



British **Orthopaedic** Association  
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Royal College  
of Nursing

# Peripheral neurovascular observations for acute limb compartment syndrome

*RCN consensus guidance*





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# Peripheral neurovascular observations for acute limb compartment syndrome

## RCN consensus guidance

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# Guidelines on peripheral neurovascular observations for acute limb compartment syndrome (ALCS)

## Patients at risk of ALCS

1. All patients (adults and children) with an acute limb injury, post orthopaedic procedure to a limb, or treatment resulting in limb compression/constriction (such as casts, skin traction, circumferential bandaging) are at risk of acute limb compartment syndrome (ALCS) (Consensus).
2. Practitioners should maintain a high level of suspicion of ALCS in all patients who report pain which is out of proportion to the injury/surgery and on passive extension of the muscle group affected (Consensus).
3. It is not possible to define a specific hierarchy of risk but some patients are more at risk than others (Consensus).
4. Patient characteristics suggestive of high risk are: male sex, 35 years or younger, underlying coagulopathy disorders or on anticoagulants (Level II).
5. Injuries suggestive of high risk are crush injuries (or prolonged limb compression, for example, following collapse after drug overdose), closed tibial or forearm fractures, soft tissue injuries, high energy trauma including open fractures (Level II).
6. Treatments suggestive of high risk are: circumferential bandages, a cast, and immobilisation or realignment of a fracture (Consensus).
7. Patients with a hip fracture are not at high risk of ALCS unless other risk factors also apply (for example, laying on a floor for a prolonged period of time leading to limb compression) (Consensus).

## Reducing the risk of ALCS

8. Circumferential bandages should not be too tight (Consensus).
9. Elevate the upper limb to heart level on a pillow when sitting/in bed and with a sling when mobilising (Consensus).
10. Elevate the lower limb to heart level when in bed and elevate on a stool when in a chair (Consensus).
11. Educate patients about the signs and symptoms of ALCS (Consensus).
12. Provide written patient information (Consensus).
13. Good fracture management (limb immobilisation) is important (Consensus).
14. The patient should be kept normotensive (Consensus).
15. Maintain oxygen saturation at 94-98 per cent for acutely ill patients not at risk of hypercapnic respiratory failure (Consensus).

## Diagnosis of ALCS – clinical observations

16. Pain is the most important indicator of ALCS (Consensus).
17. Pain on passive extension of the muscle group affected and out of proportion to the injury (or poorly responsive to analgesia) are the earliest and most sensitive clinical indicators (Consensus).
18. Pain assessment should include the severity and the responsiveness to analgesia (Consensus).
19. Other signs (paraesthesia, paresis/paralysis, altered skin colour and altered or absent peripheral pulses) are late signs, and therefore unreliable in the diagnosis of ALCS. But these signs may be useful in detecting other peripheral neurovascular injuries if these are suspected (Consensus).
20. Any suspicion of ALCS should be immediately reported to the responsible clinician (Consensus).

21. Clinical observations for ALCS (pain on passive extension and out of proportion to the injury, poor or no response to analgesia) for at-risk patients should be:
  - a. carried out at least hourly for the first 24 hours, reducing to four hourly observations for a further 24 hours if pain is stable/minimal (Consensus)
  - b. restarted after any procedure that may affect the limb compartments, for example, application of traction or surgery (Consensus).

### **Diagnosis of ALCS – compartment pressure monitoring**

22. Continuous compartment pressure monitoring (CCPM) is currently the only diagnostic investigation available for early diagnosis of ALCS (Consensus).
23. Intermittent compartment pressure monitoring in the presence of clinical signs of ALCS does not change its management (Consensus).
24. CCPM may be of benefit and should be considered in the early diagnosis of ALCS in patients with:
  - a. an impaired ability to experience or communicate pain (for example, unconscious patients or those with a spinal injury) (Consensus)
  - b. high-risk injuries, in particular high energy tibial shaft and forearm fractures (Level 2)
  - c. Equivocal clinical signs (Consensus).
25. When undertaken, intracompartmental pressures should be measured hourly for 24-48 hours (Consensus).
26. The widely accepted compartment pressure threshold for raising concern is a Delta P < 30 mm Hg or an absolute pressure over 40 mm Hg (Consensus).

## B

# Introduction

Acute limb compartment syndrome (ALCS) is a potentially serious complication of injuries and orthopaedic interventions. There is a lack of evidence-based guidance for the early detection of ALCS and there are varying practices around the United Kingdom and the world. These guidelines seek to address this.

