Pharmacologic and intermittent pneumatic compression thromboembolic prophylaxis in 563 consecutives abdominoplasty cases

Profilaxia tromboembólica farmacológica e por compressão pneumática intermitente em 563 casos consecutivos de abdominoplastia

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ABSTRACT

Background: Abdominoplasty is a common cosmetic surgery and is subject to the same complications as any surgical procedure, including thromboembolic phenomena. The aim of this study was to assess the incidence of complications in consecutive abdominoplasties performed over a 3-year period, to identify risk factors for the complications, and to compare the efficacy of two protocols for prevention of thromboembolism. **Methods:** A retrospective study was conducted of 563 patients who underwent isolated abdominoplasty or abdominoplasty combined with additional cosmetic surgeries between March 2008 and April 2011. All patients received thromboembolism prophylaxis using either pharmacological (enoxaparin; 357 patients) or mechanical (intermittent pneumatic compression, IPC; 206 patients) protocols. **Results:** Of the 563 patients studied, 4 (0.7%) were male (0.7%) and 559 (99.3%) were female. The patients underwent isolated abdominoplasty (201; 35.7%) or abdominoplasty combined with other procedures (362; 64.3%). The patient groups receiving pharmacological and mechanical prophylaxis presented similar demographic and clinical characteristics and had similar risk factors for thromboembolic events. The incidence of complications in the patient groups undergoing pharmacological versus mechanical prophylaxis were: hematoma (5.6% vs. 10.7%), infection (2.2% vs. 2.4%), dehiscence (3.1% vs. 1.9%), seroma (2.2% vs. 2.4%), and deep vein thrombosis/pulmonary embolism (0.6% vs. 0.5%). There were no statistically significant differences in the incidence of complications between the two groups. **Conclusion:** The incidence of complications in 563 consecutive cases of abdominoplasty was similar to that reported in the literature. The pharmacological and mechanical protocols for thromboembolic prophylaxis in abdominoplasty were equally effective.

Keywords: Abdomen/surgery. Venous thrombosis/prevention & control. Plastic surgery.

RESUMO

Introdução: A abdominoplastia é uma das cirurgias estéticas mais realizadas e, como qualquer outro ato cirúrgico, está sujeita a inúmeras complicações, entre as quais os fenômenos tromboembólicos. O objetivo deste estudo foi analisar a incidência de complicações em uma série consecutiva de abdominoplastias, fatores de risco e a eficácia de dois protocolos de prevenção para tromboembolia. **Método:** Estudo retrospectivo de 563 abdominoplastias, isoladas ou não, realizadas entre março de 2008 e abril de 2011, que receberam dois protocolos de profilaxia de tromboembolismo diferentes: o farmacológico, com emprego de enoxaparina (357 pacientes), e o mecânico, com compressão pneumática intermitente (206 pacientes). **Resultados:** Dentre os 563 pacientes, 4 (0,7%) eram do sexo masculino (0,7%) e 559 (99,3%), do sexo feminino. Foram submetidos a abdominoplastia isolada 201

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(35,7%) pacientes, enquanto 362 (64,3%) foram submetidos a abdominoplastia associada a algum outro procedimento. Os grupos com profilaxia farmacológica e mecânica tinham fatores de risco e características demográficas e clínicas semelhantes. Quanto à frequência de complicações, no grupo farmacológico em relação ao grupo mecânico: hematoma, 5,6% e 10,7%; infecção, 2,2% e 2,4%; deiscência, 3,1% e 1,9%; seroma, 2,2% e 2,4%; e trombose venosa profunda/tromboembolia pulmonar, 0,6% e 0,5%. Nenhuma complicação apresentou diferença estatística significante entre os grupos. **Conclusões:** A taxa de complicações em 563 casos consecutivos de abdominoplastia foi semelhante à da literatura. A eficácia da profilaxia tromboembólica em abdominoplastia é a mesma observada com a utilização de métodos farmacológicos e mecânicos isoladamente.

Descritores: Abdome/cirurgia. Trombose venosa/prevenção & controle. Cirurgia plástica.

