ABOUT THE SPORT

Water polo is a high-intensity team sport that originated in England in the 1860s as an aquatic form of rugby. It is particularly popular in Europe, but is rapidly growing in popularity in other continents. Water polo is the oldest team sport included in the Olympic programme with the men’s tournament featuring at all Olympic Games since 1900, while the women’s tournament was first conducted at the Sydney Olympic Games in 2000. The sport is considered safe to play at the recreational level, but there is a high injury burden when played at the elite level.

Only a few descriptive injury epidemiology papers and one retrospective review have been published on water polo injuries. The Fédération Internationale de Natation (FINA) has conducted injury surveillance at major international competitions since 2004. While FINA should be applauded for this initiative, unfortunately this data does not capture information regarding injuries sustained in regular training as players that are excluded from national team selection due to injury do not attend these tournaments. Accordingly, this survivor bias underestimates the burden of injury at the highest level. Prospectively recorded injury surveillance and exposure during training and match play is required before we can fully appreciate the true injury burden in this sport. This paper will therefore present level 5 evidence with reference to clinical reasoning and available literature as appropriate.

TRAINING LOADS – WHY DO WATER POLO PLAYERS GET INJURED?

Water polo requires the combined actions of throwing, swimming, defending, wrestling and tackling, making it a very physically demanding and full contact sport. A typical training week comprises up to five water polo-specific sessions, two to three swimming-specific sessions and...
three weight training sessions\(^a\). Playing elite level water polo therefore requires the athlete to cope with high training loads. Repetitive motions involved in swimming, throwing and the ‘eggbeater kick’ can result in overuse injuries, while training and match play creates risk for acute, contact injuries. Heavy weightlifting is an essential part of training for most elite water polo programmes and can also result in injuries as athletes strive to optimise their upper and lower body strength to assist in pushing around their opponents and shooting with power.

WATER POLO-SPECIFIC BIOMECHANICS

Apart from the high training loads required for the sport, there are sport-specific biomechanical demands involved in the game which are unique and can place the athlete at greater risk of injury.

**Head-up swimming**

Swimming freestyle is often performed with the head up out of the water, either swimming in possession of the ball or looking around to follow the game play (Figure 1). Head-up freestyle swimming involves extension of the cervical spine, shorter arm strokes, higher elbows and a much less streamlined body position. This results in reduced efficiency of the swimming stroke and extra load being placed on the cervical spine and shoulders.

**The eggbeater**

The eggbeater kick is used by water polo players to support their body in an elevated position for extended periods and then raise the body out of the water in an explosive action for defending, tackling, passing or shooting (Figure 2). The eggbeater kick is a biomechanically and technically complex movement pattern that involves a cyclical motion with the right and left limbs opposite in phase (Figure 2)\(^9,10\). Repetitive rotational hip motion occurs at high ranges of hip flexion, abduction and internal rotation, coupled with a dynamic boost action when shooting, tackling or defending a shot. These repetitive and dynamic loads can place the hip and groin region at risk of injury. Additionally, large valgus moments are placed across the knee during the downstroke, putting the medial structures (such as the medial collateral ligament) under tension.

**Shooting**

The water polo throw and shot are highly complex biomechanical actions which combine the familiar throwing motion of the baseball pitch (albeit using a ball weighing 400 to 450g) with an eggbeater boost kick\(^\text{a}\). Despite the biomechanical disadvantage of throwing in the unstable environment of water, the speed of the water polo shot can reach up to 95 km/hour. There is, therefore, substantial load placed on the glenohumeral joint with the repetitive throwing action, as the shoulder is commonly the most vulnerable link in the kinetic chain. There is significant variation between coaches on what is considered the ‘perfect’ shooting technique, however all agree that to shoot fast and accurately, plus deceive the goal keeper, considerable skill and co-ordination is required. Shooting with minimal load on the shoulder requires...
the optimal transfer of kinetic energy from the boost of the leg action via the pelvis and trunk to the upper body and eventually the ball. If there is dysfunction at any component of this kinetic chain, such as: reduced range of motion at the hips, reduced thoracic rotation or poor core stability, the shoulder and elbow could quickly become overloaded from the demands of throwing and shooting.

**Goalkeeping**

The goal keeper in water polo is very close to the action, often defending shots at short range – as little as 2 metres or less. They are therefore particularly vulnerable to acute injuries to the face, elbows, fingers and thumbs.

**INJURY PATTERNS**

From the available literature, the most commonly injured part of the body is the shoulder, followed by the wrist/hand, head/face, elbow and hip/groin.

**Shoulder injuries**

Water polo shoulder injuries can be a unique mixture of conditions due to the repetitive loads of throwing and swimming, combined with contact injuries that can occur in the act of throwing, tackling or blocking in front of goal. It is therefore challenging for the treating clinician to determine which loads from the sport are contributing to the pain presentation and therefore represent the greatest risk when returning to play following injury (Figure 4).

The typical mix of throwing-related injuries such as SLAP (superior labral anterior and posterior) lesions, rotator cuff and long head of biceps tendinopathy, postero-superior impingement are commonly seen in water polo players. However, these can be complicated by the presence of multidirectional hypermobility that is commonly associated with the swimmer’s shoulder. The water polo player’s shoulder has higher range of motion in the dominant compared to non-dominant shoulder, which is likely to be due to the extreme ranges of external rotation required to throw hard (analogous to the baseball pitcher’s shoulder), plus the high range of internal rotation range required for efficient swimming. In these athletes it is essential that the managing clinician closely monitors symptoms during throwing as well as swimming, ensures internal rotation range of motion is maintained and that the ratio of internal to external rotation strength is <1.5. To achieve this, the clinician needs to be prepared to work with the coach to modify throwing and/or swimming load as dictated by signs and symptoms.