## 1. Acute limb compartment syndrome

Compartment syndrome is the result of increased pressure in a muscle compartment. This results in compromised tissue perfusion locally and potential ischaemia (Duckworth and McQueen, 2011) and leads to a collection of symptoms. The condition may be acute or chronic. Acute compartment syndrome can develop in any region of the body that has a muscle compartment with little or no capacity for tissue expansion, including the buttocks, abdomen, hands, arms, legs and feet. The most frequently affected sites are the legs and forearms.

The focus of these guidelines is ALCS which is considered to be a “...true orthopaedic emergency” (Tzioupis et al, 2009) because failure to treat it in a timely manner may result in ischaemia, necrosis, neurological deficit, limb amputation and rhabdomyolysis (Wall et al, 2010). Such complications can occur very quickly after the onset of compartment syndrome and its effects can be irreversible within a few hours. Upon diagnosis ALCS requires fasciotomy and surgical decompression of the affected compartment (Foong et al, 2011). Early diagnosis is, therefore, essential.

## 2. Monitoring to detect ALCS

A literature review commissioned by the guideline development group (Ali et al, 2014) found that clinical observations and recognition of signs and symptoms appear to be the most reliable method of diagnosis in conscious patients whilst intracompartmental pressure monitoring may be useful in high-risk unconscious patients.

It is important to focus on those symptoms which are most useful (that is, are most sensitive and most specific). The review (Ali et al, 2014) found that pain out of proportion to the injury and pain on passive muscle stretch are the most effective clinical observations for early detection of ALCS. Other clinical observations, namely swelling and tenseness of the limb, paraesthesia (decreased sensation/numbness), paralysis, pallor and altered pulses or pulselessness are late signs and are, therefore, not of value in the early diagnosis of ALCS. They may, however, be useful in the assessment for other types of potential vascular or nerve injury.

Intracompartmental pressure monitoring involves electronic monitoring to record pressure readings in the compartment, using a cannula or catheter inserted into the relevant compartment (Ali et al, 2014).

## 3. Context of the guidelines: the ALCS project

The guidelines were developed as part of a three-year project led by the Royal College of Nursing’s Society of Orthopaedic and Trauma Nursing (RCN SOTN). Agreement was reached with the British Orthopaedic Association (BOA) that it would be involved in the project and co-brand the final document. A BOA member became part of the guideline delivery group (GDG) (see Acknowledgments for list of GDG members).

The GDG was co-chaired by two members of SOTN’s national committee, who led and co-ordinated the project. The other members were nurses with clinical and/or academic expertise in the subject, drawn from three of the four countries of the United Kingdom and identified by the co-chairs with the advice of the RCN adviser for the project. The role of the GDG was to plan and manage the overall project. Other planned elements of the project are an early warning score (EWS) observation chart for ALCS and a patient information leaflet.



# The development of the guidelines

## 1. Scope of the guidelines

The guidelines cover the care of adults, children and young people with potential ALCS due to injury and/or treatment for limb conditions. They consider the identification of ALCS, reducing its risk and the role of clinical observation, and compartment pressure measurement in early detection of the condition.

The guidelines do not cover chronic limb compartment syndrome or compartment syndrome of the abdomen. They also do not cover neurovascular observations as part of general orthopaedic and trauma care (for example, observations such as pulses or identification of paraesthesia used to assess for vascular or nerve injuries).

## 2. Literature review

The GDG commissioned a literature review to identify the current evidence base for practice. Six questions were posed.

- 1 Which patients are at risk of ALCS?
- 2 Can patients at risk of ALCS be stratified according to level of risk?
- 3 How can the risk of peripheral neurovascular deficit/compromise due to ALCS be reduced?
- 4 What clinical observations are most effective in diagnosing peripheral neurovascular deficit in conscious patients with ALCS?
- 5 Is compartment monitoring of value in diagnosing peripheral neurovascular deficit in ALCS?
- 6 When should concerns of peripheral neurovascular deficit in ALCS be escalated?

The commissioning brief was put out to tender by the RCN and the successful team, from the University of Hull, carried out the literature review which was completed in May 2013. The literature review (Ali et al, 2014) identified that the majority of the evidence was at level II (studies which have one of the following: narrow population, use a poor reference standard, comparison between the test and reference standard is not blind, case-control studies) or level III (studies that have at least two or three of the features listed

for level II), when considering the NICE guideline development methods for levels of evidence for studies of the accuracy of diagnostic tests (NICE, 2005). The evidence base is, therefore, weak and reinforced the need for a consensus conference to provide guidelines for clinical practice.