INTRODUCTION

All surgical procedures, including plastic surgery, carry the potential for complications such as infections, dehiscence, seroma, hematoma, scarring, thrombosis, embolism, and death. The incidence of complications from cosmetic surgery has been reported to be as high as 37%, although the vast majority of cases are not considered serious[1]. Given this, it is essential that patients are informed that complications can occur in until 25% of the cases[2], and that it may be necessary to perform additional minor surgery to achieve the best aesthetic result (for example, to diminish unsightly scars and skin excess).

With the exception of death, the most troubling complication for plastic surgeons is thromboembolic events, which include deep venous thrombosis (DVT), pulmonary thromboembolism (PTE), and post-thrombotic syndrome[3]. In general surgery, the incidence of DVT varies from 16 to 30%[4], the incidence of clinical manifestations of PTE is 1.6%, and death occurs in 0.1–0.8% of all surgeries[5]. PTE is considered the most preventable cause of death in hospitalized patients[6].

Abdominoplasty is the most common cosmetic surgery and was first described at the end of the 19th century[7]. Since then, abdominoplasty has undergone several modifications such as liposuction, mini-abdominoplasty, conventional abdominoplasty, and lipo-abdominoplasty; these changes have improved the aesthetic result and decreased the incidence of complications[8]. The risk of complications from plastic surgery is increased by several risk factors such as obesity (BMI >30), systemic arterial hypertension (SAH), diabetes, smoking, patients undergoing bariatric surgery, surgical time, and combined surgeries[1,9,10]. The first complications related to abdominoplasty were described by Grazer and Goldwyn[11], who reported incidences of 7.3% for infection, 5.4% for dehiscence, and 1.1% for DVT in a survey of surgeries performed by 958 surgeons on 10,490 patients.

As described in 1859 by the German physician Rudolf Virchow, thromboembolic events are caused by the combination of three factors: blood stasis, hypercoagulability, and endothelial damage[12]. Usually, DVT develops in the deep veins of the calf and can occur proximally to deep veins in up to 20% of cases, representing a serious risk in such patients[13]. About 50% of proximal DVT are associated with PTE, and 10% of these are fatal[14]. Therefore, prophylactic measures, early diagnosis, and appropriate treatments are essential to avoid tragedy in patients undergoing elective cosmetic surgery, who are usually healthy.

The typical signs of DVT include increased temperature, edema, severe calf pain, dilation of superficial veins, color change, and exacerbation of symptoms on lowering of the leg. The definitive diagnosis of DVT is made with Doppler ultrasound or lower limb venography. The diagnosis of PTE is suggested by symptoms such as dyspnea, ventilatory-dependent chest pain, and orthopnea (normally associated with DVT), and is confirmed by additional tests such as pulmonary scintigraphy and chest angiotomography.

Several options exist for thromboembolic prophylaxis, including early ambulation, pharmacological prophylaxis, or the use of physical interventions such as compression stockings, intermittent pneumatic compression (IPC), or vena cava filters[15,16]. Prophylactic measures have been highly successful in reducing the incidence of thromboembolic complications, although their individual mechanisms of action remain controversial. It is logical to think that IPC acts exclusively by physically increasing venous return and decreasing blood stasis[17]. However, studies have shown that IPC also lowers hypercoagulability by decreasing concentrations of inhibitors of plasminogen activation[18,19], and this effect is enhanced when IPC is combined with pharmacological therapy[20].

According to the literature, the incidence of DVT was reduced by 60%[21] in patients undergoing IPC, 69% in patients receiving unfractionated heparin, and 78% in patients receiving low molecular weight heparin[22]. A recent meta-analysis suggests that mechanical and pharmacological therapies are more effective than isolated measures in preventing DVT and

PTE in high-risk patients[23]. However, another meta-analysis failed to show that isolated mechanical prophylaxis reduced the incidence of DVT or PTE in patients with acute hemorrhagic cerebrovascular accident[24]. Nevertheless, mechanical prophylaxis should always be encouraged because no risk of bleeding or other contraindications have been identified[25].

