

## Endovenous thermal ablation versus open surgery for varicose veins of the lower extremities

# Swiss cost analysis of procedures for the treatment of varicose veins

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## Summary

**AIMS:** Truncal varicose veins (TVV) are highly prevalent in the Swiss population and have traditionally been treated with surgical high ligation and stripping (HL/S). In recent years, endovenous thermal ablation (ETA) has increasingly been performed. However, the cost efficacy of these methods within the framework of the Swiss healthcare system is currently unknown. The aim of the present study was to provide a cost-effectiveness comparison between both methods. We hypothesised that ETA would be more cost-efficient when compared with surgical stripping.

**METHODS:** A simplified decision-analytic model was used to add up baseline costs of inpatient HL/S and outpatient ETA treatment, follow-up costs over 5 years and costs caused by absence from work. Costs were calculated in Swiss francs (CHF) and per 100 patients treated. Costs were estimated on the basis of current Tarmed and SwissDRG reimbursement and yearly salary figures from three different perspectives: (i) total treatment costs for the third-party healthcare payer, (ii) revenue for the physician / facility provider, (iii) indirect costs caused by absence from work.

**RESULTS:** Outpatient ETA was associated with substantially lower total treatment costs when compared with inpatient HL/S. This was true for patients with basic insurance (CHF 2600 vs CHF 7673 per patient) and even more for semi-privately and privately insured patients (CHF 2600 vs CHF 15000 per patient). ETA was shown to be substantially less rewarding for the providers when compared with HL/S (5-year total revenue per 100 patients treated: CHF 411 200 versus CHF 1 033 510). Costs caused by sick leave were three times higher after inpatient HL/S than after ETA. The total cost difference of costs between TVV therapies was CHF 732 710 per 100 patients in favour of ETA.

**CONCLUSION:** For patients with TVV of the lower extremities, treatment with ETA causes substantially lower total expenditure than inpatient HL/S. The current reimbursement policy in Switzerland favours inpatient HL/S and thus forfeits substantial saving opportunities in the country's health system.

**Key words:** varicose veins; venous ablation; vein stripping; cost-effectiveness; recurrence; sclerotherapy



## Introduction

The prevalence of varicose veins in western countries has been estimated to be about 25–30% among women and 10–20% in men [1, 2]. Therefore, truncal varicose veins (TVV) represent a huge socioeconomic burden. In Switzerland, the prevalence of varicose veins in female workers in the chemical industry in the city of Basel was reported to be 68% [3]. Traditionally, the standard surgical treatment of TVV has been high ligation and stripping (HL/S) combined with phlebectomies [4]. The results of HL/S are long lasting and have been shown to improve disease-specific and general quality of life of the patients with primary varicose veins [5, 6]. However, HL/S is mostly performed as an inpatient procedure with general or regional anaesthesia [7].

In recent years, HL/S has increasingly been replaced by minimally invasive endovenous thermal ablation (ETA) techniques, such as endovenous laser ablation (EVLA) or radiofrequency ablation (RFA). ETA is performed almost exclusively in an outpatient setting under local anaesthesia. ETA has been shown to be associated with mid-term results comparable to HL/S for up to 5 years concerning abolition of venous reflux and absence of varicose veins [8, 9]. Furthermore, ETA is associated with higher patient acceptance, fewer complications, less postoperative pain and earlier return to normal activities and to work [10, 11].

Since 1 January 2016, ETA has been accepted as a treatment option for TVV by the ministry of health in Switzerland. Despite the popularity and strong evidence for the clinical effectiveness and safety of ETA, health insurance companies have hitherto been reluctant to reimburse ETA, notwithstanding its potential to save financial resources [12]. However, the cost-effectiveness of these therapeutic strategies has, until now, not been investigated in Switzerland.

The aim of the present study was to compare the costs of conventional inpatient HL/S with outpatient ETA. The analysis included follow-up treatments over 5 years and the cost of sick leave. We hypothesised that ETA would be more cost-efficient than inpatient HL/S for TVV.