## 3. Consensus conference

### a. Scope

A consensus conference was designed to elicit the views of experts on aspects of ALCS which the literature review had identified as having little evidence base. Consensus events are a recognised method of developing guidance where there is a lack of evidence on a topic (Nair et al, 2011; SIGN, 2008).

### b. Attendees

The GDG compiled a list of potential attendees, and 55 people were invited. The criteria for inclusion was that the potential participant should have knowledge and expertise in the topic as an academic and/or clinician. Thirty-nine delegates attended, including five of the seven GDG members and the RCN adviser. Of the delegates, 36 were nurses, including three with particular paediatric nursing expertise and one from the RCN Critical Care and Inflight Nursing Forum. Three orthopaedic consultant surgeons attended.

### c. Format

The delegates were sent the literature review and the consensus questions in advance of the meeting. The meeting was held at RCN headquarters in London in December 2013.

Delegates were divided into six tables, each with a mix of experience and knowledge. The GDG and SOTN committee members acted as facilitators.

A brief summary of the project was presented at the beginning of the day. Four sessions then took place where delegates discussed the key questions about ALCS – identifying patients at risk/stratification of risk, reducing the risk, peripheral neurovascular observations and compartment monitoring. At the beginning of each session a GDG member presented a short summary of the available

evidence and the questions to be discussed. The facilitators ensured that notes were made of the discussions which recorded the resulting consensus/lack of consensus for each group.

Due to the amount of discussion time required, the GDG agreed in advance that voting would not be used on the day. Delegates were informed that the conference discussion notes and the literature review would be used to formulate a number of statements about ALCS and that delegates would have the opportunity to vote on these in an online survey.

## 4. Consensus survey

The notes from the consensus conference were written up and considered by the GDG along with the literature review. From these, 68 statements were formulated for the consensus survey. For each statement, respondents were asked to rate their degree of agreement on a scale of 1 to 5 (1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree, 5 = Don't know/Undecided).

The survey was compiled by the RCN and an electronic link sent to those invited to the consensus event (n=55). Recipients had three weeks in which to respond. Thirty-eight responded. The survey was anonymous and therefore it is not possible to identify the responders/non-responders.

The results of the survey were collated by the RCN and presented to the GDG as descriptive statistics – percentages and number of respondents. The GDG held a face-to-face meeting in June 2014 to finalise the guidelines from the literature review and the consensus survey. A member of the BOA Trauma Group attended as they were concurrently developing a BOA Standard for Trauma (BOAST) on compartment syndrome, and it was important that these guidelines and the BOAST were in broad agreement.

## D

# The guidelines – details of the evidence base

## 1. Which patients are at risk of acute limb compartment syndrome (ALCS)?

### a. Guidelines

1. All patients (adults and children) with an acute limb injury, post-orthopaedic procedure to a limb, or treatment resulting in limb compression/constriction (such as casts, skin traction, circumferential bandaging) are at risk of ALCS (Consensus).
2. Practitioners should maintain a high level of suspicion of ALCS in all patients who report pain out of proportion to the injury/surgery and on passive extension of the muscle group affected (Consensus).
3. It is not possible to define a specific hierarchy of risk but some patients are more at risk than others (Consensus).
4. Patient characteristics suggestive of high risk are: male sex, 35 years or younger, underlying coagulopathy disorders or on anticoagulants (level II).
5. Injuries suggestive of high risk are crush injuries (or prolonged limb compression, for example, following collapse after drug overdose), closed tibial or forearm fractures, soft tissue injuries, high energy trauma including open fractures (level II).
6. Treatments suggestive of high risk are: circumferential bandages, a cast, and immobilisation or realignment of a fracture (Consensus).
7. Patients with a hip fracture are not at high risk of ALCS unless other risk factors also apply (for example, laying on a floor for prolonged period of time leading to limb compression) (Consensus).

### b. Evidence

Primary and review evidence relating to acute limb injury and the risk of ALCS focused on specific limb injuries (such as tibial fractures) rather than relative risk across all potential injuries. The specific risks are discussed in section 2 (page 10). No evidence was identified which considered the risk of undergoing invasive orthopaedic procedures such as joint replacement or treatment resulting in limb compression or constriction, for example casts or traction.

The statements were, therefore, based on consensus opinion. No literature was identified which advised whether patients can be stratified according to level of risk. Studies suggested, however, that certain groups of patients were more at risk than others, but the degree of increased risk was not stated. Thirteen primary studies and seven review studies identified risk factors for ALCS. Primary studies considered specific risk factors. The reviews studied a broader spread of factors. The studies suggested that the factors listed in section A are the key ones to consider.