Drug prophylaxis has been reported to decrease the incidence of thromboembolic events following surgery by up to 70%[26], although some studies suggest that it also increases the incidence of hematomas by up to 8%[27], especially when large volumes and masses are removed[28]. The most commonly prescribed drugs for thromboembolic prophylaxis are warfarin, heparin and its derivatives, and antiplatelet medication. Warfarin is the most effective anticoagulant but there are several disadvantages to its use, such as the need to monitor blood levels, difficulty in reversing its effects, and the high rate of hematomas[29]. Antiplatelet medications, particularly acetylsalicylic acid, also play a role in the prevention of thromboembolic events, although to a lesser extent than heparin[29]. When used in conjunction with IPC devices, however, acetylsalicylic acid has the same antithromboembolic efficacy as heparin[30]. Although they are associated with bleeding complications, unfractionated and fractionated heparins are the most studied anticoagulants and the most commonly used in daily practice[31].

The first large study of complication rates for abdominoplasties performed in the United States was published in 2009[32]. The analysis used the national databases TOPS (database of the American Society of Plastic Surgery) and CosmetAssure (database of the insurers) to evaluate 20,970 abdominoplasties performed in combination with other surgeries and 10,660 isolated abdominoplasties[32]. The most prevalent complications in this study were hematomas (0.5%–0.9%), DVT/PTE (0.1–0.4%), and infections (0.3–3.5%), although the incidences varied between the databases and among the combined and isolated surgeries. The importance of these data lies in their reflection of "real life" practices, because there was no bias for academic environments, individual surgeons, or single institutions[32]. These types of bias have been observed in studies of other procedures; for instance, carotid endarterectomy surgery[33].

Few studies in the literature address the incidence of DVT and PTE in patients undergoing plastic surgery, regardless of the type of procedure performed[34]. Surprisingly, the fact that these complications carry a high risk of morbidity and mortality does not make surgeons less resistant to the use of prophylactic measures. This resistance appears to derive from the assumption that prophylactic measures may cause higher incidences of hemorrhagic complications or that complications such as DVT and PTE are too rare to be of concern[35]. Studies in the United States show that 25.2% of surgeons do not recommend any form of prophylaxis in patients undergoing liposuction or abdominoplasty, and 18.4% do not recommend prophylaxis in patients undergoing facelifts[34,36]. In contrast, we have developed specific prophylaxis protocols that are implemented in many hospitals and clinics in Brazil, including at the Ivo Pitanguy Clinic since 2007[37].

As part of an attempt to stratify the risk of a patient developing DVT/PTE, we created protocols to guide the decision to administer prophylaxis and to select the best therapeutic option for each individual case. A previous study attempted to define the need for drug prophylaxis by identifying risk factors for thromboembolic events[38]. For plastic surgery in Brazil, one of the most common protocols is based on the work of Anger et al.[38], in which points are assigned to known risk factors for thromboembolic events, and drug prophylaxis is recommended based on the total scores. The risk factors are shown in Clinical Features 1. Patients with scores of ≤1 are considered at low risk for thromboembolic events and do not require prophylaxis. Patients with scores between 2 and 4 are considered at moderate risk, and those with scores of ≥5 are at high risk. Pharmacological prophylaxis is indicated for all patients with scores ≥2.

For abdominoplasty, the incidence of PTE and DVT has been reported to range from 0.34% to 1.1%[11,39-41] for PTE and 0.1% to 0.34%[3,32,40] for DVT. Several risk factors predispose to DVT, the most relevant being obesity (BMI >30)[42]. In practice, all patients undergoing abdominoplasty are considered at least at moderate risk (1 point for surgery of more than 60 minutes duration and 1 point for the surgery itself). Therefore, all patients submitted to abdominoplasty should receive thromboembolic prophylaxis.

Several protocols exist for PTE/DVT prevention, such as the protocols of Davison-Caprini[43] (commonly used in the

Chart 1 – Risk factors for deep venous thrombosis and pulmonary thromboembolism.

Clinical	Points	Surgical	Points
Age >60 years	2	Surgery >60 minutes	1
BMI >30	1	Fowler position	1
Neoplasia	2	Abdominal or leg dermolipectomy	1
Smoker	1	Liposuction	1
Previous immobilization > 24 horas	2	Calf or gluteal prosthesis	1
Venous insufficiency	2	Combined cosmetic surgery	1
Previous DVT or PTE	2	Breast reconstruction	1
OC or HRT	1		

BMI = body mass index; HRT = hormone replacement therapy; OC = oral contraceptive.