## Methods

A simplified decision-analytic model based on results of the randomised controlled trial published by Rasmussen et al. comparing ETA with HL/S for TVV was applied to the present analysis [13]. In the trial, HL/S was performed under tumescent local anaesthesia. The model used in the present study implied all costs (in Swiss francs, CHF) associated with patient treatment over 5 years of follow-up, i.e., costs for the initial procedure, the routine check-ups after the procedure and cost for retreatment of recurrent varicose veins. Costs were calculated on the basis of the current healthcare reimbursement tariff (Tarmed) [14] and SwissDRG Version 6.0, 2017 [15] reimbursement, and of average yearly salaries in Switzerland [16]. Costs were calculated from three different perspectives: (i) treatment costs (third-party healthcare payer), (ii) revenue for the providing physician and facility, and (iii) the total of direct and indirect costs including the procedure, follow-up and sick leave.

At present, varicose vein surgery may be coded under various DRGs, essentially depending on the extent of the disease to be treated and on comorbidities of the patient. The current SwissDRG Version 6.0, 2017 [15] F39A-B is associated with a “cost weight” of 0.696 for one leg and 0.891 for both legs. According to the base rate of the Canton Aargau, HL/S yields CHF 6730 for one and CHF 8616 for two legs when treated with HL/S. Furthermore, we hypothesised unilateral and bilateral HL/S procedures were equally frequent, each accounting for 50% of all procedures. This resulted in an average cost of CHF 7673 for patients with basic insurance. For privately insured patients, the cost is substantially higher and depends on several factors, including base rates of the individual cantons and the reimbursement schemes of hospitals. This reimbursement scheme applies only for inpatient treatment. Cost of outpatient HL/S is reimbursed via the tariff for ambulatory patients (Tarmed). According to data published by the national broadcasting company “SRF – Kassensturz 26 August 2014” [17], inpatient HL/S of a privately insured patient costs up to CHF 20 000. For our analysis, we averaged partly and fully privately insured patients and cautiously estimated the average cost for both partly- and fully privately insured patients to be CHF 15 000.

For ETA, which was always carried out on an outpatient basis, we assumed an average cost of CHF 2600. In analogy to HL/S procedures, this price included phlebectomies, if indicated. This figure corresponds to current pricing in the authors’ institutions for an even distribution of unilateral and bilateral treatments

(50% each). We did not include costs of pre-examination as these costs would be equal for HS/L and ETA.

For outpatient HL/S we assumed an average cost of CHF 3350 according to tariff (Tarmed) for an even distribution of unilateral (CHF 2600) and bilateral (CHF 4100) treatments (50% each). This is a conservative estimation, as the cost of outpatient HL/S may vary by cantons and according to the complexity of the disease.

## Model structure, statistical analysis and assumptions

A treatment strategy, either HL/S or ETA, was defined as the initial treatment (fig. 1). In accordance with the randomised controlled trial of Rasmussen et al. [13], recurrences were treated, in principle, with foam sclerotherapy after both ETA and HL/S. The observation time included in the present analysis was 5 years. In the Swiss health system, all costs of inpatient treatment are reimbursed by the insurance company (45%, via premiums) and by the canton (55%, via taxes). However, outpatient treatment costs are not supported by the canton. The following assumptions and simplifications were applied.

### Clinical assumptions:

- Treatment of varicose veins of moderate complexity, i.e., an incompetent truncal vein that can be treated with thermal ablation including phlebectomies of tributaries if indicated.
- Treatment of one or two legs were allowed for both ETA and HL/S, costs were averaged as outlined above.
- The model assumed that redo procedure rates reported by Rasmussen et al. [13] reflect those encountered in general clinical practice, i.e., 39% redo for ETA and 38% redo for HL/S, within a 5-year time frame.
- The model assumed that redo procedures after inpatient HL/S are equal to outpatient HL/S.
- The model assumed that foam sclerotherapy is the standard procedure required for redo procedures, as reported Rasmussen et al. [13].

### Economic assumptions:

- Direct costs associated with the disease and treatment were included. Indirect costs of absence from work were estimated.
- Costs of three ultrasound follow-ups after ETA was included in the calculation as this is in line with the requirements of the Swiss Tect Registry of the Swiss Society of Phlebology [18]. This registry is intended to include all ETA procedures in Switzerland for quality assessment purposes.

