Great Britain Rowing Team guideline for diagnosis and management of rib stress injury: part 1

Guy Evans, Ann Redgrave

ABSTRACT

Background Rib stress injury (RSI) is the development of pain due to bone oedema caused by overload along the rib shaft and is commonly seen in rowers. Often clinicians who manage this injury are exposed to the condition at the elite level. There may, however, be a lack of confidence in diagnosing and managing this condition by clinicians who are not regularly exposed to this injury. As a result, evidence-based guidelines have been developed to aid diagnosis and management of RSI.

Methods A detailed literature search was conducted reviewing the diagnosis and management of RSI. Detailed discussions were held by the Great Britain Medical Team to identify key issues in diagnosis and management of RSI. An up-to-date, evidence-based approach to managing RSI was created using both expert knowledge and current literature to formulate a functional guideline outlining best practice in management of RSI in rowers.

Results A clinical guideline has been created incorporating 5 key areas: diagnosis, severity grading, investigation, management and associated risk factors for RSI. Important indicators for each key area are incorporated within the guideline using relevant literature where possible alongside expert opinion. The guideline has deliberately been kept concise and tailored for use in the clinical setting.

Conclusions A new clinical guideline for management of RSIs has been developed to facilitate clinicians in identifying RSI, aiding accurate diagnosis and providing effective management. This guideline is to be disseminated to clinicians, rowing coaches and clubs throughout the UK.

BACKGROUND

Rowing is a repetitive sport with an injury profile consisting of predominantly overuse injuries. The most common sites of injury in rowing athletes are the lower back and knee. Rib stress injuries (RSIs) are the next most common injury and comprise approximately 10% of all rowing-related injuries. It has been reported that RSI affect 8.1–16.4% of elite rowers and 2% of University rowers and 1% junior elite rowers. The incidence of RSI has also been reported to be higher in international rowers versus national rowers. With recovery times of 3–8 weeks reported, RSI poses a significant problem for both coaching staff and the medical team. Hooper et al reported an average of 47.8 training days lost due to rib stress reaction and 60.0 training days lost for complete rib stress fracture. Clearly reducing morbidity through early identification and appropriate management is paramount and can lead to earlier recovery and return to sport.

RSI can be defined as the development of pain due to bone oedema caused by overload along the bone shaft and is one cause of ‘chest wall pain’ (a descriptive term often used in the literature). RSI is believed to occur due to the repetitive and forceful nature of thoracic muscle co-contraction. Serratus anterior (SA) and external oblique (EO) muscles are commonly implicated; however, the exact mechanism of injury is still debated. Both McKenzie and Karlson have hypothesised that injury may occur due to the increased magnitude of co-contraction between SA and EO at the end of the ‘drive phase’ of the rowing stroke. This was not, however, supported by Vinther et al in their study using electromyography and two-dimensional video kinematics that added weight to an alternative theory that injury occurs due to repetitive rib cage compression and excessive isometric thoracic muscle contraction at the beginning of the drive phase. A number of risk factors linked with the development of RSI have been identified which, if addressed early, can help prevent recurrence of injury or more importantly reduce the incidence of RSI when addressed proactively.

Anecdotally, the authors have noted that despite many clinicians working in sport are aware of RSI as a diagnosis, early intervention does not always occur and often the diagnosis can be mistaken for other conditions such as an ‘intercostal muscle strain’. This can lead to failure to offload the athlete early. If the athlete continues to train, symptoms often progress resulting in delayed rehabilitation and return to sport once the correct diagnosis has been established. It was for this reason, and due to the large number of direct requests to the authors from clinicians regarding diagnosis and management of RSI in rowers, that the decision was made to create an evidence-based RSI guideline to help diagnose and manage RSI. It is worth noting that due to poor understanding of this injury among clinicians who do not regularly treat rowers, it is highly likely that the condition goes under-reported especially beyond international/elite rowers and that the incidence and thus burden of injury is in fact much greater than reported in the literature.

