Aesth. Plast. Surg. 28:412–416, 2004
DOI: 10.1007/s00266-004-0021-9

Aesthetic Plastic Surgery

Abdominoplasty: Thromboembolic Risks for Both Sexes

Giuseppe Ferraro, Roberto Grella, and Francesco D'Andrea

Napoli, Italy

Abstract. During surgical procedures, coagulation complications may occur. Discriminating factors are multiple and may vary because of the anatomical regions involved and because of preexisting diseases. The aim of this study was to analyze changes in such hematological parameters of patients undergoing conventional abdominoplasty with standard surgical procedures under general anaesthesia.

For the study, 40 patients (20 men and 20 women) 30 to 60 years with normal coagulation assessments, no previous or current history of hemorrhagic or thrombotic disease, and no primary family history of such problems were selected. All the patients underwent conventional abdominoplasty surgical procedures.

Analysis of the results suggests that immediately after surgery, in the absence of any preexisting hypo- or hypercoagulability state, there was no circumstantial modification in coagulation factors considered predictive for thromboembolic risk. However, an interesting difference between male and female patients was noted. In the male group, there was an insignificant uniform downward trend of all values immediately after surgery.

In conclusion, women are less hypercoagulative than men in the postoperative period, suggesting that women have limited protection from the development of thromboembolic complications immediately after surgical procedures.

Key words: Abdominal dermolipectomy—Abdominoplasty—Hypercoagulability state—Plastic surgery—Surgical risk—Thromboembolic risk

During surgical procedures, coagulation complications may occur. Discriminating factors are multiple and may vary because of the anatomic regions involved and because of preexisting diseases (e.g., hepatopathies, nephropathies, collagen diseases, and hematologic disorders [7,22]. In the literature of many branches of surgery, the reported results often are sketchy and contrasting [13,19]. However, the thromboembolic risk in plastic surgery is largely not known. Clearly, such risks rise in the presence of hypofibrinolysis and hypercoagulability. In fact, numerous studies have reported that patients need adequate prophylaxis, and it is important to obtain information such as prothrombin time (PT), activated partial thromboplastin time (aPTT), fibrinogen, antithrombin III, and protein C [4,29].

Correspondence to Giuseppe Ferraro, Via Campiglione 18, 80100, Napoli, Italy; *email:* gaferraro@libero.it

Prothrombin Time Test

The PT test is used to show possible deficiencies, congenital or acquired, of coagulation factors from the extrinsic pathway (VII, X, V, prothrombin, fibrinogen) and the common pathway.

Activated Partial Thromboplastin Test

The aPTT test is used to measure the different coagulation factors of the intrinsic pathway (XII, XI, IX, VIII) and the common pathway (X, V, II, I). The test is of clinical importance because it effectively diagnoses coagulation disorders and is important for therapeutic monitoring of thromboembolic hemorrhagic states. Longer PT an aPTT times indicate an elevated hemorrhagic risk, and vice versa, a shortened PT or aPTT is indicative of a higher thromboembolic risk [10,25].

Antithrombin III Evaluation Test

Antithrombin III (ATIII) is a plasmatic protein synthesized by hepatocytes and endothelial cells. *In vitro* ATIII activity is strengthened by heparin. *In*

Table 1. Age Distribution of Patients

Age (years)	No. of patients	%
30–41	16	40
41–50	8	20
51–60	16	40
Total	40	100

vivo, some proteins with an heparin-like activity (located in the endothelial wall) are capable of strengthening the activity of ATIII. Antithrombin III represents one of the physiologic coagulation inhibitors by deactivating serum proteases (thrombin, aXII, aXI, aIX, aX) which have procoagulate properties. A deficiency in ATIII levels (associated with hepathopathies, DIC, burns, renal dropsy) results in a higher risk of thromboembolisms.