- Follow-up cost of HL/S was limited to dressings and stitch removal, on average CHF 160.
- According to data from Tarifsuisse [19], 30% of patients with TVV procedures have supplementary insurance coverage, “private” or “semi-private”.
- We assumed that, on average, foam sclerotherapy costs CHF 400 per session and that on average two sessions of treatment are required for recurrent varicose veins.
- The median salary in Switzerland in 2015 was CHF 50 000, which corresponds to 230 CHF per working day [20]. We assumed that a substantial proportion of our patients have no income, because they (i) are retired (20%) or (ii) take care of children at home (homemaker), are persons with disability, are unemployed or part-time employed (20%). Therefore, calculated indirect costs were reduced by 40%.
- After ETA, patients were assumed to have a loss of, on average, 4 productive working days [21]. Accordingly, surgical patients were assumed to have a loss of 12 productive days at work [21]. In summary, we assumed an additional 8 days of sick leave in surgically treated patients.
- Sick leave and loss of productive days for outpatient HL/S were assumed to be equal than inpatient HL/S.

## Results

Procedure-related healthcare expenditures per patient were substantially higher for both HL/S groups when compared with outpatient ETA (CHF 7673 for patients with basic insurance undergoing HL/S and CHF 15 000 for semi-privately and fully privately insured patients versus CHF 2600 for outpatient ETA (table 1).

### Third-party healthcare payer and physician/facility provider perspectives

ETA resulted in substantially lower treatment costs per person and per 100 persons at 5-year follow-up when compared with inpatient HL/S (CHF 3800 for ETA vs CHF 7833 for patients with standard insurance vs CHF 15 160 for semi-privately and fully privately insured patients, tables 2–3).

According to the current SwissDRG Version 6.0 (2017) [15], total earnings for physicians and/or facility providers at 5 years were substantially higher with an inpatient HL/S approach when compared with ETA (CHF 1 033 510 vs 411 200 per 100 patients treated, table 3).

### Indirect costs (sick leave)

Indirect costs in the form of loss of working days were three times higher after HL/S than after ETA (CHF 165 600 vs 55 200 per 100 patients, table 4). Thus, the dif-

**Table 1:** Division of procedure-related healthcare expenditures per patient (ETA vs outpatient and inpatient HL/S).

| Costs   | Outpatient ETA | Outpatient HL/S | Inpatient HL/S (general insured patients) | Inpatient HL/S of semi-privately and privately insured patients |
|---|----------------|-----------------|---|---|
| Basic insurance coverage (CHF)                    | 2600           | 3350            | 3453                                      | 3453  |
| Amount covered by canton (CHF)                    | 0              | 0               | 4220                                      | 4220  |
| Semi-private and private insurance coverage (CHF) | 0              | 0               | 0   | 7327*   |
| <b>Total costs (CHF)</b>                          | <b>2600</b>    | <b>3350</b>     | <b>7673</b>                               | <b>15 000</b>   |

CHF = Swiss francs; ETA = endoluminal thermal ablation; HL/S = high ligation and stripping  
\* Averaged for semi-private and private insurance

**Table 2:** Total healthcare expenditures over 5 years per patient after the index procedure (ETA vs outpatient and inpatient HL/S).

| Costs                                    | Outpatient ETA | Outpatient HL/S | Inpatient HL/S (generally insured patient) | Inpatient HL/S of semi-privately and privately insured patient |
|--|----------------|-----------------|--|--|
| General insurance (CHF)                  | 2600           | 3350            | 3453                                       | 3453   |
| Amount covered by canton (CHF)           | 0              | 0               | 4220                                       | 4220   |
| Semi-private and private insurance (CHF) | 0              | 0               | 0  | 7327*  |
| Follow-up costs (CHF)                    | 1200           | 160             | 160  | 160  |
| <b>Total costs (CHF)</b>                 | <b>3800</b>    | <b>3510</b>     | <b>7833</b>                                | <b>15 160</b>  |

CHF = Swiss francs; ETA = endoluminal thermal ablation; HL/S = high ligation and stripping  
\* Averaged for semi-private and private insurance

**Table 3:** Total healthcare expenditures over 5 years after the index procedure (ETA vs HL/S) for a total of 100 patients.