Aim of the guideline

The aim of the guideline was to create a user-friendly, informative, evidence-based flow diagram that takes the clinician through the diagnosis, severity stratification, investigation and management of RSI in rowers. The aim was to make the guideline both fluent and practical for use in the clinical setting.
setting with the aim of disseminating the information through clubs and relevant clinics throughout the UK targeting those who may see the rowing athlete as part of their caseload. It has been designed with the ‘less confident’ clinician in mind but will also serve as a detailed ‘aide memoire’ for clinicians who deal with RSI in rowers frequently.

It is worth highlighting that Hooper et al. published a very useful ‘clinical management pathway for chest wall pain in elite rowers’ in 2011. This pathway outlines a practical approach to managing elite rowers with chest wall pain based on injury surveillance data captured over two domestic and international rowing seasons. Although this guideline is hugely valuable in management of elite rowers, it does not address RSI specifically and is aimed at elite/international rowers. The management pathway is predominately ‘time-based’ if RSI is confirmed with imaging and assumes access to imaging is readily available which may not be the case in national level athletes or below. As a result, we chose to develop a guideline specifically for RSI that uses clinical markers to aid diagnosis and management rather than a time-based approach and aims to stratify the injury by severity based on these same clinical markers.

METHODS

A detailed literature research was undertaken to establish the relevant body of literature regarding RSI diagnosis and management in rowing. PubMed, EMBASE and CINAHL databases searches were conducted using the terms ‘rib’ OR ‘fracture’ AND ‘rowing’. Seventy-one articles were identified. Abstracts were reviewed and irrelevant articles excluded. Reference lists were reviewed to ensure identification of all relevant articles. Detailed discussions took place within the Great Britain Rowing Medical Team to identify ‘key points’ in both the literature and through extensive clinical experience that were felt salient to the successful identification and management of RSI in rowers. These ‘key points’ were identified in five main areas: diagnosis, severity grading, investigation, management and risk factors for RSI. The ‘key points’ were then used as the basis for the structure of the guideline and assimilated into a flow diagram taking the reader sequentially through these five main areas. Once the initial guideline had been developed, it was repeatedly reviewed by the authors for functionality, readability and accuracy until the final guideline was agreed on. The guideline then underwent a short trial in the clinical setting by five of the Great Britain Rowing Medical Team and appropriate adjustment made where necessary after feedback.

The finished guideline underwent ‘branding’ by the Great Britain Rowing Team (GBRT) administration team to ensure it conformed to branding policy. The guideline was then reviewed by the governing body for rowing, the Fédération Internationale des Sociétés d’Aviron (FISA). Following review, the FISA medical commission agreed unanimously to endorse the guideline.

RESULTS

A user-friendly, clinically relevant and evidence-based guideline for diagnosis and management of RSI was created.

Diagnosis/identification of RSI

Diagnostic features of RSI are included in the ‘diagnosis’ section of the guideline. This incorporates ‘clinical markers’ that help identify RSI and have been highlighted in the guideline in red and marked with an asterisk*. These are divided appropriately into clinical markers identified in either history or examination. These clinical markers are not just used for diagnosis but subsequently help to grade the severity of injury and guide the clinician through the management/rehabilitation. This is a key feature of the guideline as the identification of these clinical markers helps the less experience clinician progress an athlete from diagnosis through rehabilitation based on clinical markers rather than merely time-based rehabilitation which would not allow for individual variability between athletes.

The common diagnostically relevant features of RSI can be seen in Table 1.

