

Deep Venous Thrombosis Prophylaxis Practice and Treatment Strategies among Plastic Surgeons: Survey Results

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Background: Deep vein thrombosis is a known serious complication of surgical procedures and a significant cause of morbidity and mortality. Plastic surgeons' management of the risk of deep vein thrombosis and current information regarding deep vein thrombosis incidence rates are limited. A survey was designed and mailed to plastic surgeons to collect data on the patterns of practice with regard to deep vein thrombosis in patients undergoing plastic surgery procedures.

Methods: A comprehensive self-administered, anonymous survey was mailed to 1557 plastic surgeons in March of 2003.

Results: A total of 334 completed responses were available for analysis. Subsets of surgeons do not use any deep vein thrombosis prophylaxis: 16.4 percent who perform face lifts; 21.3 percent who perform liposuction; and 8.7 percent who perform a combined abdominoplasty-liposuction procedure. Only 48.7 percent of surgeons performing face lifts, 43.7 percent of surgeons performing liposuction, and 60.8 percent performing a combined procedure use deep vein thrombosis prophylaxis all the time.

Conclusions: These results demonstrate a need for educational efforts and guidelines to direct clinical practice in line with evidence-based data concerning plastic surgery procedures and deep vein thrombosis. Plastic surgeons should be aware of the potential and real risks of deep vein thrombosis and procedures for prevention and treatment to reduce morbidity and mortality associated with deep vein thrombosis in all plastic surgery patients. (*Plast. Reconstr. Surg.* 119: 157, 2007.)

Deep vein thrombosis leads to catastrophic complications of death, pulmonary embolism, and postthrombotic syndrome that are well documented in the general surgery and orthopedic surgery literature. The incidence of

postoperative deep vein thrombosis in general surgery patients ranges from 16 to 30 percent, with an incidence of clinically significant pulmonary embolism of 1.6 percent^{1,2} and fatal pulmonary embolism in 0.1 to 0.8 percent.² The incidence is even higher for orthopedic surgery patients undergoing hip or knee surgery. Without adequate thromboembolic prophylaxis, 45 to 70 percent of hip surgery patients³ and 53 to 84 percent of knee surgery patients⁴ will develop a deep vein thrombosis.

Deep vein thrombosis most commonly develops in the deep veins of the calf muscle, where there is a low incidence of clinically significant pulmonary embolism.⁵ Without appropriate treatment, 20 percent of calf vein thrombi will propagate proximally, where they pose a serious threat. At least 50 percent of proximal deep vein thromboses were associated with a pulmonary embolism or recurrent deep vein thrombosis; 10 percent were immediately fatal with pulmonary embolism^{5,6} and 5 percent caused death later (as

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a result of right ventricular dysfunction and/or pulmonary hypertension).⁵ Although the incidence of a fatal pulmonary embolism seems very low in a surgeon's personal practice, pulmonary embolism accounts for over 200,000 deaths per year in the United States alone.^{3,7,8}

Postthrombotic syndrome is a consequence of venous stasis and venous hypertension caused by damaged venous valves that no longer regulate the unidirectional flow of venous blood out of the legs and back to the heart. As a later complication of deep vein thrombosis, postthrombotic syndrome presents clinically, with the patient complaining of pain, varicose veins, and swelling of the affected lower limb, and develops in 60 to 70 percent of patients with proximal deep vein thrombosis and 16 percent of patients with calf deep vein thrombosis.⁹ A total of 800,000 patients suffer annually in the United States from immediate and later complications of deep vein thrombosis.³

Few publications in the literature report incidence rates of deep vein thrombosis and pulmonary embolism among plastic surgery patients. Reinisch et al.¹⁰ reported a deep vein thrombosis incidence of 0.35 percent, a pulmonary embolism incidence of 0.14 percent, and a deep vein thrombosis-related death incidence of 0.001 percent from a survey of 273 surgeons performing 9937 face lifts. A recent literature search using "deep vein thrombosis" and "plastic surgery" in both OVID and Entrez PubMed databases (1966 to present) yielded only 10 English language articles that discussed deep vein thrombosis incidence or prophylaxis in plastic surgery patients.^{2,10-18}

A survey was prepared that asked for specific information on the numbers of deep vein thromboses experienced by individual plastic surgeons. In addition, prophylaxis treatment data were also requested. We present an overview and summary of reported deep vein thrombosis occurrences and the respective prophylaxis and treatments used by members of the American Society of Plastic Surgeons.

MATERIALS AND METHODS

The survey consisted of eight questions on practice habits for three types of surgical procedures: face lifts, liposuction alone, and liposuction combined with abdominoplasty (Table 1). Responders had to check a box corresponding to their answer for each procedure; only one question required the responder to write in an answer [i.e., How long is the average procedure (hr)?].

Surveys were mailed to all current members (1557) of the American Society of Plastic Surgeons.

Statistical Analysis

Survey results were tabulated in a Microsoft Excel worksheet (Microsoft Corp., Redmond, Wash.) as a logical expression (a marked answer would be entered with a value of 1 and nonselected answers would have a value of 0). Statistical analyses were performed using SPSS for Windows, release 11.5 (SPSS Inc., Chicago, Ill.). All data were analyzed by Pearson chi-square test unless otherwise stated. In all analyses, a probability value of $p < 0.05$ was considered significant.

RESULTS

A total of 1557 surveys were mailed to all of the current members of the American Society of Plastic Surgeons in March of 2003. Three hundred thirty-four surveys (21.4 percent response) were returned within a 2-month period. Not all queries were answered on all the surveys. Therefore, the numbers of responders are indicated in the tables and reported percentages represent the percentage of responders and not the total number of returned surveys.

Operative Experience

The number of face lifts, liposuctions, and combined procedures of abdominoplasty and liposuction (referred to from here on as *combined procedure*), and average reported times to complete each procedure are shown (Table 2). The majority of responders perform 20 or fewer face lifts per year at an average operating time of 4 hours per operation per procedure. More than 50 liposuctions per year are performed by 35 percent of the responders, with approximately 40 percent completing between 11 and 30 procedures. The group average for liposuctions was 2.25 hours' operative time, with a range of 1.5 to 3 hours. Thirty-one percent (31 percent) of responders perform 0 to 10 combined procedures per year and 46.4 percent complete 11 to 30 procedures per year, with an average operative time of nearly 3½ hours. The average time it took for different groups of responders to perform surgery did not change by the numbers of each procedure performed per year. No statistical significance was observed in operating time among all surgeons who perform any of the procedures.

Table 1. Survey

	Face Lifts	Liposuction	Liposuction plus Abdominoplasty
1. How many of each procedure do you perform per year?			
0–10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11–20	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21–30	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31–40	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40–50	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
>50	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. How long is the average procedure (hours)?			
3. What type of DVT prophylaxis do you use?			
Nothing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stockings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Foot pumps	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SCDs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heparin (unfractionated heparin) SQ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LMWH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combination stocking/foot pump	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combination stocking/SCD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combination heparin/foot pump	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combination heparin/SCD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combination LMWH/foot pump	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Combination LMWH/SCD	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. How often do you use DVT prophylaxis?			
Not consistent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10% of the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
About 50% of the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
About 75% of the time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Always	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. How many DVT/PE events in the past 5 years?			
None	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1–3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5–7	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8–10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
>10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. How many deaths from PE in the past 5 years?			
None	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
>3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. How do you treat a DVT/PE event occurring within 24 hours of surgery?			
No treatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ASA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IV heparin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LMWH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coumadin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
tPA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IVC filter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. How do you treat a DVT/PE 24–72 hours postoperatively?			
No treatment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ASA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IV heparin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
LMWH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coumadin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
tPA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IVC filter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

ASA, aspirin; DVT, deep vein thrombosis; IV, intravenously; IVC, inferior vena cava; LMWH, low-molecular-weight heparin; SCD, sequential compression device; SQ, subcutaneously; tPA, tissue plasminogen activator.