United States), Sandri[44], and the modified version of Sandri[45] (more common in Brazil and very similar to the protocol of Anger). The Davison-Caprini protocol recommends high-risk patients receive 40 mg enoxaparin delivered subcutaneously at 12 hours after surgery. Several studies have attempted to improve the Davison-Caprini protocol by taking into consideration additional plastic surgery-related risk factors, such as the use of hormone replacement therapy (HRT) and oral contraceptives (OC), BMI >30, and circumferential abdominoplasty[46]. The protocol of Sandri[44] recommends that moderate- and high-risk patients receive the same pharmacological prophylaxis as in the Davison-Caprini protocol. A significant difference between the two protocols is that the protocol of Sandri[44] includes risk factors common to cosmetic surgeries, such as the Fowler position, abdominal or crural dermolipectomy, gluteal and calf implants, combined cosmetic surgery, and liposuction. The modified protocol of Sandri[45] includes 3 risks factors (general anesthesia, malignancy, bed rest of >72 hours) and recommends pharmacological prophylaxis for high-risk patients only, starting 12 hours after the procedure[45]. It is interesting to note that these three protocols have a degree of recommendation of two, and a level of evidence of C[47], the highest score that can be given to studies that are not randomized and controlled.

Although abdominoplasty has a low mortality rate overall, the leading cause of death from this surgery is PTE. However, the relationship between PTE and abdominoplasty has still to be elucidated by surgeons[48]. Compared to other plastic surgeries, there are abdominoplasty-specific procedures that might be considered additional risk factors for PTE, such as plication of the abdominal muscles with increased intra-abdominal pressure, or development of abdominal compartment syndrome[49]. This effect might also be caused by the use of tight elastic compressive meshes[50].

Because there is little literature on the relationship between abdominoplasty and thromboembolic events, we analyzed several characteristics of a patient population who underwent abdominoplasty from March 2008 to April 2011, including the complications from surgery, in particular thromboembolic events, and the possible risk factors. We also analyzed the incidence of complications in surgeries using two different protocols for thromboembolism prevention; one pharmacological and one mechanical.

METHODS

A retrospective study was carried out by analyzing the medical records of all patients undergoing consecutive abdominoplasty between March 2008 and April 2011. The cases included patients undergoing abdominoplasty either alone or in combination with other procedures. No patients were excluded from the analysis.

The patients were categorized as those who underwent pharmacological thromboembolic prophylaxis alone or those who underwent mechanical prophylaxis with IPC alone. No patients received combined therapy.

According to the classification published by Anger et al.[38], all patients undergoing abdominoplasty have at least a moderate risk of thromboembolic events (score ≥2). Therefore, all patients received prophylaxis.

Patients operated on between March 2008 and April 2010 received pharmacologic therapy, and those operated on between May 2010 and April 2011 received mechanical therapy with IPC.

For drug prophylaxis, enoxaparin (Clexane®) was administered at a dose of 0.5 mg/kg body weight, starting 12 hours after surgery and continuing once a day until the patient was ambulatory. For mechanical prophylaxis with IPC, pneumatic compression of feet and calves was performed (DVT Phlebopress®) with pressure varying between 50 and 60 mmHg, starting before the induction of anesthesia and continuing until the patient was ambulatory.

The surgical technique employed was a typical abdominoplasty with horizontal incision above the pubic hair, detachment of the aponeurosis to the xiphoid appendix, plication of the rectus abdominis muscles, repositioning of the umbilical scar, drainage with closed system vacuum, lipectomy of the abdominal flap, and synthesis of the skin by planes. In specific cases, liposuction of the epigastric region and flanks was performed, as indicated by aesthetics.

Statistical analysis was carried out using IBM SPSS software version 19.0. The data were analyzed using two-tailed tests with the level of significance set at $P < 0.05$.

This work was approved by the Ethics Committees of the hospitals where the surgeries were performed.

RESULTS

Between March 2008 and April 2011, 563 patients underwent abdominoplasty, 4 (0.7%) of which were males and 559 (99.3%) females.