Grading of severity

The clinical markers identified in the ‘diagnosis’ section of the guideline are also used to help the clinician assess the severity of the RSI in conjunction with other features of injury. These include features such as whether the rower can race or train ‘through the injury’. No previous injury severity stratification was identified in the literature, and thus the authors propose the following stratification dividing RSI in to three broad groups within the guideline: mild, moderate and severe. Each severity group is based on the level of clinical markers displayed by the athlete. In addition, a range of visual analogue scores (VAS) for pain is attributed to each grading scale based on the authors’ experience of RSI severity. The reader is encouraged to interpret VAS cautiously as these can be highly subjective to the individual athlete. The VAS should not be used in isolation but helps to contribute to the overall clinical picture of severity grade. The purpose of this section of the guideline is to help the less experienced clinician understand the severity of injury, and thus help to manage the expectation of the athlete/coach. Although the guideline aims to steer away from ‘time-based’ rehabilitation, it may be useful to give all parties involved a suggestion of severity and anticipated time away from the boat. This section can also be used to track the athletes progress through rehabilitation as their injury becomes ‘less severe’ through the recovery process.

Investigations

The investigation section encourages the clinician to consider making a clinical diagnosis in the first instance and manage the athlete accordingly to avoid delay while waiting for imaging. Clinically improving RSI may not require confirmatory imaging; however, the clinician is encouraged to consider further investigation if the RSI is not improving with appropriate treatment or if the diagnosis remains unclear. Smoljanovic and Bojancic report a case of Ewing’s sarcoma of the rib in a 13-year-old female rower which presented in a similar fashion to RSI and highlights the importance of remaining vigilant if symptoms of RSI do not settle with appropriate management or if the initial

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Common diagnostic features of rib stress injury</th>
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<tbody>
<tr>
<td>History</td>
<td>Examination</td>
</tr>
<tr>
<td>Insidious, sudden onset or crescendo pain over a few days or weeks</td>
<td>Tenderness commonly mid-axillary line of chest wall</td>
</tr>
<tr>
<td>Pain on deep breathing*</td>
<td>Ribs 5–8 in particular</td>
</tr>
<tr>
<td>Pain on pushing/pulling doors*</td>
<td>Tender spot over oedema and sometimes palpable callous</td>
</tr>
<tr>
<td>Difficulty rolling over in bed or sitting up from a lying position*</td>
<td>Positive spring/compression of rib cage (AP and lateral)*</td>
</tr>
<tr>
<td>Unable to sleep on affected side*</td>
<td>Pain with press up or resisted serratus anterior testing*</td>
</tr>
<tr>
<td>Possible cough/sneeze pain*</td>
<td>Pain on initiating trunk flexion (sit up position including oblique bias)*</td>
</tr>
</tbody>
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*Clinical markers identified with asterisk. AP, anteroposterior.
diagnosis is not clear. In these circumstances, imaging is important in making an accurate and early diagnosis. It was noted at the recent combined FISA/GBRT Sport Science and Medicine Conference in January 2015 that there may be international variation in practice regarding imaging athletes for RSI due to differences in availability of imaging modalities between countries. MRI is often the imaging of choice in the UK; however, isotope bone scans may be more commonly used in the USA.

When interpreting imaging of RSI, it is worth noting that images can be misleading as changes in bone density or the presence of callous do not always correlate with the athletes clinical recovery. It is therefore necessary to interpret imaging with caution and pay close attention to clinical markers when monitoring an athlete’s recovery.

Management

Management of RSI is divided into two stages for simplicity. Stage 1 broadly consists of immediate interventions, and stage 2 focuses on secondary measures. In reality, there will be considerable overlap between the two stages and the confident clinician may incorporate much of stage 2 early in the rehabilitation process. Stage 1 highlights the importance of offloading the rib by cessation of rowing-based activities. Cross training is permitted if pain free. Analgesia may be used but non-steroidal anti-inflammatory drugs are best avoided due to their potential impact on bone healing. Taping and soft tissue therapy is recommended. Ultrasound/laser treatment may aid recovery but is by no means essential. A gradual return to rowing-based activities is recommended ensuring resolution of all aforementioned clinical markers. A loose time frame of 3–6 weeks is suggested to give the less experienced clinician an indication of likely time frame for recovery.