Table 2. Average Surgical Operating Time Examined as a Function of the Number of Procedures Performed per Year

Time (hr)	Face Lifts Performed per Year (n = 329) (%)					Liposuctions Performed per Year (n = 329) (%)					Combined Procedures* Performed per Year (n = 323) (%)									
	0-10	11-20	21-30	31-40	41-50	0-10	11-20	21-30	31-40	41-50	0-10	11-20	21-30	31-40	41-50	41-50	>50	Total†		
	Time					Time					Time					Time				
1	—	—	—	—	—	—	2.9	—	—	—	—	—	—	—	—	—	—	0.8		
1.00	—	—	—	—	—	—	—	7.7	9.1	10.0	—	—	—	—	—	—	—	5.5		
1.25	—	—	—	—	—	—	—	3.0	6.1	—	—	—	—	—	—	—	—	1.5		
1.50	—	—	—	—	—	7.1	23.5	10.8	6.1	35.0	—	—	—	4.5	7.7	—	—	16.7		
1.75	—	—	—	—	—	—	—	1.5	6.1	—	—	—	—	—	—	—	—	2.2		
2.00	1.7	2.3	2.3	—	3.7	2.7	32.4	38.5	39.4	20.0	—	—	—	—	—	—	—	35.6		
2.25	1.7	2.3	—	—	3.7	—	—	1.5	3.0	—	—	—	—	—	—	—	—	0.7		
2.50	10.2	3.5	7.0	—	11.1	10.8	17.6	12.3	9.1	5.0	—	—	—	—	—	—	—	12.0		
2.75	1.7	—	—	—	—	2.7	7.1	—	—	—	—	—	—	—	—	—	—	0.4		
3.00	22.0	25.6	16.3	6.3	18.5	24.3	20.6	20.0	3.0	20.0	—	—	—	—	—	—	—	15.6		
3.25	—	—	—	—	3.7	—	—	—	3.1	9.1	—	—	—	—	—	—	—	2.7		
3.50	10.2	10.5	18.6	25.0	3.7	—	—	7.1	1.5	3.0	10.0	—	—	—	—	—	—	2.9		
4.00	27.1	23.3	18.6	25.0	18.5	24.3	2.9	7.1	3.0	10.0	—	—	—	—	—	—	—	4.4		
4.50	6.8	7.0	7.0	6.3	22.2	5.4	—	—	—	—	—	—	—	—	—	—	—	0.4		
5.00	10.2	16.3	20.9	18.8	11.1	16.2	14.2	14.3	3.0	—	—	—	—	—	—	—	—	1.5		
5.50	1.7	—	—	—	3.7	2.7	—	—	—	—	—	—	—	—	—	—	—	—		
6.00	5.1	4.7	9.3	18.8	—	8.1	—	—	—	—	—	—	—	—	—	—	—	—		
7.00	1.7	2.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		
>7	—	2.4	—	—	—	2.7	—	—	—	—	—	—	—	—	—	—	—	—		
Surg./year	21.9	33.1	16.1	6.1	9.1	13.7	15.2	23.7	11.9	9.1	35.0	26.3	20.1	8.7	5.3	—	—	31.0		
Total‡	Average ± SEM, 3.96 ± 0.07 hr					Average ± SEM, 2.24 ± 0.05 hr					Average ± SEM, 3.48 ± 0.06 hr					Average ± SEM, 3.48 ± 0.06 hr				

*Combined abdominoplasty and liposuction procedure.

†The entire surgery group's average operative times independent of the number of operations performed per year.

‡The entire surgery group's distribution of the number of operations performed per year independent of the operative time.

Deep Vein Thrombosis/Pulmonary Embolism Events

The number of deep vein thrombosis, pulmonary embolism events, and mortalities from pulmonary embolism in the past 5 years among the different procedures are listed in Table 3. The distributions of deep vein thrombosis/pulmonary embolism events and pulmonary embolism-associated mortalities were different among the groups ($p = 0.001$). In face-lift procedures, only 2.5 percent of responders performing face lifts reported one to three deep vein thrombosis incidents and no mortalities.

In liposuction procedures, three mortalities (1 percent) from pulmonary embolism were reported, with a 6.8 percent total deep vein thrombosis/pulmonary embolism incidence [6.4 percent reported one to three deep vein thrombosis/pulmonary embolism episodes and one responder (0.4 percent) reported four to seven deep vein thrombosis/pulmonary embolism episodes]. One surgeon reported a pulmonary embolism-associated mortality but no deep vein thrombosis/pulmonary embolism incidents. Two of the three mortalities were from surgeons reporting one to three deep vein thrombosis events (10 percent). No deaths were reported.

The numbers of deep vein thrombosis/pulmonary embolism events and pulmonary embolism-associated mortalities were the highest in the combined procedure group. The reported mortality incidence was approximately 3 percent, with a 13 percent deep vein thrombosis/pulmonary embolism event rate (12.3 percent had one to three events and 0.7 percent had four to seven). Two surgeons (0.7 percent) reported a pulmonary embolism-associated death without reporting any deep vein thrombosis/pulmonary embolism incidents. A pulmonary embolism-associated mortality was reported by 15.8 percent of the surgeons who reported one to three deep vein thrombosis/pulmonary embolism events and by 50 percent of the surgeons who reported four to seven deep vein thrombosis/pulmonary embolism events.

Deep Vein Thrombosis/Pulmonary Embolism Events and Mortalities by Number of Operations Performed per Year

The number of deep vein thrombosis/pulmonary embolism events for each surgical procedure type was examined as a function of the number of procedures performed per year (Table 4). The difference in number of deep vein thrombosis/pulmonary embolism events relative to number-

Table 3. Number of DVT/PE Events Compared with the Number of Mortalities in the Past 5 Years*

No. of Mortalities from PE§	Face Lifts				Liposuction				Combined Procedure†			
	No. of DVT and/or Pulmonary Embolism Events in the Past 5 Years‡				No. of DVT and/or Pulmonary Embolism Events in the Past 5 Years‡				No. of DVT and/or Pulmonary Embolism Events in the Past 5 Years‡			
	None	1-3	4-7	Mortality Total	None	1-3	4-7	Mortality Total	None	1-3	4-7	Mortality Total
None	97.5 (307)	2.5 (8)	—	100 (315)	99.7 (289)	90 (18)	100 (1)	99 (308)	99.3 (266)	84.2 (32)	50 (1)	97.1 (299)
One	—	—	—	0	0.3 (1)	10 (2)	—	1 (3)	0.7 (2)	15.8 (6)	50 (1)	2.9 (9)
DVT/PE	97.5 (307)	2.5 (8)	—	(315)	93.2 (290)	6.4 (20)	0.4(1)	(311)	87.0 (268)	12.3 (38)	0.7 (2)	(308)
Total												

DVT, deep vein thrombosis; PE, pulmonary embolism.

*Results are displayed as a percentage of mortality and numbers of observations are enclosed in parenthesis (*n*). The "Mortality Total" found in the right hand column of each operation type is the (number) and percentage of reported mortalities. The percentage and (numbers) shown on the last row, titled "DVT/PE Total" are frequencies of the numbers of DVTs and PEs reported. For example, looking under liposuction, 99% (308) of the responders reported no mortalities from PE, 6.4% (20) reported one to three DVT/PE events, but only two (10 percent of those reporting one to three DVT/PE episodes in the past 5 years) had an associated mortality.