Protein C Evaluation Test

The inactive plasmatic form of protein C is hepatically synthesized. It is activated by thrombin and then specifically modulates the endothelial cofactor thrombomodulin [12]. Protein C inhibits the active forms of factors V and VIII, as well as procoagulative platelet activity. Protein C stimulates fibrinolysis. A reduction in protein C plasma levels (e.g., in cases of hepathopathy) may largely increase thromboembolic risks [6,18].

The aim of this study was to analyze changes in hematologic parameters among patients undergoing conventional abdominoplasty using standard surgical procedures under general anesthesia at the time of admission and 7 days after surgery. We aimed to underscore the influence of surgical actions on coagulation activity by quantifying thromboembolic risks. Abdominoplasty is commonly considered a plastic surgery procedure with a high thromboembolic risk [15,27,31].

Materials and Methods

For this study, 40 patients (20 men and 20 women ages), 30 to 60 years, with normal coagulation assessments, no previous or current history of hemorrhagic or thrombotic disease, and no primary family history of such problems were selected (Table 1).

All the patients underwent conventional abdominoplasty surgical procedures with umbiliculus transposition and cutaneous adipose tissue excision ranging from 1,200 to 2,000 g. The patients were mobilized for 24 h after surgery and discharged after 72 h with antibiotic therapy.

The patients were divided into two groups according to gender. Blood samples for PT, aPTT, fibrinogen, ATIII, and Protein C levels were taken from the cephalic vein 1 day before the surgical procedure and 7 days afterward. The samples were collected in test tubes with 3.8% sodium citrate.

Prothrombin time was measured using coagulative and nonchromogenic methods with recombinant partial thromboplastin reagent base (RecombiPlastin-Instrumentation Laboratory Company, Lexington, MA, USA) to calculate the time required for clot formation. Thromboplastin is capable of activating the extrinsic coagulation pathway. Thus, a deficiency results in prolonged clotting times. Levels of PT are expressed in percentage of activity (normal values, 80–120%) [4].

Activated partial thromboplastin was calculated using coagulative methods. This test measures the time required for clot formation when citrated plasma is recalcified after incubation with activated substances (phospholipid platelet-like mixture). Normal times were 25 to 35 s.

Fibrinogen was calculated using a known concentration of recombined thrombin in citrated plasma and the time necessary for clot formation (normal values, 200–400 mg/dl).

Protein C was calculated using chromogenic techniques after activation with reptile poison derivatives (Electrachrome Protein C-Instrumentation Laboratory Company, Lexington, MA, USA). The protein C value is expressed as a percentage of activity taken from a calibration curve with a plasma or reference standard [5,23].

Antithrombin III was measured in the presence of heparin. Plasma dilution was tested with a fixed time for thrombin in excess. The residual thrombin quantity was inversely proportional to the ATIII plasma activity. The ATIII value is expressed as a percentage of activity taken from a calibration curve with a plasma or reference standard (normal range, 80–120%) [14].

All the values obtained were interpreted for each parameter, and the following statistical data were calculated: medium, standard derivation, and significance test [28].

Presurgical Evaluations

Presurgical values allowed us to categorize a group of patients without alterations to the assessment parameters. Independent of gender and admission diagnosis, individual values were normally ranged. Notwithstanding normal data ranges, values obtained from male patients at t0 were moderately higher than those for females (Tables 2, and 3).

Postoperative Evaluations

Each patient underwent blood sampling 7 days after the surgical procedure (t7). No patients were under-

Table 2. Admission T0 coagulative parameters in male patients

	Mean ± SD
PT (%)	104.31 ± 12.05
aPTT (sec)	28.49 ± 3.68
FIBR (mg/dl)	340.56 ± 103.25
ATIII (%)	110.66 ± 20.40
PC (%)	135.57 ± 28.68

PT, prothrombin time; aPTT, activated partial thromboplastin time; FIBR, fibrinogen; ATIII, antithrombin III; PC, protein C