Stage 2 of management focuses on secondary measures to be considered. Biomechanical assessment of the athlete should be undertaken and deficits in thoracic spine mobility should be improved and maintained as training load increases. Technical errors while rowing should be corrected to minimise areas of potential thoracic overload. Stage 2 concludes by signposting the clinician to consider potential risk factors for development of RSI and implementation of a prevention programme.

Risk factors

The last section of the guideline highlights both intrinsic and extrinsic factors for the development of RSI (table 2).

<table>
<thead>
<tr>
<th>Intrinsic factors</th>
<th>Extrinsic factors</th>
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<tbody>
<tr>
<td>Poor trunk strength/endurance</td>
<td>Rowing or ergo at high load/low rate or overgeared</td>
</tr>
<tr>
<td>Poor trunk mobility/flexibility</td>
<td>Rowing against strong wind/current</td>
</tr>
<tr>
<td>Concurrent shoulder pathology/injury</td>
<td>Rapid increases in training load/volume/intensity</td>
</tr>
<tr>
<td>Low back injury</td>
<td>Long steady state rowing</td>
</tr>
<tr>
<td>Previous rib injury</td>
<td>Change from sweep to sculling and vice versa</td>
</tr>
<tr>
<td>Lightweight rower</td>
<td>Change from large to small boat</td>
</tr>
<tr>
<td>Female</td>
<td>Rigging overgeared or too much height</td>
</tr>
<tr>
<td>Reduced bone density</td>
<td>Weight loss</td>
</tr>
<tr>
<td>RED-S</td>
<td>RED-S, Relative Energy Deficiency in Sport; RSI, rib stress injury.</td>
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Intrinsic factors include poor core stability and trunk mobility, concurrent shoulder pathology or low back injury as well as factors related to low body weight or energy availability including any features of Relative Energy Deficiency in Sport (RED-S).

Extrinsic factors include those factors related to change of load such as increased intensity or volume of training, rowing against strong wind/current, changing from sweep to sculling and vice versa, and altered training balance between ergometer training and rowing.

Identifying and addressing risk factors forms an important part of understanding why injury may have occurred in the first instance but also to minimise the chance of injury recurrence. The final section of the guideline on risk factors should serve as an important ‘aide memoire’ even for the experienced clinician.

CONCLUSIONS

A new, evidence-based guideline for diagnosis and management of RSI has been developed for use in the clinical setting. The guideline aids the clinician in diagnosis, investigation and management of RSI. It outlines evidence-based risk factors to be addressed when rehabilitating the athlete.

The guideline has been trialled in clinical practice and has received positive feedback from clinicians. The guideline is to be disseminated through relevant clinics and rowing clubs in an effort to support the clinician working with rowing athletes and to help with earlier diagnosis and appropriate management of RSI. It is hoped that this will help to significantly reduce the morbidity associated with the injury.

Once the guideline is in regular clinical use, it will be reviewed following clinician feedback. The authors aim to create a corresponding guideline in the near future focusing in more detail on a suggested rehabilitation programme for athletes following RSI.

What are the findings?

- An evidence-based clinical guideline has been developed for the diagnosis and management of rib stress injury (RSI).
- The guideline aims to assist in the timely diagnosis and management of RSI, thus reducing the associated morbidity through early and appropriate intervention.
- Risk factors for the development of RSI are included to reduce the risk of injury recurrence.

How might this impact on clinical practice in the future?

- A new guideline has been developed to support clinicians in the diagnosis and management of rib stress injury in rowers.
- It is hoped that the guideline will aid early and accurate diagnosis of rib stress injury and thus reduce the morbidity associated with the condition.

Twitter Follow Guy Evans at @drguyevans

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Contributors GE was responsible for conception and design of the rib stress injury guideline. GE drafted and revised the article for publication and approved the final.
REFERENCES