†Combined procedures refer to a combined abdominoplasty and liposuction procedure.

‡Distribution of DVT and/or PE events is significant by Pearson chi-square analysis ($p = 0.001$).

§Distribution of mortalities from PE is significant by Pearson chi-square analysis ($p = 0.001$).

Table 4. Number of DVT/PE Events in the Past 5 Years Distributed by the Number of Procedures Performed

No. of DVT and PE Events†	Face Lifts Performed per Year*					Liposuctions Performed per Year					Combined Procedures† Performed per Year					DVT/PE Total						
	0-10	11-20	21-30	31-40	41-50	>50	Total	0-10	11-20	21-30	31-40	41-50	>50	Total	0-10		11-20	21-30	31-40	41-50	>50	Total
	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)		(No.)	(No.)	(No.)	(No.)	(No.)	(No.)
None,	100	99	100	100	90	90.9	97.5	100	95.8	94.7	94.7	96.6	89.2	93.4	33.8	25.4	18.4	9.2	4.8	8.5	87.5	87.5
%	(70)	(104)	(53)	(18)	(27)	(40)	(312)	(15)	(46)	(72)	(36)	(28)	(99)	(296)	(92)	(69)	(50)	(25)	(13)	(23)	(272)	(272)
1-3,	—	1	—	—	10	91.1	2.5	—	4.2	5.3	5.3	3.4	9.9	6.3	5.4	32.4	35.1	8.1	8.1	10.8	11.9	11.9
%	—	(1)	—	—	(3)	(4)	(8)	—	(2)	(4)	(2)	(1)	(11)	(20)	(2)	(12)	(13)	(3)	(3)	(4)	(37)	(37)
4-7,	—	—	—	—	—	—	—	—	—	—	—	—	0.9	0.3	1.1	—	1.6	—	—	—	—	0.6
%	—	—	—	—	—	—	—	—	—	—	—	—	(1)	(1)	(1)	—	(1)	—	—	—	—	(2)
(No.)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total by	21.9	32.8	16.6	5.6	9.4	13.8	320	4.7	15.1	24	12	9.1	35	30.5	26.0	20.6	9.0	5.1	8.7	8.7	311	311
No. performed,	(70)	(105)	(53)	(18)	(30)	(44)	(320)	(15)	(48)	(76)	(38)	(29)	(111)	(317)	(95)	(81)	(64)	(28)	(16)	(27)	(27)	(311)
% (No.)																						

DVT, deep vein thrombosis; PE, pulmonary embolism.

*Number of face lifts performed per year and the number of DVT/PE events is significant by Pearson chi-square analysis ($p = 0.002$).

†Combined procedures refer to a combined abdominoplasty and liposuction procedure.

‡Distribution of DVT and/or PE events is significant by Pearson chi-square analysis ($p = 0.001$).

performed per year within each procedure type was not statistically significant (i.e., the number of deep vein thrombosis/pulmonary embolism events in surgeons performing 11 to 20 procedures per year was statistically the same as surgeons performing 41 to 50 procedures per year). The total difference in the number of deep vein thrombosis/pulmonary embolism events among the three procedure types was statistically significant ($p = 0.001$), with the combined procedure group having the most, followed by the liposuction procedure group and face lifts having the least number of events. The distribution of pulmonary embolism-associated mortality (Table 5) reflects the same distribution as deep vein thrombosis/pulmonary embolism events; however, differences were not significant among the three procedure types ($p > 0.05$). One additional pulmonary embolism-associated mortality in the combined group was not included in this analysis because the responder did not indicate how many combined procedures he or she performed per year.

Deep Vein Thrombosis Prophylaxis Practice

Deep vein thrombosis prophylaxis practices among the responding surgeons by number of procedures performed per year and the procedure group averages are presented in Table 6. Combination/other refers to a deep vein thrombosis prophylaxis regimen that is nonconventional or practiced by only a few responding surgeons. Interestingly, 18.4 percent of surgeons performing face lifts, 25.2 percent of those performing liposuction, and 8.6 percent of those performing a combined procedure use no deep vein thrombosis prophylaxis in their practice.

The number of reported deep vein thrombosis/pulmonary embolism events (none, one to three, and four to seven) divided by deep vein

thrombosis prophylaxis regimen was not statistically different (Table 7). Surprisingly, for both the face lift and liposuction procedure groups, the incidence of deep vein thrombosis/pulmonary embolism was greater in the any prophylaxis group than in the no prophylaxis group (Table 8). In the combined procedures group, the deep vein thrombosis/pulmonary embolism incidence was statistically significant, and the incidence of deep vein thrombosis/pulmonary embolism was lower in the any prophylaxis group.

The majority of responders for all three operations report using deep vein thrombosis prophylaxis all the time (Table 9). The number of deep vein thromboses was higher among those who use deep vein thrombosis prophylaxis all the time compared with those who use it less than 10 percent of the time or inconsistently. An opinion of this finding is found in the Discussion. In addition, no statistically significant differences in the distribution of prophylaxis regimen or number of procedures performed were observed for any of the operations (see Tables A, B, and C in the online *Journal* at www.PRSJournal.com).

Reported Mortality

There were no reported pulmonary embolism mortalities among those surgeons who perform face lifts. In liposuction alone, the deep vein thrombosis prophylaxis methods used for the three reported mortalities from pulmonary embolism are listed in Table 10. One responder who reported not having any deep vein thrombosis/pulmonary embolism events did report having mortality. One death was reported among those who use stockings and sequential compression devices. For combined procedures of abdominoplasty and liposuction, deep vein thrombosis prophylaxis practices for the seven pulmonary embolism-associated deaths are listed in Table 11.

Table 5. Number of Reported PE Deaths Distributed by the Number of Procedures Performed

Reported DVT-Associated Mortality	Liposuctions Performed per Year							Combined Procedures* Performed per Year						
	0-10	11-20	21-30	31-40	41-50	>50	Total	0-10	11-20	21-30	31-40	41-50	>50	Total
No, % (No.)	5.0 (15)	14.5 (44)	24.4 (74)	11.2 (34)	9.6 (29)	35.3 (107)	99 (303)	30.8 (90)	25.7 (75)	20.2 (59)	9.6 (28)	5.1 (15)	8.6 (23)	97.1 (292)
Yes, % (No.)	—	66.7 (2)	—	—	—	33.3 (1)	1 (3)	—	44.4 (4)	33.3 (3)	—	11.1 (1)	11.1 (1)	2.9 (9)
Procedures performed per year total, % (No.)	4.9 (15)	15.0 (46)	24.2 (74)	11.1 (34)	9.5 (29)	35.3 (108)	306 (306)	29.9 (90)	26.2 (79)	20.6 (62)	9.3 (28)	5.3 (16)	8.6 (26)	301 (301)

Table 6. DVT Prophylaxis Practice Divided by the Number of Procedures Performed per Year*