Table 3. Admission T0 coagulative parameters in female patients

	Mean ± SD
PT (%)	100.02 ± 15.33
aPTT (sec)	31.44 ± 3.80
FIBR (mg/dl)	361.10 ± 125.38
ATIII (%)	98.90 ± 2.45
PC (%)	103.0 ± 20.74

PT, prothrombin time; aPTT, activated partial thromboplastin time; FIBR, fibrinogen; ATIII, antithrombin III; PC, protein C

going therapy with anticoagulants or other drugs capable of interfering with coagulation mechanisms. A statistical significance test was performed for each of the reported results (Tables 4, 5, and 6).

Discussion

A detailed analysis of coagulation parameters allowed us to identify patients at high risk for thrombosis or hemorrhaging. Such analysis also allows for adequate prophylaxis and therapy even for patients with no history of elevated coagulative risks [20,29]. Silent coagulation disorders often are exposed during surgical procedures, whereas many thromboembolic manifestation often are not noticed clinically or statistically [20]. The incidence of profundae vein thrombosis, together with its most common sequel, pulmonary embolism, is elevated after surgical operations, notwithstanding variations of incidence attributable to diverse anatomic locations of the procedure, the type of operations performed, undergone and individual preexisting (individual) conditions [19] (Table 7).

Several studies have demonstrated that the thromboembolic risk for the general population exponentially increases with age [17,24], but more precisely, such risk increases when risk factors are present or after particular surgical procedures (Table 8) [30].

Table 4. Postoperative (T7) coagulative parameters in male patients

	Median
PT (%)	97.46 ± 8.05
aPTT (sec)	25.00 ± 9.94
FIBR (mg/dl)	305.00 ± 64.90
ATIII (%)	101.25 ± 3.68
PC (%)	117.77 ± 24.09

PT, prothrombin time; aPTT, activated partial thromboplastin time; FIBR, fibrinogen; ATIII, antithrombin III; PC, protein C

Table 5. Postoperative (T7) coagulative parameters in female patients

	Median
PT (%)	104.30 ± 16.09
aPTT (sec)	30.30 ± 4.41
FIBR (mg/dl)	411.10 ± 127.07
ATIII (%)	101.38 ± 2.35
PC (%)	125.65 ± 14.31

PT, prothrombin time; aPTT, activated partial thromboplastin time; FIBR, fibrinogen; ATIII, antithrombin III; PC, protein C*correct?*

Table 6. Comparison of Pre- and Postoperative Results (t0/t7)

Male Patients[a]	
PT (%)	Slightly decreased
aPTT (sec)	Slightly decreased
FIBR (mg/dl)	Moderately decreased
ATIII (%)	Slightly decreased
PC(%)	Slightly decreased
Female Patients[b]	
PT (%)	Slightly decreased
aPTT (sec)	Slightly decreased
FIBR (mg/dl)	Moderately increased
ATIII (%)	Slightly increased
PC (%)	Moderately increased

[a]Evaluation of examined results in male patients (t0/t7)
[b]Evaluation of examined results in female patient (t0/t7)
PT, prothrombin time; aPTT, activated partial thromboplastin time; FIBR, fibrinogen; ATIII, antithrombin III; PC, protein C

In our patient group, the analysis of coagulation parameters allowed us to identify patients with thrombotic and hemorrhagic risks, independently of others risk factors, that could influence the thromboembolic event during surgical procedures. None of the parameters, whether measured before or after surgery, varied significantly from the physiologic range. The statistical significance test (t test) confirmed this data (0.03, 30%). These data suggest that

Table 7. Incidence of thromboembolisms after surgery

	%
Elective iliac surgery	60–70
Traumatic iliac surgery	45–70
General surgery	25–40
Urologic surgery	20–40
Neurosurgery	10–50
Gynecologic surgery	7–45
Colorectal surgery	35–70
Transurethral surgery	5–10
Maxillofacial surgery	45–55

