Evidence Summary: Lymphoedema: Objective assessment using volumetry

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QUESTION

What is the best available evidence on using volumetry to assess lymphoedema?

BACKGROUND

Lymphoedema is a form of chronic, progressive oedema in which there is significant, persistent swelling of a limb or other body region due to excess and abnormal accumulation of protein-rich fluid in body tissues[1-5]. The lymphatic system is unable to manage the volume of accumulated fluid[4].

Lymphoedema occurs due to primary, secondary or mixed causes. Primary causes are described as congenital (for example, an inherited disorder such as Milroy's disease), praecox (onset at puberty, for example, Meig's disease) or tarda (sudden onset, no apparent cause)[6-8]. Secondary causes arise from direct damage or trauma to the lymphatic system such as injury surgery or radiotherapy (usually related to treatment of breast cancer), or parasitic invasion[7-9]. Lymphatic filariasis (also called elephantitis) is a cause of secondary lymphoedema in endemic areas primarily in Africa and Asia. Lymphatic filariasis is a parasitic (roundworm) infection that is spread by mosquitoes and causes damage to the lymphatic system that may result in lymphoedema. Infection generally occurs in childhood. Management focuses on large-scale treatment programs to reduce disease spread[5,10]. Mixed lymphoedema describes lymphoedema arising from decompensation or failure of the lymphatic system associated with other disease or conditions, including but not limited to obesity, immobility, venous disease or lipoedema[7,8,11].

Without management, lymphoedema may lead to:[4,12]

- progressive swelling
- superficial tissue changes — increasing adiposity and fibrosis
- physical and functional limitations
- increased risk of chronic infection
- lymphorrhoea (leaking of lymph fluid)
- pain and discomfort
- reduced ability to undertake activities of daily living (ADLs).

Comprehensive assessment of lymphoedema includes objective measures of volume/size, and subjective assessment of signs and symptoms, including their impact on the patient[13]. In patients with mixed lymphoedema, it is also important to assess factors associated with the underlying disease or condition (not addressed in this evidence summary).

This evidence summary presents evidence related to the reliability and validity of one objective measurement used to assess lymphoedema: volumetry.

Volumetry is the measure of limb volume, the gold standard for which is water displacement[14]. Limb volume measurements may be reported as a volume, or as an estimated volume that is calculated from limb circumference measurements using a standardised formula. The second option is less reliable as it assumes a consistent cylindrical circumference, which is not usually reflective of the oedematous limb[1]; however, it may be more practical in clinical settings where water displacement is inconvenient to perform[14].

CLINICAL BOTTOM LINE

Performing volumetry

Assessment is performed using a volumeter, in which the patient's arm is submerged in water and the difference in water level before and during arm placement is made[4], or the displaced water is measured using a scale or container[15] (Level 1.b evidence). Various techniques are used.

- The patient may be standing or seated, and the limb may be submerged to the point of the axilla, or to a point at 65% of the distance between the cubital fossa and the acromion[15] (Level 1.b evidence).
- The water must be stabilised before a measurement of displaced water is taken, with care to ensure the patient is as still as possible[15] (Level 1.b evidence).
- For all measures of limb size and/or volume, comparison should be made with:[13,16]
    - a pre-condition measurement of the affected limb (where available) to determine severity of lymphoedema;
    - the unaffected limb to determine severity; and
    - the affected limb over time to objectively assess the effectiveness of the management plan.

Reliability of volumetry

- In one validation study involving 14 patients with breast cancer-associated lymphoedema, the reliability of water displacement measures was investigated. Both intrarater (two measurements) and interrater (two raters) reliability were excellent (ICC=0.999, 95% CI 0.997 to 1.00, $p<0.05$ for both comparisons). Standard error of measurement was 1.1% for both intrarater and interrater reliabilities[17] (Level 3.e evidence).

- In one validation study (n=23 women, mostly breast cancer surgery) the water displacement method was found to be a valid measure of lymphoedema in a comparison with (computed tomography) scan and magnetic resonance imaging (MRI). Arm volume measured by water displacement was significantly correlated (r=0.904) with CT scan measures of total cross-section area (CSA) and to CSA of both subcutaneous tissue (R=0.867, p<0.001) and muscle tissue (R=0.725, p<0.001)[18] (Level 3.c evidence).
- Published opinion on diagnostic cut-off points recommend using a limb volume difference of 200mL or a 10% difference; however, there are currently no standardised cut-offs[1,4] (Level 5.c evidence).

Limitations of volumetry

- The measurement method is unable to distinguish between muscle, bone, fat and fluid[15].
- Insufficient presence of lymphoedema results in a detectable change in water volume[4]. The minimal detectable change is reported to be above 150 mL[15].
- Impaired skin integrity in the limb precludes use of this measurement method[4,19].
- Water overflow has previously been an issue, but modern options reduce this limitation[1,17].
- Infection control is required between uses of the measurement device, particularly between patients[1,20].
- Provides no data on localised oedema or shape of the extremity[1].
- Water temperature must be kept within a specific range[19].

CHARACTERISTICS OF THE EVIDENCE

This evidence summary is based on a structured literature and database search combining search terms that describe lymphoedema and assessment. The evidence in this summary comes from:

- Systematic reviews of studies of various design[2,15] (Level 1.b evidence).
- Cohort studies with control groups[16,18,20] (Level 3.c evidence).
- Observational studies with no control group[9,13,17,19] (Level 3.e evidence).
- Case series report[11] (Level 4.c evidence).
- Expert consensus[5,7] (Level 5.b evidence).
- Expert opinion[1,3,4,6,8,10,12,14] (Level 5.c evidence).

BEST PRACTICE RECOMMENDATIONS

Volumetry is a reliable and valid strategy for assessing the presence and degree of lymphoedema in adults. (Grade B)

Related evidence summaries

JBI 10912 Identification of people at risk of venous leg ulcers

JBI 11559 Lymphedema: classification

JBI 11564 Lymphedema: objective assessment using bioimpedance spectroscopy

JBI 11562 Lymphedema: objective assessment using perometry

JBI 11560 Lymphedema: subjective assessment

JBI 11870 Lymphedema: objective assessment using tonometry

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