DVT Prophylaxis Practice	Face Lift										Liposuction										Combined Procedure									
	Procedures Performed per Year					Total (%)	Procedures Performed per Year					Total (%)	Procedures Performed per Year					Total (%)	Procedures Performed per Year					Total (%)						
	0-10 (%)	11-20 (%)	21-30 (%)	31-40 (%)	41-50 (%)		>50 (%)	0-10 (%)	11-20 (%)	21-30 (%)	31-40 (%)		41-50 (%)	>50 (%)	0-10 (%)	11-20 (%)	21-30 (%)		31-40 (%)	41-50 (%)	>50 (%)									
Nothing	15 (25.9)	22 (37.9)	7 (12.1)	3 (5.2)	5 (8.6)	58 (18.4)	4 (5.3)	14 (18.4)	15 (19.7)	11 (14.5)	5 (6.6)	27 (35.5)	76 (25.2)	8 (32)	6 (24)	3 (12)	5 (20)	1 (4)	2 (8)	25 (8.6)										
SCD	12 (17.1)	22 (31.4)	15 (21.4)	6 (8.6)	7 (10)	70 (22.2)	3 (5.8)	7 (13.5)	16 (30.8)	4 (7.7)	3 (5.8)	19 (36.5)	52 (17.2)	16 (27.6)	15 (25.9)	14 (24.1)	3 (5.2)	4 (6.9)	6 (10.3)	58 (20)										
Foot Pumps	6 (12.3)	21 (43.8)	7 (14.6)	4 (8.3)	2 (4.2)	48 (15.2)	2 (4.9)	5 (12.2)	6 (14.6)	5 (12.2)	6 (14.6)	17 (41.5)	41 (13.6)	14 (31.1)	10 (22.2)	3 (6.7)	4 (8.9)	4 (8.9)	4 (8.9)	45 (15.5)										
Stockings plus SCD	8 (17.8)	12 (26.7)	9 (20)	1 (2.2)	5 (11.1)	45 (14.2)	2 (7.7)	2 (7.7)	6 (23.1)	4 (15.4)	4 (15.4)	8 (30.8)	26 (8.6)	13 (34.2)	14 (36.8)	7 (18.4)	3 (7.9)	1 (2.6)	0 (0)	38 (13.1)										
Stockings plus foot pumps	5 (17.9)	7 (25)	5 (17.9)	2 (7.1)	4 (14.3)	28 (8.9)	1 (4.3)	3 (13)	6 (26.1)	3 (13)	3 (13)	7 (30.4)	23 (7.6)	13 (37.1)	8 (22.9)	7 (20)	3 (8.6)	1 (2.9)	3 (8.6)	35 (12.1)										
Stockings	7 (31.8)	6 (27.3)	1 (4.5)	1 (4.5)	2 (9.1)	22 (7)	2 (6.9)	6 (20.7)	7 (24.1)	0 (0)	2 (6.9)	12 (41.4)	29 (9.6)	11 (39.3)	5 (17.9)	5 (17.9)	1 (3.6)	1 (3.6)	5 (17.9)	28 (9.7)										
Foot pumps or SCD	3 (42.9)	2 (28.6)	1 (14.3)	1 (14.3)	1 (14.3)	7 (2.2)	1 (20)	1 (20)	2 (20)	1 (20)	3 (60)	5 (1.7)	5 (1.7)	1 (50)	1 (50)	1 (50)	1 (50)	1 (50)	2 (0.7)	2 (0.7)										
Stocking plus foot pumps or SCD	3 (60)	3 (60)	1 (20)	1 (20)	1 (20)	5 (1.6)	3 (50)	3 (50)	2 (33.3)	2 (33.3)	1 (16.7)	6 (2)	6 (2)	3 (27.3)	5 (45.5)	1 (9.1)	1 (9.1)	1 (9.1)	1 (9.1)	11 (3.8)										
Stockings or stockings plus SCD	1 (25)	1 (25)	1 (25)	1 (25)	3 (75)	4 (1.3)	1 (25)	1 (25)	1 (25)	1 (25)	1 (25)	4 (25)	4 (1.3)	1 (16.7)	3 (50)	1 (16.7)	1 (16.7)	1 (16.7)	6 (2.1)	6 (2.1)										
Stockings or other	2 (50)	1 (25)	1 (25)	1 (25)	1 (25)	4 (1.3)	1 (25)	1 (25)	2 (50)	1 (25)	1 (25)	4 (1.3)	4 (1.3)	1 (25)	3 (50)	1 (25)	1 (25)	1 (25)	6 (2.1)	6 (2.1)										
Heparin																														
Combinations/other	8 (82)	8 (32)	4 (16)	2 (8)	1 (4)	25 (7.9)	6 (17.1)	6 (17.1)	9 (25.7)	6 (17.1)	0 (0)	14 (40)	35 (11.6)	12 (28.6)	8 (19)	11 (26.2)	3 (7.1)	2 (4.8)	6 (14.3)	42 (14.5)										
Total						316						302								290										

DVT, deep vein thrombosis; SCD, sequential compression device.
 *Combinations/other represent all other DVT prophylaxis practice not already shown. Combined procedures refer to a combined abdominoplasty and liposuction procedure. Percentages shown under "Procedures Performed per Year" are for the DVT prophylaxis method (e.g., 15 surgeons performing 0-10 face lifts per year responded that they use nothing for DVT prophylaxis; this represents 25.9% of all surgeons performing face lifts and use "Nothing" for DVT prophylaxis). Percentages under "Total" represent percentage of DVT prophylaxis practice among all surgeons performing listed surgery [e.g., 58 (18.4%) of all surgeons performing face lifts use nothing for DVT prophylaxis]. In cases where there is an "or" (e.g., "Stockings or foot pumps") the responder selected each individually and did not select possible combination choices (such as "Stockings plus foot pumps").

Table 7. DVT/PE Events in 5 Years and DVT Prophylaxis Method Used*

	Face Lift			Liposuction			Combined Procedure				
	No. of DVT/PE Events in 5 Years			No. of DVT/PE Events in 5 Years			No. of DVT/PE Events in 5 Years				
	None	1-3	Total	None	1-3	4-7	Total	None	1-3	4-7	Total
DVT Prophylaxis											
Nothing	59	1	60	75	1	1	77	18	7		25
% of each DVT/PE event†	19.1	12.5		26.5	6.3	100.0		7.2	21.2		
% of total‡	18.6	0.3	18.9	25.0	0.3	0.3	25.7	6.3	2.4		8.7
Stockings	21	1	22	26	3		29	28	0		28
% of each DVT/PE event†	6.8	12.5		9.2	18.8			11.2	0.0		
% of total‡	6.6	0.3	6.9	8.7	1.0		9.7	9.8	0.0		9.8
Foot pumps	46		46	39	1		40	38	5		43
% of each DVT/PE event†	14.9			13.8	6.3			15.1	15.2		
% of total‡	14.5		14.5	13.0	0.3		13.3	13.3	1.7		15.0
SCD	68	1	69	45	5		50	50	5	1	56
% of each DVT/PE event†	22.0	12.5		15.9	31.3			19.9	15.2	50.0	
% of total‡	21.5	0.3	21.8	15.0	1.7		16.7	17.5	1.7	0.3	19.6
Stockings plus foot pumps	28	1	29	22	1		23	30	5		35
% of each DVT/PE event†	9.1	12.5		7.8	6.3			12.0	15.2		
% of total‡	8.8	0.3	9.1	7.3	0.3		7.7	10.5	1.7		12.2
Stockings plus SCD	42	3	45	22	3		25	35	3		38
% of each DVT/PE event†	13.6	37.5		7.8	18.8			13.9	9.1		
% of total‡	13.2	0.9	14.2	7.3	1.0		8.3	12.2	1.0		13.3
SQ Heparin plus SCD	1		1	2			2	2			2
% of each DVT/PE event†	0.3			0.7				0.8			
% of total‡	0.3		0.3	0.7			0.7	0.7			0.7
LMWH plus foot pumps	1		1	1			1	1			1
% of each DVT/PE event†	0.3			0.4				0.4			
% of total‡	0.3		0.3	0.3			0.3	0.3			0.3
SQ heparin				1			1	1			1
% of each DVT/PE event†				0.4				0.4			
% of total‡				0.3			0.3	0.3			0.3
Combinations/other	43	1	44	51	2		53	49	8	1	58
% of each DVT/PE event†	13.9	12.5		18.0	12.5			19.5	24.2	50.0	
% of total‡	13.6	0.3	13.9	17.0	0.7		17.7	17.1	2.8	0.3	20.3

DVT, deep vein thrombosis; PE, pulmonary embolism; SCD, sequential compression device; LMWH, low-molecular weight heparin; SQ, subcutaneous.

