Evidence Summary:
Managing lymphoedema: Pneumatic compression

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QUESTION

What is the best available evidence on the effectiveness of pneumatic compression in managing lymphoedema?

SUMMARY

Intermittent pneumatic compression (IPC) is used to treat lymphoedema. The application of pressure assists in the reduction of oedema by creating pressure differentials within the affected limb that promote shifting of fluid from interstitial space to the lymph system. There is evidence from good quality studies that show a significant effect of IPC in reducing lymphoedema measured by either limb circumference or limb volume.[1] (Level 1.b evidence)[2, 3] (Level 1.c evidence) There is also some evidence that IPC reduces pain[2, 3] (Level 1.c evidence) and promotes physical function2 (Level 1.c evidence)[4] (Level 3.e evidence). There is insufficient evidence to recommend specific regimens; applied pressure should be individualised.

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. This fluid contains a range of inflammatory mediators and adipogenic factors.[5-9] The lymphatic system is unable to manage the volume of accumulated fluid.[8]

Lymphoedema occurs due to primary, secondary or mixed causes. Primary causes are described as congenital (e.g. an inherited disorder such as Milroy's disease), praecox (onset at puberty, e.g. Meig's disease) or tarda (sudden onset no apparent cause).[10-12] 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.[11-13] Lymphatic filariasis (also called elephantitis) is a cause of secondary lymphoedema in endemic areas primarily in Africa and Asia. Lymphatic filariasis 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.[9, 14] 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 lipodema.[11, 12, 15]

Without management, lymphoedema may lead to:[8, 16]

- 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, and
- reduced ability to undertake activities of daily living (ADL's)

Intermittent pneumatic compression produces a pressure gradient through sequential inflation and deflation that is thought to promote the relocation of accumulated fluid from interstitial space into the lymphatic system, thereby reducing oedema.[2, 17] However, some studies suggest that protein may not shift with the fluid, reducing the long term sustainability of the intervention.[1]

Intermittent pneumatic compression devices are air-inflated sleeves that fit over the limb in order to exert pressure. They vary with respect to:[18]

- number of air chambers in the device;
- sequential/dynamic (i.e. changing between chambers) or static pressure;
- cycle lengths of compression versus decompression; and
- peak pressure applied.

CLINICAL BOTTOM LINE

Effectiveness in reducing oedema

- One systematic review included 13 studies that reported on the effectiveness of IPC in managing lymphoedema. The studies ranged from RCTs to observational studies and variability in results was reported, possibly related to the variation in devices used or the study designs. The review concluded that there is good quality evidence that IPC at pressures between 30 and 60 mmHg are effective in leading to clinically relevant reduction in lymphoedema. Consideration should be given to tissue resistance and blood pressure in determining appropriate pressure for each individual.[1] (Level 1.b evidence)

- In an RCT, IPC (2 hours at 60 mmHg administered five times weekly for four weeks) was effective in significantly reducing oedema which was measured using difference between healthy and oedematous limbs in limb circumference (n = 24 women post-mastectomy) immediately following the therapy regimen (18.9cm versus 13.9cm, p<0.001). The effect remained evident at three (18.9cm versus 14.4cm, p<0.001) and six months (18.9cm versus 14.8cm, p<0.01) follow up but was no longer significant 12 months following therapy (18.9cm versus 18.2cm, p=not significant [NS]). When compared to a group (n = 23) receiving low level laser therapy (20 minutes at 2800Hz, 1.5J/cm^2 three times weekly for four weeks), the low level laser therapy was associated with significantly greater reduction in limb circumference immediately following treatment (p=0.04) and at 12 month follow up (p=0.02).[2] (Level 1.c evidence)

- In one RCT, IPC (25mmHg for 45 minutes administered daily for six weeks) in conjunction with self-administered lymphatic drainage (n=15 women post cancer surgery) was effective in significantly reducing mean arm volume after six weeks (3,581ml versus 3142ml, 14.9% decrease, p<0.001). There was no significant difference in effect when compared to a group (n=15) receiving daily manual lymphatic drainage performed by a physiotherapist and compression bandaging.[3] (Level 1.c evidence)

- Various advanced IPC devices for treating participants with lower limb lymphoedema (n=196) were investigated in an observational study. There was an overall mean reduction in limb volume of 8% (<0.0001) at 60 day follow up. Participants who had a larger baseline limb volume, larger body mass index (BMI) and those who had bilateral lymphoedema were more likely to experience a beneficial response to IPC.4 (Level 3.e evidence)