### c. Consensus opinion

There was strong agreement in the consensus survey on all three categories of at-risk patients; 97 per cent of respondents agreed or agreed strongly with regard to acute limb injury, 95 per cent for invasive orthopaedic procedures and 92 per cent for limb compression/constriction. Any patient with such injuries or undergoing these procedures should be assessed for their relative risk of developing ALCS using the most appropriate method taken from those outlined in the guidelines. Consensus was greatest (over 75 per cent agreed/agreed strongly) for the risk factors outlined above. There was less agreement regarding lower limb replacement, with 45 per cent agreeing/strongly agreeing that this was a risk. For upper limb replacement, 36 per cent agreeing/strongly agreed it was a risk but up to 25 per cent were undecided/did not know. A majority of respondents, 82 per cent, indicated that they felt that a hip fracture was low risk.

## 2. Reducing the risk of ALCS

### a. Guidelines

8. Circumferential bandages should not be too tight (Consensus).
9. Elevate the upper limb to heart level on a pillow when sitting/in bed and with a sling when mobilising (Consensus).
10. Elevate the lower limb to heart level when in bed and elevate on a stool when in a chair (Consensus).
11. Educate patients about the signs and symptoms of ALCS (Consensus).
12. Provide written patient information (Consensus).
13. Good fracture management (limb immobilisation) is important (Consensus).
14. Patient should be kept normotensive (Consensus).
15. Maintain oxygen saturation at 94-98 per cent for acutely ill patients not at risk of hypercapnic respiratory failure (Consensus).

### b. Evidence

Only two studies – a review of Australian orthopaedic surgeons' practice and a literature review (Wall, et al, 2007; Wall, et al, 2010) – considered reducing the risk of ALCS. However, the focus of both papers was on actions when ALCS is suspected to have developed, rather than on risk reduction.

### c. Consensus opinion

Respondents were almost all agreed that circumferential bandaging should be avoided where possible and that elevation of the limb was important (97 per cent for lower limb, 92 per cent for upper limb). Patient education – both written and verbal – was seen as important (92 per cent for education generally, 87 per cent for written information). For the remaining methods outlined, over 80 per cent of respondents agreed or agreed strongly that these were appropriate. The oxygen saturation consensus statement was taken from British Thoracic Society guidelines (British Thoracic Society, 2008).

## 3. Diagnosis of ALCS – clinical observations

### a. Guidelines

16. Pain is the most important indicator of ALCS (Consensus).
17. Pain on passive extension of the muscle group affected and out of proportion to the injury (or poorly responsive to analgesia) are the earliest and most sensitive clinical indicators (Consensus).
18. Pain assessment should include the severity and the responsiveness to analgesia (Consensus).
19. Other signs (paraesthesia, paresis/paralysis, altered skin colour and absent or altered peripheral pulses) are late signs and therefore unreliable in the diagnosis of ALCS. But these signs may be useful in detecting other peripheral neurovascular injuries if these are suspected (Consensus).
20. Any suspicion of symptoms of ALCS should be immediately reported to the responsible clinician (Consensus).
21. Clinical observations for ALCS (pain on passive extension/out of proportion to the injury/poor or no response to analgesia) for at-risk patients should be:
  - a. carried out at least hourly for the first 24 hours, reducing to four hourly observations for a further 24 hours if pain is stable/minimal (Consensus)
  - b. restarted after any procedure that may affect the limb compartments, for example, application of traction, surgery (Consensus).

### b. Evidence

The evidence suggests that clinical observations have a high specificity and low sensitivity and therefore can be used to exclude ALCS. The odds of ALCS increase in the presence of two signs (pain/pain on passive extension) and three or four signs (paresis and paraesthesia) to 68 per cent, 93 per cent and 98 per cent respectively. However, paresis and paraesthesia are late signs and indicate that damage may already have occurred.

### c. Consensus opinion

While there was consensus that pain was the most important indicator, there was less agreement on how to define this pain – 61 per cent of respondents agreeing with the definition of pain as cramp-like, but 26 per cent not

knowing. It was agreed at the consensus conference that the guidance should not ignore other clinical observations, particularly as they could be indicators of problems other than ALCS (nerve damage, for example).

There was less agreement on the frequency of observations. Hourly observations for six hours then a reduction in frequency was sufficient according to 73 per cent of respondents, whilst 61 per cent felt that hourly observations should be continued for 24 hours. Following discussion at the final GDG meeting, taking into account practical and patient safety issues and considering BOA plans to produce BOAST guidelines relating to compartment syndrome, it was agreed that clinical observations for ALCS (for at-risk patients) should be carried out a minimum of hourly intervals for the first 24 hours, reducing to four hourly observations for the following 24 hours if pain is stable/minimal, and that hourly observations should be restarted after any procedure that may affect the limb compartments, such as surgery or the application of traction. This also takes into account clinical experience that ALCS most often develops in the first 24 hours after injury or surgical procedures.