Table 1 provides the details of patient age, weight, height, and BMI, as well as the weight of the excised abdominal flap and surgery time.

All patients (n=357) undergoing abdominoplasty between March 2008 and April 2010 received pharmacological thromboembolic prophylaxis, and patients operated on between May 2010 and April 2011 (n=206) received mechanical prophylaxis with IPC. The descriptive statistics of the two groups is presented in Tables 2 and 3.

Analysis of the data in Tables 2 and 3 shows non-parametric distribution of the patient populations. Using the Mann-Whitney U test to compare the groups receiving pharmacological and IPC prophylaxis, there were no significant differences in age ($P = 0.089$), weight ($P = 0.971$), height

($P = 0.811$), weight of tissue removed ($P = 0.545$), or surgery time ($P = 0.087$).

The patient risk factors that we considered might predispose to complications, especially thromboembolic events, included undergoing combined surgery, surgery time, obesity (BMI >30), and a history of smoking. Of the 563 patients, only 201 (35.7%) underwent isolated abdominoplasty, whereas 362 (64.3%) underwent abdominoplasty combined with other procedures (Table 4). The types of combination surgeries performed were similarly distributed in the patient groups receiving pharmacological and mechanical IPC prophylaxis (Figures 1 and 2).

The distributions of risk factors for thromboembolic events in the general population and in the two treatment groups are shown in Table 5. There was only one significant difference in risk factors between the groups, with a higher frequency of OC use in the group subjected to ICP prophylaxis (chi-square test; $P = 0.012$). No other significant differences in risk factors were detected (chi-square test; smoking, $P = 0.754$; previous bariatric surgery, $P = 0.299$;

Table 1 – Patient clinical and demographic characteristics.

Variable	n = 563			
	Minimum	Maximum	Average	Standard deviation
Age (years)	21	71	39.7	8.834
Weight (kg)	48	130	71.55	12.401
Height (cm)	148	184	162.72	6.034
BMI (kg/m^2)	17.93	52.07	27.0272	4.51793
Weight of the flap (g)	650	9200	1439.69	598.280
Surgery time (min)	55	240	133.04	40.018

BMI = body mass index; n = number of patients.

Table 2 – Clinical and demographic characteristics of patients undergoing pharmacological prophylaxis.

Variable	n = 357			
	Minimum	Maximum	Average	Standard deviation
Age (years)	24	71	40.35	8.829
Weight (kg)	50	130	71.43	12.211
Height (cm)	148	184	162.75	5.980
BMI (kg/m^2)	17.93	52.07	26.9731	4.43736
Weight of the flap (g)	650	9200	1422.82	573.049
Surgery time (min)	55	240	135.30	41.267

BMI = body mass index; n = number of patients.

Table 3 – Clinical and demographic characteristics of patients undergoing ICP prophylaxis.

Variable	n = 206			
	Minimum	Maximum	Average	Standard deviation
Age (years)	21	64	38.58	8.750
Weight (kg)	48	116	71.75	12.751
Height (cm)	148	178	162.67	6.142
BMI (kg/m^2)	18.42	46.47	27.1211	4.66371
Weight of the flap (g)	800	7000	1468.93	640.040
Surgery time (min)	55	200	129.13	37.533

BMI = body mass index; n = number of patients.

mental disorders, $P = 0.164$; endocrine disorders, $P = 0.430$; SAH, $P = 0.809$; neoplasia, $P = 0.282$; and previous DVT/PTE, $P = 0.187$).

No patient had venous insufficiency, previous immobilization exceeding 24 hours, breast reconstruction, or gluteal or calf prostheses, which are common risk factors for developing thromboembolic events according to the studies of Anger et al.[38].

Only three patients were in surgery for less than 60 minutes (two in the pharmacological prophylaxis group and one in the ICP group). However, all three patients were using OC and one was a smoker, which placed them at moderate risk and indicated the use of DVT/PTE prophylaxis.

Only the group subjected to pharmacological prophylaxis contained patients with two serious risk factors for the occurrence of thromboembolic events; namely, the presence of neoplasia (2 patients) and previous DVT or PTE (3 patients). However, none of these patients developed new thromboembolic events after surgery, demonstrating the efficacy of the prophylaxis.