*Combinations/other represent all other DVT prophylaxis practice not already shown. Combined procedures refer to a combined abdominoplasty and liposuction procedure.

†The percentage of a DVT incident for all prophylaxis methods (e.g., there was one DVT in the “Nothing” DVT prophylaxis group in the face lift surgery group; this single episode represents 12.5% of all 1-3 DVT/PE incidents in the past 5 years).

‡The percentage of DVT prophylaxis practice among all surgeons performing listed surgery [e.g., under face lifts, 60 (18.9%) of all surgeons use nothing for DVT prophylaxis, and of those 60 surgeons, one had a DVT incident, which is 0.3% of the total].

Table 8. Comparison of DVT/PE Incidents with and without DVT Prophylaxis

Any DVT/PE?	Face Lift		Liposuction		Combined Procedure*	
	Any Prophylaxis (%)	No Prophylaxis (%)	Any Prophylaxis (%)	No Prophylaxis (%)	Any Prophylaxis (%)	No Prophylaxis (%)
No	243 (97.2)	58 (98.3)	209 (93.7)	75 (97.4)	233 (89.3)	18 (72)
Yes	7 (2.8)	1 (1.7)	14 (6.3)	2 (2.6)	28 (10.7)	7 (28)
Total	300 (83.6)	59 (16.4)	284 (78.7)	77 (21.3)	261 (91.3)	25 (8.7)

DVT, deep vein thrombosis; PE, pulmonary embolism.

* $p = 0.002$. Combined procedures refer to a combined abdominoplasty and liposuction procedure.

Two surgeons reported pulmonary embolism mortality without reporting any deep vein thrombosis/pulmonary embolism events. The highest incidence of pulmonary embolism death was with those who used some combination of deep vein thrombosis prophylaxis methods (42.9 percent) followed by those using sequential compression devices alone as their deep vein thrombosis prophylaxis method (28.6 percent). No statistical significance was found with the prophylaxis regimen used and pulmonary embolism–associated mortality.

Treatment Practices

Tables 12 and 13 list how responders treat a DVT during the first 24 hours and 24 to 72 hours postoperatively, respectively. Responders from all three surgery types use heparin the most for the treatment of deep vein thrombosis. The second most commonly used treatment was other; the majority of responders choosing other would consult another medical service to manage the deep vein thrombosis.

Reported deep vein thrombosis treatment was grouped by deep vein thrombosis prophylaxis (those who use any deep vein thrombosis prophylaxis) and those who used no prophylaxis (Table 14). For all three procedure groups, a high percentage of surgeons failed to indicate both a deep vein thrombosis prophylaxis practice *and* a deep vein thrombosis treatment plan. The nonresponder rate was 41.3 percent ($n = 133$) in the face lift procedure group, 42.5 percent ($n = 137$) in the liposuction procedure group, and 40.4 percent ($n = 130$) in the combination group. For all three procedure groups, the reported differences of deep vein thrombosis treatment practice between those who used no deep vein thrombosis prophylaxis and any deep vein thrombosis prophylaxis was statistically significant by chi-square analysis ($p < 0.001$).

DISCUSSION

Deep Vein Thrombosis Prophylaxis

This survey has demonstrated that plastic surgeons may not be fully aware of their patients' deep vein thrombosis risk. Among those surgeons performing face lifts, 16.4 percent do not use any deep vein thrombosis prophylaxis; for those surgeons performing liposuction, 21.3 percent do not use any deep vein thrombosis prophylaxis and 8.7 percent of surgeons performing a combined abdominoplasty-liposuction procedure have decided not to use any deep vein thrombosis prophylaxis. Only 48.7 percent of surgeons performing face lifts, 43.7 percent of surgeons performing liposuction, and 60.8 percent performing a combined procedure use deep vein thrombosis prophylaxis *all the time*. Common to all three operations, the most common deep vein thrombosis prophylaxis practice is to use sequential compression devices alone. Some improvement has been made within the plastic surgery community. In the survey by Reinisch et al.¹⁰ 60.7 percent of the responding surgeons performing face lifts reported using no deep vein thrombosis prophylaxis. Fifty-seven percent of otolaryngologists performing head and neck surgery for cancer responded in a survey¹⁹ that they do not use deep vein thrombosis prophylaxis.

Proper deep vein thrombosis prophylaxis unquestionably decreases the incidence of deep vein thrombosis. Sequential compression device use alone has been shown to reduce the incidence of deep vein thrombosis by 60 percent.²⁰ Low-molecular-weight heparin has decreased the incidence of proximal vein thrombosis (without any increase in bleeding complications) by 78 percent.²¹ Subcutaneous heparin (minidose heparin or low-dose unfractionated heparin) administered twice daily reduces the incidence of deep vein thrombosis by 69 percent and fatal pulmonary embolism by 96 percent.²²

Table 9. DVT Prophylaxis Practice and DVT/PE Events*

DVT Prophylaxis Use	Face Lifts			Liposuction			Combined Procedure		
	No DVT/PE (%)	DVT/PE (%)	DVT Prophylaxis Total (%)	No DVT/PE (%)	DVT/PE (%)	DVT Prophylaxis Total (%)	No DVT/PE (%)	DVT/PE (%)	DVT Prophylaxis Total (%)
Not consistent	29	1 (12.5)†	30 (9.7)	28	—	28 (9.3)	14	—	14 (4.9)
10% of time	15	1 (12.5)†	16 (5.2)	24	3 (18.8)†	27 (9.0)	7	3 (8.6)†	10 (3.5)
50% of time	12	—	12 (3.9)	29	2 (12.5)†	31 (10.3)	4	2 (5.7)†	6 (2.1)
75% of time	16	—	16 (5.3)	20	—	20 (6.7)	15	1 (2.9)†	16 (5.6)
Always	190	5 (62.5)†	195 (63.1)	131	7 (42.8)†	138 (46.0)	174	25 (71.4)†	199 (69.9)
No response	39	1 (12.5)†	40 (12.9)	55	4 (25)†	59 (19.7)	37	4 (11.4)†	41 (14.3)
DVT total	301 (97.4)	8 (2.6)	309	284 (94.7)	16 (5.3)	300	251 (87.8)	35 (12.2)	286

DVT, deep vein thrombosis; PE, pulmonary embolism.

*DVT prophylaxis use compared with reported DVT/PE events in the past 5 years. Combined procedures refer to a combined abdominoplasty and liposuction procedure.

†Percentage of total DVT/PE occurrence associated with a DVT prophylaxis practice. For example, among the 309 responders performing face lifts, 30 (9.7 percent) do not give their patients DVT prophylaxis consistently; among those 30, 29 reported not having a patient with a DVT/PE and one responder did report having a patient with a DVT/PE. That one response represents 12.5 percent of the eight responders reporting a DVT/PE with their patients.