| Costs                            | Outpatient ETA       | Outpatient HL/S      | Inpatient HL/S       |
|----------------------------------|----------------------|----------------------|----------------------|
| General insurance (CHF)          | 100 × 2600 = 260 000 | 100 × 3350 = 335 000 | 100 × 3453 = 345 300 |
| Amount covered by canton (CHF)   | 0                    | 0                    | 100 × 4220 = 422 000 |
| Semi and private insurance (CHF) | 0                    | 0                    | 30 × 7327 = 219 810* |
| Follow-up costs (CHF)            | 100 × 1200 = 120 000 | 100 × 160 = 16 000   | 100 × 160 = 16 000   |
| Foam sclerotherapy (CHF)         | 39 × 800 = 31 200    | 38 × 800 = 30 400    | 38 × 800 = 30 400    |
| <b>Total costs (CHF)</b>         | <b>411 200</b>       | <b>381 400</b>       | <b>1 033 510</b>     |

CHF = Swiss francs; ETA = endoluminal thermal ablation; HL/S = high ligation and stripping

\* Averaged for semi-private and private insurance

**Table 4:** The overall national healthcare expenditures summing direct and indirect costs over 5 years after the index procedure (ETA vs HL/S) for a total of 100 patients

| Costs                                     | Outpatient ETA               | Outpatient HL/S                | Inpatient HL/S                 |
|---|------------------------------|--------------------------------|--------------------------------|
| Basic insurance (CHF)                     | 100 × 2600 = 260 000         | 100 × 3350 = 335 000           | 100 × 3453 = 345 300           |
| Amount covered by canton (CHF)            | 0                            | 0                              | 100 × 4220 = 422 000           |
| Semi private and private insurance (CHF)* | 0                            | 0                              | 30 × 7327 = 219 810            |
| Follow-up costs (CHF)                     | 100 × 1200 = 120 000         | 100 × 160 = 16 000             | 100 × 160 = 16 000             |
| Foam sclerotherapy (CHF)                  | 39 × 800 = 31 200            | 38 × 800 = 30 400              | 38 × 800 = 30 400              |
| Indirect costs †                          | 100 × 4 × 0.6 × 230 = 55 200 | 100 × 12 × 0.6 × 230 = 165 600 | 100 × 12 × 0.6 × 230 = 165 600 |
| <b>Total costs (CHF)</b>                  | <b>466 400</b>               | <b>547 000</b>                 | <b>1 199 110</b>               |

CHF = Swiss francs; ETA = endoluminal thermal ablation; HL/S = high ligation and stripping

\* Averaged for semi-private and private insurance

† Assuming a difference of 8 days between sick leave after ETA and HL/S and assuming 40% of TVV patients are retired or others without a regular income (homemaker, unemployed and part-time employed)

ference of 8 lost working days after ETA and HL/S results in an indirect cost difference of CHF 110 400.

### Total cost over 5 years

The total cost over 5 years, which included primary treatment, sclerotherapy of recurrent varicose veins and sick leave, differed considerably between ETA and HL/S. For 100 patients, the total cost was CHF 466 400 in the case of outpatient ETA, CHF 547 000 for outpatient HL/S and CHF 1 199 110 for inpatient HL/S. Thus, inpatient HL/S was associated with about 2.5 times more total expenditure than ETA (table 4).

### Discussion

This study compared the costs of outpatient ETA with those of in- and outpatient HL/S over a period of 5 years on the basis of the current reimbursement system in Switzerland. We found that ETA is a very cost-effective strategy for third-party payers, but is associated with substantially reduced earnings of physicians and/

or facility providers in the absence of dedicated reimbursement structures within the Swiss healthcare framework. According to the literature, ETA is associated with similar clinical efficacy and slightly fewer complications [22] than HL/S. In contrast, HL/S was associated with significantly increased costs within the Swiss healthcare system.