We also studied the correlation between thromboembolic events and the presence of some risk factors not generally considered to increase the incidence of DVT/PTE, including SAH, previous bariatric surgery, mental disorders (depression, anxiety, epilepsy), and endocrine disorders (diabetes mellitus, hypothyroidism). Among these risk factors, only the presence of previous bariatric surgery has previously been associated with an increased risk for thromboembolic events.

The incidence of post-operative complications in the general population and in groups undergoing pharmacological and ICP prophylaxis is shown in Table 6. Using chi-square analysis, no significant differences were observed between the two groups in the incidence of any complication: infection, $P = 0.977$; seroma, $P = 0.977$; DVT/PTE, $P = 0.991$; dehiscence, $P = 0.716$; and hypertrophic or keloid scar, $P = 0.568$. The only complication showing a difference, albeit not statistically significant (chi-square; $P = 0.080$), was the higher occurrence of hematoma in the ICP prophylaxis group. Despite the lower incidence of hematomas in the pharmacological prophylaxis group, the severity of the hematomas was higher. Thus, of the 20 hematomas observed in the pharmacological prophylaxis group, 6 required surgical re-intervention and 2 patients required blood transfusions. In contrast, only 2 of the 22 hematomas occurring in the ICP prophylaxis group required surgical re-intervention and neither patient required blood transfusion.

Two unusual complications were observed in the group subjected to pharmacological prophylaxis; severe pulmonary atelectasis, and intussusception and volvulus of the

Table 4 – Patients undergoing isolated or combined abdominoplasty.

Surgery	n	Percentage
Isolated	201	35.7
Mastoplasty	212	37.7
Breast prosthesis	119	21.0
Liposuction (other areas)	10	1.8
Lifting of arms or legs	9	1.6
Facial surgeries	11	2
Others	1	0.2
Total	563	100

n = number of patients.

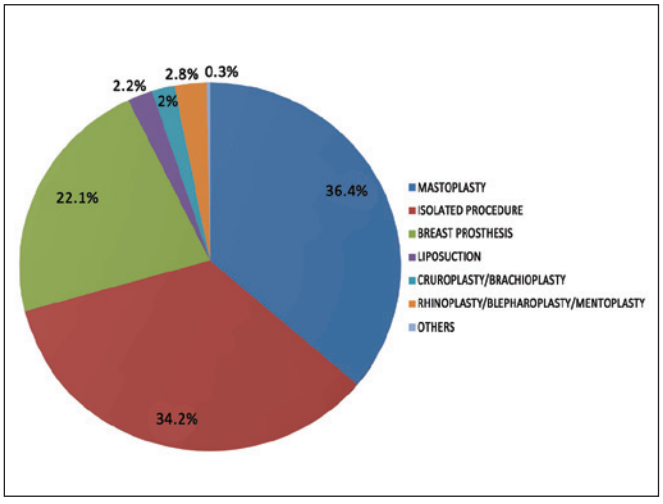

Figure 1 *– Distribution of combined surgeries in the population undergoing pharmacological prophylaxis.*

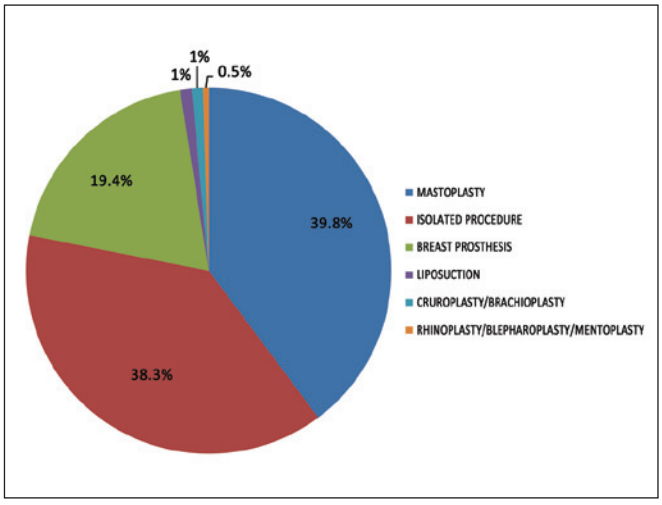

Figure 2 *– Distribution of combined surgeries in the population undergoing ICP prophylaxis.*

Table 5 – Distribution of risk factors.