Table 10. Reported DVT-Associated Mortality among Surgeons Performing Liposuction Divided by 5-Year DVT/PE Events and DVT Prophylaxis*

No. of DVT/PE Events in Past 5 Years	Reported DVT Prophylaxis Method for Liposuction								Total	
	Nothing	Stockings	Foot Pumps	SCD	Heparin	Stockings plus Foot Pumps	Stockings plus SCD	Heparin plus SCD		Combinations
No DVT-associated mortality										
None	70	26	39	43	1	22	19	2	48	270
% of no DVT†	25.8	9.6	14.4	15.9	0.4	8.1	7.0	0.7	17.7	99.6
% of no DVT mortality‡	24.6	9.1	13.7	15.1	0.4	7.7	6.7	0.7	16.8	94.7
1-3	1	2	1	4		1	3		2	14
% 1-3 of DVTs†	6.3	12.5	6.3	25.0		6.3	18.8		12.5	87.5
% of no DVT mortality‡	0.4	0.7	0.4	1.4		0.4	1.1		0.7	4.9
4-7	1									1
% 4-7 of DVTs†	100									100.0
% of no DVT mortality‡	0.4									0.4
Total										
% of no DVT mortality‡	72	28	40	47	1	23	22	2	50	285
One DVT-associated mortality	25.3	9.8	14.0	16.5	0.4	8.1	7.7	0.7	17.5	100.0
None	1									1
% of no DVT†	0.4									0.4
% Mortality‡	33.3									33.3
1-3		1		1						2
% 1-3 of DVTs†		6.3		6.3						12.5
% mortality‡		33.3		33.3						66.7
Total mortality	1	1	1	1		1	1		3	3
% mortality‡	33.3	33.3	33.3	33.3		33.3	33.3		33.3	100.0

DVT, deep vein thrombosis; PE, pulmonary embolism; SCD, sequential compression device.
 *This table shows DVT prophylaxis regimens and reported DVT/PE events in the past 5 years and is further divided into two parts: DVT/PE events *not* associated with a DVT-associated mortality and DVT/PE events that are associated with a mortality. Combinations are any other combination of DVT prophylaxis not already shown. One mortality was reported without an associated DVT/PE incident in the "Use Nothing" DVT prophylaxis group.
 †The percentage a particular DVT prophylaxis regimen makes to a specific 5-year DVT/PE incidence. For example, 70 surgeons responded that they do not use any form of DVT prophylaxis and did not report any DVT/PE incidence; these 70 surgeons represent 25.8% of all DVT prophylaxis regimens that also did not report any DVT/PE incidents. However, one surgeon in the "Use Nothing" group reported one to three DVT/PE events in 5 years; that one surgeon represents 6.3% of all "1-3 DVT/PE events" (including the two in the mortality part of the table).
 ‡The percentage a particular DVT prophylaxis regimen within a group DVT/PE events makes to either a DVT-associated mortality or not. For example, one surgeon reported using stockings for DVT prophylaxis also had one to three DVT/PE events in 5 years and reported a DVT-associated mortality. This one incident of mortality is 33.3% of all DVT-associated deaths and 6.3% of all "1-3 DVT/PE" events (there were two reported mortalities in the "1-3 DVT/PE" group (those two incidents are 12.5% of all "1-3 DVT/PE" events)).

Table 11. Reported DVT-Associated Mortality among Surgeons Performing Liposuction/Abdominoplasty Procedures Divided by 5-Year DVT/PE Events and DVT Prophylaxis*

No. of DVT/PE Events in the Past 5 Years	Reported DVT Prophylaxis Method for Combined Procedure								Total	
	Nothing	Stockings	Foot Pumps	SCD	Heparin	Stocking plus Foot Pumps	Stockings plus SCD	Heparin plus SCD		Combinations
No DVT-associated mortality										
None	18	27	37	46	30	33	2	45	238	27
% of no DVT†	7.5	11.6	15.4	19.2	12.5	13.8	0.8	18.8	99.2	11.6
% of no DVT mortality‡	6.7	10.1	13.8	17.2	11.2	12.3	0.7	16.8	88.8	10.1
1-3	7		5	4	4	2		7	29	
% of 1-3 DVTs†	21.2		15.2	12.1	12.1	6.1		21.2	87.9	
% of no DVT mortality‡	2.6		1.9	1.5	1.5	0.7		2.6	10.8	
4-7								1	1	
% of 4-7 DVTs†								50	100.0	
% of no DVT mortality‡								0.4	0.4	
Total	25	28	27	42	50	34	35	2	53	268
% of no DVT mortality‡	9.3	9.8	10.1	15.7	18.7	12.7	13.1	0.7	19.8	100.0
One DVT-associated mortality										
None										
% of No DVT†										
% mortality‡										
1-3										
% of 1-3 DVTs†										
% mortality‡										
4-7										
% of 4-7 DVTs†										
% mortality‡										
Total mortality	1	1	1	1	2	1	1	1	3	7
% mortality‡	33.3	33.3	33.3	14.3	28.6	14.3	14.3	14.3	42.9	100.0

DVT, deep vein thrombosis; PE, pulmonary embolism; SCD, sequential compression device.

*Table shows DVT prophylaxis regimens and reported DVT/PE events in the past 5 years and is further divided into two parts: DVT/PE events not associated with a DVT-associated mortality and DVT/PE events that are associated with a mortality. Combinations are any other combination of DVT prophylaxis not already shown. One mortality was reported without an associated DVT/PE incident in the "Use Nothing" DVT prophylaxis group.

†The percentage a particular DVT prophylaxis regimen makes to a specific 5-year DVT/PE incidence. See Table 10.

‡The percentage a particular DVT prophylaxis regimen makes to either a DVT-associated mortality or not.

Table 12. DVT Treatment Practice during the First 24 Hours Postoperatively

DVT Treatment	Face Lifts (%)	Liposuction (%)	Combined Procedure* (%)
None	8 (4.1)	6 (3.1)	6 (3.0)
ASA	3 (1.5)	1 (0.5)	2 (1.0)
Heparin	96 (49.5)	95 (49.7)	100 (50.5)
LMWH	17 (8.8)	16 (8.4)	18 (9.1)
Coumadin	2 (1.0)	3 (1.6)	1 (0.5)
tPA	4 (2.1)	3 (1.6)	3 (1.5)
IVC filter	10 (5.2)	13 (6.8)	17 (8.6)
Other	28 (14.4)	27 (14.1)	26 (13.1)
ASA plus heparin	2 (1.0)	2 (1.0)	1 (0.5)
Heparin plus Coumadin	8 (4.1)	9 (4.7)	9 (4.5)
LMWH plus Coumadin	1 (0.5)	1 (0.5)	1 (0.5)
Heparin plus IVC filter	7 (3.6)	4 (2.1)	5 (2.5)
Heparin plus other		2 (1.0)	2 (1.0)
Coumadin plus IVC filter		1 (0.5)	
Heparin plus tPA	1 (0.5)	1 (0.5)	1 (0.5)
Heparin plus LMWH	2 (1.0)	2 (1.0)	1 (0.5)
LMWH plus IVC filter	3 (1.5)	3 (1.6)	3 (1.5)
ASA plus LMWH		1 (0.5)	1 (0.5)
ASA plus heparin plus Coumadin		1 (0.5)	
ASA plus Coumadin plus other	1 (0.5)		
None or IVC filter	1 (0.5)		
Total responders	194	191	198

DVT, deep vein thrombosis; ASA, aspirin; LMWH, low-molecular-weight heparin; tPA, tissue plasminogen activator; IVC, inferior vena cava.
*Combined procedures refer to a combined abdominoplasty and liposuction procedure.

