Which kind of anti-embolism stockings – up to knee or up to thigh – are more effective?

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Keywords
Anti-embolism stocking, thromboprophylaxis

Summary

Aim: To evaluate the preventative effect of knee-length and thigh-length anti-embolism stockings (AES).

Methodology: The databases PubMed, Cochrane Library and Health Technology Assessment (HTA) reports were searched for systematic reviews, meta-analyses and guidelines using the search terms "thrombosis prevention" and "anti-embolism stockings".

Results: Two productive guidelines and two very extensive systematic reviews were found, all published between 2010 and 2015. Both the NICE and SIGN guidelines recommend knee-length or thigh-length anti-embolism stockings (AES), whereas four reviews found no consistent results in the prevention of thrombosis.

There is no clear difference in the preventative effects of the two types of AES:

- It is not possible to calculate the preventative effect of the two types of AES, because the various studies are significantly heterogeneous.
- The preventative effect of the thigh-length AES combined with pharmacotherapy shows a non-significant positive trend.
- The preventative effect of a thigh-length AES plus pharmacotherapy is more effective than that of a knee-length AES plus pharmacotherapy.

Schlüsselwörter
Medizinischer Thromboseprophylaxestrumpf, Thromboseprophylaxe

Zusammenfassung

Ziel: Es sollte der präventive Effekt knielanger (Wadenstrumpf) und oberschenkellanger (Schenkelstrumpf) medizinischer Thromboseprophylaxestrümpfe (MTPS) evaluiert werden.

Methode: In den Datenbanken Pubmed, Cochrane Library, HTA-Berichte wurde nach den Stichwörtern „Thromboseprävention" und „Thromboseprophylaxestrümpfe" gesucht, und zwar in systematischen Reviews, Metaanalysen und Leitlinien.

Ergebnisse: Es finden sich zwei ergiebige Leitlinien und zwei sehr umfangreiche systematische Reviews, alle im Zeitraum von 2010 bis 2015 publiziert.

Die NICE-Leitlinie und die SIGN-Leitlinie empfehlen knielange oder oberschenkellange MTPS, vier Reviews dagegen zeigen keine eindeutigen Ergebnisse in der Prävention von Thrombosen.

Der präventive Effekt beider MTPS ist nicht deutlich unterschiedlich:

- Die Berechnung des präventiven Effekts beider MTPS ist nicht möglich, da die Studien signifikant heterogen sind.
- Der präventive Effekt des oberschenkellangen MTPS, kombiniert mit der Pharmakotherapie, zeigt einen nicht signifikanten positiven Trend.
- Der präventive Effekt eines oberschenkellangen MTPS plus Pharmakotherapie ist effektiver als der eines knielangen MTPS plus Pharmakotherapie.

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On average, the annual incidence of symptomatic deep venous thrombosis (DVT) in the general population is 0.1 % (1). DVT can lead to a pulmonary embolism or later to post-thrombotic syndrome as well. Without preventative measures, the in-hospital peri- and postoperative rate of DVT is between 0.2 and 0.5 %, depending on the type of surgical intervention (Tab. 1). In addition to age, other factors also carry a considerable risk for the patient. For example, a pregnant woman has a ten-fold risk and a cancer patient a five- to seven-fold risk (Tab. 2). Since in the hospital setting, not only an operation, but also the subsequent immobilisation of the patient are associated with a risk of thrombosis, prevention of DVT through the wearing of anti-embolism stockings (AES) and possible additional anticoagulation is advised.

The indications for AES are as follows:

- pre-, intra- and postoperative thrombosis prevention,
- peri- and postpartum thrombosis prevention,
- general thrombosis prevention in bedridden patients.

The following contraindications must be kept in mind:

- advanced peripheral arterial disease,
- phlegmasia coerulea dolens, septic phlebitis,
- decompensated heart failure,
- dermatitis, venous leg ulcer.

AES are made from polyamide and elastane and – unlike medical compression hosiery (MCH) – are not subject to any standard or norm. For example, depending on the brand, AES are available in 5 to 40 different sizes, in different lengths (knee-length, thigh-length) and with different elasticity (only transverse elasticity or transverse elasticity/lengthwise elasticity).

The pressure exerted by the AES in the ankle region is generally 18 mmHg. Patients prefer knee-length AES. Inspection of the literature reveals that there are other names for AES in the various publications, e.g. anti-thrombosis stockings (ATS), graduated compression stockings (GCS) or thromboembolic deterrent stockings. The term GCS should not be used at all in this context, because it is already synonymous with medical compression hosiery (MCH).