Risk factor	Drug prophylaxis (n = 357)		ICP prophylaxis (n = 206)		Total population (n = 563)	
	n	%	n	%	n	%
OC or HRT	71	19.9	24	11.7	95	16,9
Smoking	32	9	16	7.8	48	8,5
Bariatric surgery	4	1.1	5	2.4	9	1,6
Mental disorder	5	1.4	–	–	5	0,9
Endocrine disorder	13	3.6	5	2.4	18	3,2
SAH	28	7.8	15	7.3	43	7,6
Neoplasia	2	0.6	–	–	2	0,4
Previous DVT or PTE	3	0.8	–	–	3	0,5
BMI >30	70	19.6	50	24.3	120	21,3
Age >60 years	8	2.2	6	2.9	14	2,5
Combined surgeries	235	65.8	127	61.7	362	64,3

BMI = body mass index; DVT = deep venous thrombosis; HRT = hormone replacement therapy; n = number of patients; OC = oral contraceptive; PTE = pulmonary thromboembolism.

Table 6 – Distribution of complications.

Complication	Drug prophylaxis (n = 357)		ICP prophylaxis (n = 206)		Total population (n = 563)	
	n	%	n	%	n	%
Hypertrophic or keloid scar	31	8.7	14	6.8	45	8
Hematoma	20	5.6	22	10.7	42	7.5
Seroma	8	2.2	5	2.4	13	2.3
Infection	8	2.2	5	2.4	13	2.3
Dehiscence	11	3.1	4	1.9	15	2.7
DVT or PTE	2	0.6	1	0.5	3	0.5
Severe atelectasis	1	0.3	–	–	1	0.2
Intussusception or cecal volvulus	1	0.3	–	–	1	0.2

DVT = deep venous thrombosis; n = number of patients; PTE = pulmonary thromboembolism.

cecum. In the first case, the patient required admission to the intensive care unit for clinical pulmonary compensation. After examination and evaluation by the thoracic surgery and pneumology team, the possibility of PTE was excluded and the patient was treated for severe pulmonary atelectasis, with complete resolution of symptoms. In the case of intussusception and volvulus of the cecum, the patient showed signs of acute intra-abdominal pathology 30 days after abdominoplasty and imaging examinations suggested the diagnosis of intussusception and volvulus of the cecum. The patient underwent exploratory laparotomy using the previous abdominoplasty incision and the suspected condition was confirmed by visual examination. The case achieved a good outcome. This complication, although rare, has previously been associated with abdominoplasty[51].

The three patients experiencing DVT or PTE all recovered. These patients had undergone abdominoplasty combined with other cosmetic surgeries and had thromboembolism risk scores of ≥5, making them high risk. In the pharmacological prophylaxis group, one patient had isolated DVT and the second had DVT followed by moderate PTE, which required intensive care measures. The single patient in the ICP prophylaxis group had DVT followed by mild PTE, which did not require intensive therapy. No patient developed post-thrombotic syndrome and there were no deaths.

DISCUSSION

Plastic surgery is an easy target for criticism in the media and is the subject of many legal battles. Many people consider that because it is elective, cosmetic surgery should be free of complications and should achieve pleasing results regardless of the procedure employed. Moreover, the expectations of the patient should always be met as stated in the Consumer Protection Code. These interpretations, in addition to being misleading, question the medical and scientific knowledge on which the specialty is based, and make plastic surgeons easy prey for the media and legal system. Every surgery has the potential for complications, as amply demonstrated in the world medical literature. The cases presented in this work are no different.