Table 13. DVT Treatment Practice 24 to 72 Hours Postoperatively

DVT Treatment	Face Lifts (%)	Liposuction (%)	Combined Procedures* (%)
None	5 (2.7)	3 (1.6)	2 (1.1)
ASA	1 (0.5)		
Heparin	100 (54.3)	100 (54.3)	105 (55.6)
LMWH	11 (6.0)	10 (5.4)	11 (5.8)
Coumadin	12 (6.5)	13 (7.1)	16 (8.5)
tPA		1 (0.5)	1 (0.5)
IVC filter	4 (2.2)	5 (2.7)	6 (3.2)
Other	23 (12.5)	25 (13.6)	23 (12.2)
ASA plus heparin	2 (1.1)	2 (1.1)	1 (0.5)
Heparin plus Coumadin	13 (7.1)	12 (6.5)	10 (5.3)
LMWH plus Coumadin	2 (1.1)	2 (1.1)	2 (1.1)
ASA plus LMWH plus heparin	1 (0.5)	1 (0.5)	1 (0.5)
Heparin plus IVC filter	3 (1.6)	3 (1.6)	3 (1.6)
Heparin plus other	2 (1.1)	2 (1.1)	2 (1.1)
Heparin plus LMWH plus other	2 (1.1)	2 (1.1)	2 (1.1)
IVC filter plus tPA plus heparin	1 (0.5)	1 (0.5)	1 (0.5)
ASA plus Coumadin plus IVC filter	1 (0.5)		
ASA plus Coumadin plus tPA	1 (0.5)		
Coumadin plus IVC filter		2 (1.1)	2 (1.1)
Total responders	184	184	188

DVT, deep vein thrombosis; ASA, aspirin; LMWH, low-molecular-weight heparin; tPA, tissue plasminogen activator; IVC, inferior vena cava.
*Combined procedures refer to a combined abdominoplasty and liposuction procedure.

It is well established that deep vein thrombosis prophylaxis will result in a lower reported deep vein thrombosis/pulmonary embolism incidence compared with no prophylaxis.^{1-3,19,21} In this survey, the reported deep vein thrombosis incidence among surgeons using *no* deep vein thrombosis prophylaxis was **lower** for the face lift group (2.8 percent among those using prophylaxis versus 1.7 percent for those who do not) and the liposuction group (6.3 percent among those who use prophylaxis versus 2.6 percent who do not). Only the

combined procedure group had an expected deep vein thrombosis incidence of 10.7 percent for those using prophylaxis versus 28 percent for those who do not. An assumption is made that among those surgeons who use prophylaxis, there is a higher awareness and surveillance for deep vein thrombosis compared with those who do not use any deep vein thrombosis prophylaxis. Table 15 shows the results of an adjusted deep vein thrombosis/pulmonary embolism incident for the no prophylaxis group based on this assumption.

Table 14. DVT Treatment Practice for the First 24 Hours Divided by Those Who Use No DVT Prophylaxis and Those Who Use Any DVT Prophylaxis*

DVT Treatment	Face Lifts		Liposuction		Combined Procedures	
	No Prophylaxis (%)	Any Prophylaxis (%)	No Prophylaxis (%)	Any Prophylaxis (%)	No Prophylaxis (%)	Any Prophylaxis (%)
None	1 (2.9)	7 (4.5)	1 (2.9)	5 (3.3)	1 (2.6)	5 (3.2)
ASA	0	3 (1.9)	0	1 (0.7)	1 (2.6)	1 (0.6)
Heparin	9 (26.5)	83 (53.5)	8 (22.9)	83 (55.3)	10 (26.3)	85 (55.2)
LMWH	7 (20.6)	9 (5.8)	7 (20)	8 (5.3)	7 (18.4)	10 (6.5)
Coumadin	0	2 (1.3)	0	3 (2)	0	1 (0.6)
tPA	1 (2.9)	3 (1.9)	0	3 (2)	0	3 (1.9)
IVC filter	4 (11.8)	6 (3.9)	4 (11.4)	9 (9)	5 (13.2)	12 (7.8)
Other	1 (2.9)	27 (17.4)	1 (2.9)	25 (16.7)	1 (2.6)	25 (16.2)
ASA plus heparin	1 (2.9)	1 (0.6)	1 (2.9)	1 (0.7)	1 (2.6)	0
Heparin plus Coumadin	0	8 (5.2)	1 (2.9)	8 (5.3)	1 (2.6)	8 (5.2)
LMWH plus Coumadin	1 (2.9)	0	1 (2.9)	0	1 (2.6)	0
Heparin plus IVC filter	11.8)	3 (1.9)	2 (5.7)	2 (1.3)	2 (5.3)	3 (1.9)
Heparin plus other Coumadin plus IVC filter	0	0	2 (5.7)	0	2 (5.3)	0
Heparin plus tPA	1 (2.9)	0	0	1 (0.7)	0	1 (0.6)
Heparin plus LMWH	1 (2.9)	0	1 (2.9)	0	1 (2.6)	0
LMWH plus IVC filter	3 (8.8)	0	3 (8.6)	0	3 (7.9)	0
ASA plus LMWH	0	0	1 (2.9)	0	1 (2.6)	0
ASA plus Coumadin plus other	0	1 (0.6)	0	0	0	0
ASA plus heparin plus Coumadin	0	0	1 (2.9)	0	0	0
None or IVC filter	0	1 (0.6)	0	0	0	0
Total responders	34 (18)	155 (82)	35 (18.9)	150 (81.1)	38 (19.8)	154 (80.2)

DVT, deep vein thrombosis; ASA, aspirin; LMWH, low-molecular-weight heparin; tPA, tissue plasminogen activator; IVC, inferior vena cava. *Distribution of treatment practices for responders who used no prophylaxis or any prophylaxis is significant (*p* 0.001) by Pearson chi-square analysis. Percentages represent the percent of responders using the listed treatment option for each the no prophylaxis or any prophylaxis group. Combined procedures refer to a combined abdominoplasty and liposuction procedure. One responder in the face lift group responded that he would use nothing or have an IVC filter placed.

Table 15. Calculated Expected DVT/PE Incidence in the No Prophylaxis Group*

Incidence	Face Lift (n = 59) (%)	Liposuction (n = 77) (%)	Combined Procedures (n = 25) (%)
Actual	1 (1.7)	2 (2.6)	7 (28)
Expected incidence† in the no prophylaxis group if DVT prophylaxis resulted in a:			
66% decrease	4 (6.8)	11 (14.3)‡	8 (32)
50% decrease	3 (5.1)	8 (10.4)‡	5 (20)
40% decrease	2 (3.4)	6 (7.8)	4 (16)
25% decrease	2 (3.4)	5 (6.5)	4 (16)

DVT, deep vein thrombosis; PE, pulmonary embolism.

*Table shows the calculated expected incidence of deep vein thrombosis/pulmonary embolism events in the no prophylaxis subgroups. Calculated numbers were rounded off and are reported as whole numbers. Numbers were calculated by using the DVT/PE incidence in the any prophylaxis group (see Table 8) and adjusting the DVT/PE incidence in the no prophylaxis group by assuming that DVT prophylaxis will decrease the incidence of reported DVTs by 66 to 25 percent. For example, in the liposuction group, the actual reported DVT incidence in the any prophylaxis group was 14 (6.3 percent). If DVT prophylaxis decreases the incidence of DVT, the incidence of DVT should be higher in the no prophylaxis group, but in this case it was lower at a reported incidence of two (2.6 percent). If the incidence of DVT was 6.3 percent in the any prophylaxis group and this represented a decreased incidence of 66 percent, the adjusted DVT incidence in the no prophylaxis group should have been 11 (or 14.3 percent of the group).