Biomechanical factors that may contribute to inefficient shooting or swimming technique could include: reduced hip motion, poor co-ordination of the eggbeater kick, reduced thoracic or pelvic rotation, incorrect timing of the kinetic chain and poor scapular or core stability. These biomechanical deficiencies should be discussed with the player’s coach (and other technical staff involved with the sport) as potential influencing factors to the clinical presentation of any water polo player with overuse-related shoulder pain. Our experience also suggests that these athletes can often suffer exacerbation of pain with repeated injuries when performing bench press exercises and we have noted some success in avoiding performing bench press below the horizontal.

The physical nature of the sport means that acute traumatic injuries to the shoulder are common, with glenohumeral instability a relatively frequent finding. These injuries may require a prolonged rehabilitation time as recurrence of instability is a significant risk when returning to this contact sport. Surgery is often required if there is a significant structural injury resulting in mechanical instability, with the restoration of adequate range of motion a particular concern if surgery is required on the throwing shoulder.

**Wrist/hand injuries**

Wrist injuries seen in the water polo player include acute injuries to the triangular

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**Figure 3:** Eggbeater kick action.
fibrocartilage complex or carpal ligaments, sustained either while tackling a player or blocking a shot. Finger and thumb injuries are very common and typically include acute, ligamentous strains when blocking a shot, catching a ball, tackling a player or when the fingers get caught in the swim suit of the opponent. If these injuries are in the dominant hand, they can often be difficult to manage due to the ongoing pain and dysfunction with ball handling. Therefore optimal acute injury management using ice and local compression are essential in the early management of these injuries. Strapping and splinting, preferably without interfering with the fine motor function of the hand, may be required for an extended period to prevent recurrence.

**Head/face injuries**

Otitis externa (swimmer’s ear) is common in water polo players. Head and face injuries are also unfortunately quite common in the sport and can be life-threatening as the injured player must be brought to the side of the pool by the other players in the water to allow for medical evaluation. The most common types of head/facial injuries are skin lacerations, bone fractures and eye lacerations, but concussion or retinal detachment can also occur and the clinician caring for these athletes needs to have in place appropriate training and clear pathways for these critical injuries.

**Elbow injuries**

Two patterns of injury to the elbow are commonly seen in the water polo player, similar to that described for the handball goalkeeper’s elbow: acute traumatic strain injury to the anterior capsule and ulnar collateral ligament and overuse medial/posterior/lateral elbow pain comparable to valgus extension overload spectrum of injury. Acute ulnar collateral ligament injuries occur particularly in water polo goalkeepers, but also in field players, as a result of a hyperextension injury during the blocking action of defending the goal. Strengthening the elbow flexor-pronator muscles and eccentric biceps action are important components of the rehabilitation programme. Taping for prolonged periods may also be required to protect the elbow joint once returning to training and match play. Bracing is not usually recommended as the loss of terminal extension can interfere with the player’s reach and inhibit swimming and throwing action. These elbow hyperextension injuries can often be difficult to manage and recurrence is common. Technique training, in consultation with the coach and technical staff, is therefore an important part of management and prevention of these injuries. This should focus on maintaining the arm in front of the body where possible and defending against shots using: leg work, trunk motion, scapular protraction and horizontal flexion/internal rotation of the shoulder, particularly for the goalkeeper.

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**Figure 4:** Flow diagram for key features in planning the assessment of a water polo player presenting with shoulder pain. Note that each of the three presented subjective features may co-exist providing a mixed presentation which will need to be individually examined. IR=internal rotation, ER=external rotation, GIRD=glenohumeral internal rotation deficit, GH=glenohumeral.
Figure 5: Optimising goalkeeper defending technique to protect against elbow injuries. (a) The goalkeeper maintains their arm in front of their body and reaches the shot by jumping powerfully to the side. (b) The goalkeeper’s arms are behind his body, with the elbows at greater risk of hyperextension injury.
Overuse injuries to the elbow as a result of throwing may require extensive technique correction and a rehabilitation programme that addresses deficiencies in the entire kinetic chain. Control of throwing load, improved eggbeater efficiency, timing of the shooting technique and a more elevated elbow position relative to the body (ideally between 90° and 110° of shoulder abduction) are essential components of injury management and will typically be done in conjunction with technical coaching staff.

**Hip/groin pain**

The load of eggbeater kick means that intra-articular hip joint lesions, chronic adductor-related groin pain and acute adductor muscle strain injuries are relatively common in water polo. The management and prevention of these injuries requires the maintenance of range of motion – particularly hip abduction/internal rotation range – and strength of the abductor, adductor, internal and external rotator muscles plus optimal core stability. In conjunction with a biomechanist and coach, technique training using underwater cameras can sometimes be required for improving the efficiency and effectiveness of the eggbeater kick.

**Knee pain**

Lastly, medial knee pain similar to breaststroker’s knee is quite a common injury seen in water polo players due to the training and playing loads of eggbeater kick. The managing clinician should assess range of motion and strength around the hip, as reduced abduction/internal rotation range of motion and weakness of hip abduction commonly creates excess valgus stress at the knee and consequent pain in the medial knee structures.

In summary, this exciting sport can be challenging for the treating clinician to maintain an injury-free water polo team. However, as in most contact sports, many water polo players play with discomfort from overuse injuries. These require ongoing close monitoring, management and prevention which can help reduce the burden of overuse injuries to the team.

**References**