Effect

The positive effect of AES on the lower extremity has been demonstrated with objective measurements. As a result of an enlarged venous cross-section caused by a loss of tone and failure of calf and ankle pumps, there is a considerable reduction in venous flow velocity in bedridden patients. Pressure on the leg exerted by the AES increases tissue pressure, reduces the venous cross-section and, as a consequence, increases flow velocity and reduces blood volume in the leg (Lawrence et al., Sigel et al., Sparrow et al.).

Methodology

A systematic search for systematic reviews, meta-analyses and guidelines using the search terms "thrombosis prevention", "anti-embolism stockings knee-length, thigh-length" was performed in the databases PubMed, Cochrane Library and Health Technology Assessment.

Tab. 1 Postoperative DVT in the absence of preventative measures (according to [8])

Type of procedure	DVT (%)
Major abdominal OP	20–40
Vascular surgery (e.g. aorta)	20–27
Hip or knee OP	50
Breast cancer OP	5–20
Chest OP	9–18
Neurosurgical OP	20–35
Major spinal OP	0.3–2.2
Varicose vein OP	0.2
Urological OP	up to 30

Results

Two relevant guidelines and two extensive systematic reviews were found, all of which had been published between 2010 and 2015.

AES were not mentioned in two of the twelve guidelines that we considered (3, 6).

The NICE guideline (2010) of the Institute for Health and Care Excellence (7) recommends thigh-length or knee-length AES, often also combined with anticoagulation, for immobile patients undergoing the following procedures:

- Heart operations
- Gastroenterological, gynaecological, thoracic and urological operations
- Neurosurgical procedures (cranial, spinal)
- Hip replacements
- Knee replacements
- Hip fracture surgery
- Vascular surgery
- Surgery after major injuries, also of the spine

This guideline also recommends the use of thigh-length or knee-length AES in patients with internal diseases, if pharmacoprophylaxis is not indicated.

The guideline does not recommend the use of AES in stroke patients.

Another significant risk factor is previous DVT. However, age is the greatest risk factor. The annual incidence of DVT in persons younger than 40 years is 1:10.000, in those 60–69 years old 1:1.000 and in those older than 80 years 1:100 (10).

Tab. 2 DVT risk factors (SIGN)

Pregnancy	10-fold risk
Obesity	2–3 fold
Cancer	5–7 fold
Oral contraception	3–6 fold
Varicose veins	1.5–2.5 fold

SIGN guideline (2014) (Scottish Intercollegiate Guidelines (10)

According to most of the randomised, controlled trials (RCTs), thigh-length AES are used for prevention.

The number of RCTs that deal with the subject of knee-length AES is too small to enable the effect of these stockings to be determined. The conclusion of a meta-analysis was that there is no major difference in terms of the effect in surgical patients.

This guideline therefore recommends that knee-length or thigh-length AES should be used for DVT prevention in surgical patients, provided there are no contraindications and the stockings fit correctly.

According to the ten systematic reviews that we examined, AES are indicated for different procedures, sometimes in combination with pharmacotherapy.

Cochrane Library (2012) (2)

This systematic review considers three randomised controlled trials involving a total of 496 patients (n=201 knee-length AES, n=295 thigh-length AES). The results showed no significant difference in the reduction of post-operative DVT. Knee-length AES were equally effective as the thigh-length AES in respect of thrombosis prophylaxis. In the authors' view, the conclusion must not be regarded as meaningful, because the studies show considerable heterogeneity both in terms of the randomisation technique and also in the statistical power and intention-to-treat analysis.

Health Technology Assessment (2015) (4)

This is a systematic review (219 pages), in which data from five RCT's were pooled to compare the effect of knee-length (n=359) and thigh-length AES (n=590), often also combined with pharmacotherapy. A non-significant positive trend for the thigh-length AES (Odds ratio 1.48) was identified.

A network meta-analysis of 13 RCTs (n=3691) showed a greater effectiveness of thigh-length combined with pharmacotherapy than the combination therapy with knee-length AES (Odds ratio 1.76).

Discussion

In terms of the preventative effect of knee-length and thigh-length AES, the reviews show no clear result. This can be easily explained, because patients in the studies were prescribed both single-stretch AES (with only transverse elasticity) and two-way stretch AES (with both transverse and lengthwise elasticity). In contrast to single-stretch AES, the two-way stretch variety with different longitudinal stretch also has a different transverse stretch and is therefore hardly capable of ensuring the graduated compression pressure at defined points of the leg.

In addition, the studies involved AES of different manufacturers, who, depending on the product, offer from 5 to 40 different sizes. A product that is manufactured in less than 10 sizes cannot cover the needs of the whole population. In addition, the pressure and the pressure pattern of the different AES are not uniform. The above-named factors reduce the informative value of the quoted systematic reviews.

Conflict of interest

The authors declare that they have no conflicts of interest.

Ethical guidelines

Preparation of the manuscript did not involve any studies on humans or animals.

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