [29] because a definitive evaluation of their effectiveness is not available. As a matter of fact, these kinds of meshes have been designed to be biocompatible and usable in contaminated fields. Their cost is notoriously lower than that of biological prostheses, with a complete resorption time ranging from 6 to 18 months [114], so their use has been mainly reserved for incisional and ventral hernia repair even in contaminated surgical fields [115]. One of these prostheses is the biosynthetic poly-4-hydroxybutyrate (P4HB) Phasix mesh, which is resorbed after 12–18 months and hypothetically provides the right timing for the abdominal wall to reconstruct, while long-term mesh complications like pain and infection susceptibility are decreased compared to permanent synthetic meshes [115, 116]. Phasix meshes have shown a recurrence rate ranging between 6.9% and 20% [115–119]. Of note is that the on-lay location of the mesh was found to be a significant independent risk factor for recurrence [118]. Reports on Phasix use in RAD repair are scarce. Although no significant differences in the outcome have been reported in comparison with synthetic mesh, due to the limited follow-up, the recurrence rate was not possible to define [29].

Large prospective and multicentric cohort studies with adequate follow-up are needed to establish the surgical approach to choosing and validating the effectiveness of biosynthetic meshes in the surgical repair of RAD.

Conclusion

This consensus provides a structured framework for RAD management in post-gravidic women without skin excess, emphasizing accurate diagnosis, tailored treatments, and patient-centered care. Future studies should focus on long-term surgical outcomes, particularly recurrence rates and functional improvements across different techniques. Standardized patient-reported outcome measures are needed to assess symptom resolution and quality of life. The effectiveness of exercise-based rehabilitation remains uncertain, with no standardized protocols or clear selection criteria. Further research should also clarify the role of imaging modalities, standardizing measurement techniques for RAD diagnosis. Finally, mesh reinforcement strategies require investigation to determine optimal patient selection, mesh type, and placement approach. The absence of plastic surgeons in the expert

panel and Delphi process was a limitation to this work and reduces the applicability of these recommendations to the subset of women with RAD but without skin excess.

It should also be emphasized that our recommendations address scenarios in which patients do not request, or do not require, abdominoplasty. Future multidisciplinary collaborations, including input from plastic surgeons, are encouraged to broaden the applicability of these recommendations.

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Data availability Datasets used and/or analyzed during the current study will be available from the corresponding author upon reasonable request.

Declarations

Ethics approval This study does not involve any patient data and does not need formal ethics approval.

Consent for publication All authors of this study provided their full consent for the publication of this work.

Competing interests The Authors of this study declare that they have no competing interests.

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