## 4. Diagnosis of ALCS – compartment pressure monitoring

### a. Guidelines

22. Continuous compartment pressure monitoring (CCPM) is currently the only diagnostic investigation available for early diagnosis of ALCS (Consensus).
23. Intermittent compartment pressure monitoring in the presence of clinical signs of ALCS does not change its management (Consensus).
24. CCPM may be of benefit and should be considered in the early diagnosis of ALCS in patients with:
  - a. an impaired ability to experience or communicate pain (for example, unconscious patients or those with a spinal injury) (Consensus)
  - b. high-risk injuries, in particular high energy tibial shaft and forearm fractures (Level 2)
  - c. equivocal clinical signs (Consensus).
25. When undertaken intracompartmental pressures should be monitored hourly for 24-48 hours (Consensus).
26. The widely accepted compartment pressure threshold for raising concern is a Delta P < 30 mm Hg or an absolute pressure over 40 mmHg (Consensus).

### b. Evidence

The evidence considers different types of compartment monitoring, different measurement regimes and different limbs (Ali, et al, 2014). Comparison is, therefore, difficult.

### c. Consensus opinion

This was the most controversial subject in discussions at the consensus conference and in the subsequent survey. Forty three per cent of the survey respondents felt that the use of compartment monitoring was beyond their knowledge/experience. The percentage of ‘don’t know/undecided’ was also higher – over 25 per cent (except for questions relating to patients with tibial shaft fractures and those with an impaired ability to experience/communicate pain or equivocal clinical signs). There was also less agreement on the frequency of continuous monitoring (57 per cent in favour of hourly for 24 hours, 46 per cent in favour of hourly for 48 hours). When to raise concerns was also not clear – with 40 per cent not knowing/undecided whether Delta P < 30 should be a threshold.



## Conclusion and next steps

The literature review, consensus event and online survey enabled the GDG to identify some key issues related to ALCS, but not to provide all the answers. Nevertheless, the process has enabled the GDG to make recommendations for practice and to identify areas for future research.

An observation chart recommended for use with patients identified as at risk of ALCS and a patient information leaflet are planned to be developed by the GDG.

# References

- Ali P, Santy-Tomlinson J, Watson R (2014 In Press) *Assessment and Diagnosis of Acute Limb Compartment Syndrome: A literature review*, London: RCN/BOA.
- British Thoracic Society (2008) Guideline for emergency oxygen use in adult patients, *Thorax*, 63, supplement VI, London: BMJ Publishing Group Ltd.
- Duckworth AD and McQueen M (2011) Focus on diagnosis of acute compartment syndrome, *Journal of Bone and Joint Surgery*. Available from: <http://boneandjoint.org.uk/content/diagnosis-acute-compartment-syndrome> (accessed 15 July 2014).
- Foong DP, Jose RM, Jeffery S (2011) Fasciotomy: a call for proper placement, *Surgeon*, 9 (5), 249-254.
- Nair R, Aggarwal R and Khanna D (2011) Methods of formal consensus in classification: diagnostic criteria and guideline development, *Seminars in Arthritis and Rheumatism*, 41 (2) 95-105.
- National Institute for Health and Clinical Excellence (2005) *Guideline development methods: Information for national collaborating centres and guideline developers*, London: National Institute for Health and Clinical Excellence.
- Scottish Intercollegiate Guidelines Network (SIGN) (2008) *Sign 50: A guideline developer's handbook*, Edinburgh: SIGN. Available at [www.sign.ac.uk/guidelines/fulltext/50/index.html](http://www.sign.ac.uk/guidelines/fulltext/50/index.html) (accessed 15 July 2014).
- Tzioupis C, Cox G and Giannoudis PV (2009) Acute compartment syndrome of the lower extremity, *Orthopaedics & Trauma*, 23 (6) 433-440.
- Wall CJ, Richardson MD, Lowe AJ, Brand C, Lynch J, de Steiger RN (2007) Survey of management of acute, traumatic compartment syndrome of the leg in Australia, *ANZ Journal of Surgery*, 77 (9) 733-737.
- Wall CJ, Lynch J, Harris IA, Richardson MD, Brand C, Lowe AJ, Sugrue M, (2010) Clinical practice guidelines for the management of acute limb compartment syndrome following trauma, *ANZ Journal of Surgery*, 80 (3) 151-156.



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