Apart from patient mortality, the greatest concern of surgeons is the occurrence of thromboembolic events, which is considered to be the Achilles heel during this type of surgery. The pathophysiology of these phenomena was described by Virchow, who assigned blood stasis, damage to the endothelium, and hypercoagulability as the primary factors in thrombosis. All three factors can be exacerbated by surgery, abdominoplasty in particular, due to the prolonged immobilization, surgical position, damage to the endothelium, and production of procoagulant factors (cytokines and hormones)[13,52]. Several additional risk factors such as smoking, obesity, venous insufficiency, neoplasia, age, and duration of surgery may further increase the possibility of developing thromboembolic events[38,43].

This study presents a retrospective analysis of 563 patients who underwent abdominoplasty in combination with either pharmacological (enoxaparin) or mechanical (ICP) prophylaxis for the prevention of thromboembolic events. Several prophylaxis protocols already exist, usually pharmacological, and should be recommended to all patients undergoing abdominoplasty because the surgical time and post-operative position constitute a moderate risk of thromboembolic events[38,43]. However, plastic surgeons have shown strong resistance to perform pharmacological prophylaxis. Studies show that up to 25% of plastic surgeons do not recommend any type of prophylaxis for patients undergoing abdominoplasty[34], either because they fear hemorrhagic complications or consider thromboembolic events too rare to be of concern[34]. Thus, it is important to develop protocols and safety guidelines for prophylaxis of thromboembolism in patients undergoing abdominoplasty[53].

It is interesting to note that in the present study, 64.3% of abdominoplasties were performed in combination with other cosmetic procedures. This practice is increasingly common in plastic surgery because it is more convenient for both the doctor and patient. However, combination surgery increases the occurrence of thromboembolic events[54]; not only should this be explained to the patient, but it should also mandate the use of DVT and PTE prophylaxis.

The complications found in this study were hypertrophic scar or keloid (8.0%), hematoma (7.5%), seroma (2.3%), infection (2.3%), dehiscence (2.7%), and DVT/PTE (0.5%). We also observed a case of severe pulmonary atelectasis requiring intensive support, and a case of intussusception and volvulus of the cecum, which has been previously described and associated with abdominoplasty[51].

The previously reported incidences of these complications following abdominoplasty are: keloid or hypertrophic scars 5–16%[55-57], hematomas 0.5–8.0%[2,32,37,58], seroma 1.0–8.0%[3,26], infection 2.2–7.3%[11,32], dehiscence 0.7–5.4%[3,11], and DVT/PTE 0.5–1.1%[11,32,39]. However, the incidence of DVT/PTE can reach 6.6% when abdominoplasty is combined with other procedures[59].

The data presented in this study are consistent with those in the literature, except that we observed a higher incidence of hematoma in the ICP prophylaxis population (10.7%). In contrast, the rate of hematoma in the pharmacological prophylaxis group (5.6%) was similar to that reported in the literature. The incidence of bleeding and hemorrhagic complications is known to be increased by pharmacological prophylaxis[31], but not by mechanical prophylaxis[17,19] as was observed in our study. We cannot explain the higher incidence of hematoma in the ICP prophylaxis group, although it should be noted that the incidence between the two groups was not statistically different (chi-square; $P = 0.08$). Moreover, the bleeding complications in the pharmacological prophylaxis group were more severe and required more frequent surgical re-intervention and hemotherapy, demonstrating an advantage to the use of ICP mechanical prophylaxis.

The incidence of thromboembolic events in our study was 0.6% in the pharmacological prophylaxis group, 0.5% in the ICP prophylaxis group, and 0.5% in the general population, which is similar to the literature worldwide[3,11,32]. The results show that thromboembolic complications do occur following abdominoplasty, albeit at low incidence. The high rates of morbidity and mortality associated with these events necessitates that prophylactic measures should be taken for every surgery.

This is the first report to compare pharmacological and mechanical protocols for prophylaxis of thromboembolic events in patients undergoing plastic surgery, and specifically abdominoplasty. We found that the prophylactic methods were equally effective in preventing DVT/PTE, and either one can be used in isolation for this purpose.

CONCLUSION

The incidence of complications observed in this study is similar to that reported in the literature. ICP mechanical prophylaxis is as effective as pharmacological prophylaxis in preventing thromboembolic events in patients undergoing abdominoplasty. Although the incidence of hemorrhagic

phenomena was the same in both groups of patients, the events were less severe in patients receiving ICP mechanical prophylaxis.

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