In view of a large difference in cost between the procedures and the less invasive nature of ETA, the opportunity to avoid larger scars and general anaesthesia, and potential reduction in recovery time or earlier return to work, ETA is today suggested as the first choice of treatment by various international societies [23, 24]. However, as long as the reimbursement incentives of outpatient ETA are low, widespread adoption of this technique may be precluded. Even outpatient surgery for TVV would be cost-saving, as costs are similar to outpatient ETA [17]. There is no doubt that a proportion of TVV procedures are performed as an outpatient HL/S in Switzerland, but it is – as we suggest – a very small part of all the patients who could have ambula-

tory treatment. Several cantons are fostering this development to reduce healthcare expenditures. However, data on the exact numbers of outpatient HL/S procedures are lacking. In general, care of patients in an outpatient setting is cost saving and not cost increasing, as mentioned recently by Schlup [25] in his view on the cost paid by insurances alone, ignoring the costs paid by the Cantons. An analysis by Price Waterhouse Coopers Switzerland recently demonstrated that ambulatory treatments are largely underused but have the potential to save costs of up to one billion Swiss francs [26].

Data concerning the duration of sick leave vary considerably in the literature, especially regarding HL/S [21]. Therefore, a difference of 8 days between ETA and HL/S may look somewhat arbitrary and can be debated. Notwithstanding, comparative studies almost unanimously agree that ETA entails shorter sick leave than HL/S. Therefore, there is little doubt that ETA saves financial resources not only within the Swiss health system, but also beyond. Policy makers and insurance companies may therefore have to rethink their strategy and provide more appealing reimbursement for ETA, thereby allowing substantial cost savings for the Swiss healthcare and social insurance system. Also, the financial contributions of the cantons, which are at present restricted to in-hospital patient care, should be reconsidered.

Several limitations of the present study have to be addressed. First, the economic model chosen here was deliberately simplified. Since the focus of this analysis was the initial investment and follow-up costs associated with each method, it seemed justifiable to reduce the scope of the economic comparison to the financial perspective. This is a decision against expanding the model to quality of life or other dimensions, as quality of life seems to be equally improved after both procedures [27]. From the investment-cost perspective, all direct costs that occur over the life-cycle of a treatment should be considered – the model applied within the present analysis took this into account.

Second, the present model was based on a variety of assumptions that may limit the generalisability of results to all patients encountered in clinical practice and in various international healthcare scenarios. Thus, the results of this analysis are intended to be indicative rather than definitive and need to be interpreted with considerable caution. However, our cost assumptions were conservative, thus reducing the bias of possibly overestimation.

Third, we assumed costs to be stable throughout the time period of observation for the present analysis and

that the cost perceptions are stable from both perspectives, the principal's and the agent's. Thus, a change in prices for the devices analysed, which may be frequent once competitive products are commercially available and a technology becomes increasingly adapted in clinical practice, is not reflected in the present analysis and may require adaptation over time.

Fourth, we calculated costs on the basis of a presumed Swiss average, although costs can moderately differ between regions (cantons) and hospitals.

Concerning the frequency of ETA procedures during recent years and today, no official figures are available in Switzerland since an official tariff (Tarmed) is lacking so far. Therefore, we assumed that the sum of thermal catheters sold by the most relevant companies [28] would allow us to estimate the number of ETA procedures performed. From 2014 to 2016, annual ETA catheter sales ranged from 3000 to 4000 items [28].

Moreover, we attempted to obtain frequencies of HL/S from the Swiss Federal statistical office, from Santesuisse / Sasis and from Tarifsuisse. The figures provided were very inconsistent, especially in comparison to figures published earlier by Price Waterhouse Coopers [26]. However, it became clear that despite the clinical efficacy and low complication rate of ETA, and regardless of an increasing number of national and international guidelines favouring ETA over HL/S as a standard treatment [23, 24], inpatient HL/S remains, until now, by far the most common treatment modality for TVV in Switzerland. An overdue shift towards outpatient ETA is hampered by a lack of remuneration for outpatient ETA in contrast to HL/S.

## Conclusion

Our study suggests that outpatient ETA has the potential to save a great deal of money to the Swiss health system. However, policy makers and insurance companies have to provide an adequate reimbursement system to foster outpatient ETA.

### Disclosure statement

Nicolas Diehm: Member Faculty TASK FORCE ETA  
MarkusENZler: Member Faculty TASK FORCE ETA  
Daniel Holtz: Chairman Faculty TASK FORCE ETA  
No other potential conflict of interest relevant to this article was reported.

### Authors' contribution

Hak Hong Keo and Nicolas Diehm contributed equally

### References

The full list of references is included in the online version of the article at [www.cardiovascmed.ch](http://www.cardiovascmed.ch).

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