Effectiveness in reducing pain

- Intermittent pneumatic compression administered five times weekly for four weeks was effective in significantly reducing pain measured on a 100mm visual analogue scale (VAS) in post-mastectomy women with lymphoedema (n = 24) immediately following the therapy regimen (23.9mm versus 13.5mm, p<0.01). The effect was not significant at three, six or 12 months follow up.[2] (Level 1.c evidence)

- Intermittent pneumatic compression administered daily for six weeks in women following cancer surgery (n=15) was effective in significantly reducing pain (p=0.005) scored on a 4 point Likert scale.[3] (Level 1.c evidence)

Effectiveness in improving function

- In an RCT, IPC (2 hours at 60 mmHg administered five times weekly for four weeks) was effective in significantly improving grip strength measured using a hand dynamometer in post-mastectomy women with lymphoedema (n = 24) immediately following treatment and at three, six and 12 month follow up (p=0.05 for all). There was no significant difference in effect compared with a group (n = 23) receiving low level laser therapy.[2] (Level 1.c evidence)

- Intermittent pneumatic compression administered daily for six weeks (n=15 women post cancer surgery) did not influence self-rated (4 point Likert scale) physical function (p=NS). However, significant improvements were noted in self-rated emotional functioning (p=0.03) and self-rated social function (p=0.003).[3] (Level 1.c evidence)

- In one study in participants with lower limb lymphoedema receiving advanced IPC (n=196), 85% of participants were subjectively assessed by (non-blinded) clinicians as having an increased ability to perform activities of daily living and 77% demonstrated improvements in range of motion.[4] (Level 3.e evidence)

Comparison of intermittent pneumatic compression regimens

- In a four study group RCT conducted in women with upper limb lymphoedema following breast cancer therapy, IPC regimens conducted over five weeks (25 sessions) and consisting of either a 45 second or 90 second cycle with either a single chamber or triple chamber sleeve at an individualised pressure (between 30 and 50 mmHg) were equally effective in achieving a statistically significant reduction in lymphoedema measured as a difference in limb volume between the healthy and oedematous limb. When a 45 second cycle was used, the triple sleeve chamber was more effective (p=0.04) than the single sleeve chamber.[19] (Level 1.c evidence)

- One RCT compared the effectiveness of a standard IPC device (n=18, four chamber sleeve, slow cycle sequential pressure at 30 mmHg) to an advanced IPC device (n=18, 26 to 28 chamber sleeve, fast cycle sequential pressure at 9 to 13 mmHg) in reducing lymphoedema of the upper limb in women who had undergone breast cancer therapy.

Both groups had significant improvement in limb oedema measured as a percent oedema volume at 12 weeks, but the effect was greater in the group receiving advanced, fast cycle sequential compression.[17] (Level 1.c evidence)

- One study comparing various IPC regimens in 15 participants with lower limb oedema, found that varied pressure applied at different levels of the limb, together with longer compression times was more effective at attaining a tissue fluid pressure differential sufficient to promote fluid shifting.[20] (Level 3.e evidence)
- In an observational study comparing different IPC regimens for people with lower limb lymphoedema, there was no significant difference in outcomes for people with bilateral lymphoedema who received two treatments daily on both limbs versus one treatment daily on alternating limbs (8.5% reduction versus 8.4% reduction, p =0.93).[4] (Level 3.e evidence)

Adverse events associated with intermittent pneumatic compression

- In one study (n=36), seven participants (19%) experienced adverse events. Three serious events were considered to be possibly related to treatment: increased arm swelling, breast inflammation leading to infection and fibrosis and increased axilla lymph node swelling. Serious hand swelling in two participants was considered to be definitely related to IPC (both using a device with a four chamber sleeve and slow cycle sequential pressure at 30 mmHg).[17] (Level 1.c evidence)
- In one study (n=196) four participants (2%) experienced adverse events. Two events were considered likely to be related to treatment: one case of muscle cramps and one case of increased limb erythema. These events resolved and did not interfere with treatment.[4] (Level 3.e evidence)

CHARACTERISTICS OF THE EVIDENCE

This evidence summary is based on a structured database search combining search terms describing lymphoedema and compression therapy. The evidence comes from:

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

BEST PRACTICE RECOMMENDATIONS

- There is good evidence that intermittent pneumatic compression significantly reduces lymphoedema after a four to 12 week course of therapy; with the effect evident for up to six months. (Grade A)
- There is some evidence that intermittent pneumatic compression significantly improves functional outcome measures and pain in individuals with upper or lower limb lymphoedema. (Grade B)
- There is insufficient evidence to recommend any specific type of intermittent pneumatic compression device or regimen.

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

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