†Expected DVT incidence (n) = [DVT number in the any prophylaxis group / (1 - percent change)] ÷ Total number in the any prophylaxis group × Total number in no prophylaxis group.

‡*p* 0.05 by chi-square analysis (calculated DVT incidence compared with actual).

The adjusted values were calculated by using the deep vein thrombosis/pulmonary embolism numbers for the any prophylaxis use group (see Table 8) and assume that this value represents an expected 66 percent, 50 percent, 40 percent, or 25 percent decrease from the no prophylaxis group's deep vein thrombosis/pulmonary embolism occurrences. The adjusted deep vein thrombosis/pulmonary embolism numbers were not significantly different from the actual numbers for the face lift group.

The adjusted values for a 66 percent and 50 percent decrease of deep vein thrombosis/pulmonary embolism occurrences was found to be significant from the reported number for the liposuction group. For example, if deep vein thrombosis prophylaxis results in a 66 percent decrease in the deep vein thrombosis incidence, the expected reported deep vein thrombosis incidence without any deep vein thrombosis prophylaxis would be 14.3 percent (significantly higher than the actual reported incidence of 2.6 percent).

For the combined procedures group, the adjusted deep vein thrombosis incidence was found to be consistent with the actual reported deep vein thrombosis incidence (28 percent actual incidence versus 32 percent for a calculated adjusted value). In this group, deep vein thrombosis prophylaxis resulted in a 61.7 percent decrease in the reported deep vein thrombosis/pulmonary embolism numbers. The authors stress to the reader that these percentages *are not* the incidences of deep vein thrombosis for each of the listed procedures; rather, they are the percentages of responding surgeons reporting a deep vein thrombosis.

The results of this survey suggest that plastic surgeons need to incorporate a deep vein thrombosis prophylaxis regimen into their practices and to be more vigilant for the signs and symptoms of deep vein thrombosis. Part of the problem may be a paucity of literature on deep vein thrombosis and deep vein thrombosis prophylaxis for plastic surgery patients. The American College of Chest Physicians remarked in their Sixth Consensus Conference on Antithrombotic Therapy²³ that many physicians do not use thromboprophylaxis because of the belief that the overall incidence of deep vein thrombosis among hospitalized and postoperative patients has declined to a point so low that prophylaxis is no longer warranted. Another possible reason may be the concern for bleeding complications. A complete discussion of this topic is beyond the scope of this article; however, multiple studies have shown no increase in

the risk of major bleeding with low-dose unfractionated heparin or low-molecular-weight heparin use. There is a slightly higher risk of minor bleeding with low-dose unfractionated heparin use compared with low-molecular-weight heparin.²⁴

The American Society of Plastic and Reconstructive Surgeons convened a Task Force on Deep Vein Thrombosis in 1998. Their findings and recommendations were published² as a detailed and elegant discussion on deep vein prophylaxis and recommendations for prophylaxis inferred from the recommendations made by the American College of Chest Physicians at the Fifth American College of Chest Physicians Consensus Conference.²⁵ The Task Force had to infer their recommendations because plastic surgery patients were not included in the studies that American College of Chest Physicians used to formulate their recommendations. In 2001, the Sixth American College of Chest Physicians Consensus Conference on Antithrombotic Therapy²³ published a comprehensive discussion on deep vein thrombosis prophylaxis that stratified the risk of developing a deep vein thrombosis as low, moderate, high, and highest; within each level of risk are steps labeled A, B, and C. The levels and steps of risk are defined by the patient's age (i.e., <40, 40 to 60, or >60 years), type of surgery (i.e., minor, major, nonmajor, certain orthopedic procedures, and trauma), and additional risk factors (there is a long list of risk factors). Plastic surgery patients were not included in this Consensus Conference. The problem that remains, especially for the plastic surgeon, is how to decide what are major, nonmajor, or minor operations and then assign an arbitrary risk level. The Practice Advisory on Liposuction^{15,26} recommends the intraoperative use of intermittent compression devices and low-molecular-weight heparin for patients at higher risk—but "higher risk" is not defined.

Kaboli et al.²⁷ compiled a deep vein thrombosis prophylaxis options table for specific surgical patients based on the recommendations of the American College of Chest Physicians and a comprehensive review of the literature. The recommendation includes guidance on what modalities can be used as the sole antithrombotic agent/device and those that should be used in combination. Davison et al.¹² developed an algorithm for deep vein thrombosis prophylaxis to be used by plastic surgeons based on risk assignment. The article contains a detailed discussion on risk assignment and detailed information about the different treatment modalities.

Deep Vein Thrombosis Treatment

Treatment strategies for venous thrombosis for the first 24 hours and the following 24 to 72 hours were similar between all three procedure groups (Tables 12 and 13). The survey did reveal some disturbing points about deep vein thrombosis treatment. First, approximately 40 percent or more of total responders for each procedure group failed to indicate what their plan is for the treatment of a deep vein thrombosis. Second, approximately 35 percent of those who did respond chose incorrect or contraindicated treatment plans or would consult another service to manage their patients' deep vein thromboses (approximately 14 percent would consult). When responders to these questions were divided into those who did not use any deep vein thrombosis prophylaxis versus those who used "any" deep vein thrombosis prophylaxis (Table 14), the treatment strategies for a deep vein thrombosis during the first 24 hours were studied and found to be statistically different. Among those surgeons who do not use deep vein thrombosis prophylaxis, a higher percentage of them elected to use a low-molecular-weight heparin treatment compared with those who do use deep vein thrombosis prophylaxis. A much higher percentage of the no deep vein thrombosis prophylaxis group would use an inferior vena cava filter either alone or in combination with something else (32 percent in the no prophylaxis group compared with 6.4 percent in the any prophylaxis group). The percentage of responders who selected an incorrect or contraindicated treatment option (or other) was higher in the no prophylaxis group—approximately 56 percent versus 40 percent in the any prophylaxis group. Inexplicably, a higher percentage of responders in the any prophylaxis group selected no treatment for a deep vein thrombosis.

CONCLUSIONS

The results of this survey indicate that plastic surgeons need to improve their understanding of deep vein thrombosis and its complications so we can provide the best medical care to our patients. The results of this survey do not purport to characterize the incidence of deep vein thrombosis and pulmonary embolism in plastic surgery patients—only the experiences and practices of a few hundred established plastic surgeons.

This survey may be limited by a low response rate and a high percentage of unanswered questions from those who did respond. There is always the unanswered question: Did the surgeon actu-

ally complete the survey or did someone on his or her staff complete it? Is this a true reporting of the surgeon's practice? Assuming that the polled surgeons took the time to complete and return the survey, an unacceptably high percentage of them do not use effective thromboprophylaxis and do not practice established deep vein thrombosis treatment strategies. A fault of this survey design was failing to ask what anesthetic type is used by the surgeon. A surgeon performing a limited face lift or liposuction using sedation and a local anesthetic would not necessarily need to use deep vein thrombosis prophylaxis.

These findings are not unique, and similar attitudes and practices can be found among surgeons of all disciplines.²³ There is a need to learn the true incidence of deep vein thrombosis and pulmonary embolism among plastic surgery patients, to learn what thromboprophylaxis methods are effective and safe, and for all plastic surgeons at large to be cognizant and proactive about deep vein thrombosis prophylaxis and treatment for the safety and benefit of our patients.

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