Table 8. Thromboembolic risk factors, according to the consensus group 30]

Relevant patient factors	Preexisting diseases or particular surgical procedures
Age	Extended bone traumatology
Obesity	Traumatologic surgery
Varicose veins	Pelvic surgery
No mobilization	Malignant neoplasm
Pregnancy	Heart failure
Puerperium	Previous myocardial infarction
High-dose estrogen therapy	Inferior limb paralysis
Previous DTVoEP	Serious infections
Thrombophilia	Renal dropsy
ATIII, PC, PS deficiencies	Paraproteinemia
Antiphospholipid antibodies	Paroxysmal Haemoglobinuria
	Polycythaemia
	Connective tissue diseases

DVT, deep venous thrombosis; EP, pulmonary embolia; ATIII antithrombin III; PC, protein C; PS, protein S

during the postoperative period, women have a lower risk of hypercoagulative (thromboembolic) complications.

To the best of our knowledge, other studies have not addressed such issues in plastic surgery, although there are many studies pertaining to other surgical specializations such as gynecology, maxillofacial surgery, abdominal surgery, and heart surgery [1,2,8,9,11,16,21,26]. In other works, physiologic antithrombotic (PC and ATIII) pre- and postoperative levels were discordant. A similar trend was observed in a group of abdominal surgery patients, with a maximum decrease of PC and ATIII recorded 2 days after surgery [16,29]. However, our study is not suitable for comparative purposes because of the insignificant statistical test (*t* test).

With regard to other parameters (PT, aPTT, fibrinogen) in the literature, the results from pre- and postsurgical monitoring were in accordance. Prothrombin time and aPTT showed no evidence of any change, but there was a moderate increase in fibrinogen. Our study demonstrated a statically important trend only with fibrinogen [3].

Conclusions

Analysis of the results suggests that immediately after surgery, in the absence of any preexisting hypo- or hypercoagulability state, there was no circumstantial modification in coagulation factors considered suggestive of thromboembolic risk. However, an interesting difference between male and female patients was found. In the male group, there was an unimportant uniform downward trend of all values immediately after surgery. In the female group, instead, there was a global upward trend (except for aPTT). Interestingly, the PC and ATIII results were statically significant. In conclusion, females are less hypercoagulative postoperatively, suggesting that females may have slight protection from the development of thromboembolic complications immediately after surgical procedures.

References

1. Amparo E, Gilabert J, Espana F, Martinez M, et al.: Alteration in fibrinolytic and protein C pathways in gynaecological surgery. *Haemostasis* **24:**252–260, 1994
2. Ayhn A, Develioglou O, Okoye JM, et al.: Activated protein C levels in patients with gynecologic tumors. *Gynecol Obstet. Invest* **35:**53–61, 1993
3. Basu D, Gallus A, Hirsh J, et al.: Activated PIT control. *N Engl J Med* **507:**324–326, 1982
4. Becker U, Lill K, Walefeld AW: Development of a photometric activated thromboplastin time and its application. *Thromb Res* **40:**721–730, 1985
5. Bertina RM, Broekmans AW, Krommenhoec-van Es C, van Wijngaarden A: The use of a functional and immunologic assay for plasma protein C in the study of the heterogeneity of congenital protein C deficiency. *Thromb Haemost* **51:**1–6, 1984
6. Bertina RM, Broekmans AW, van der Linden IK, et al.: Protein C deficiency in a Dutch family with thrombotic disease. *Thromb Haemost* **48:**1–5, 1982
7. Bianco M, Fine J, Kaltman SJ: Prevention and management of DVT and pulmonary embolism in the oral and maxillofacial surgery. *J Oral Maxillofac Surg* **42:**600–604, 1984
8. Boldt J, Knothe C, Schlindler E, Welters A, et al.: Thrombomodulin in pediatric cardiac surgery. *Ann Thorac Surg* **57:**1584–1591, 1994
9. Cwasnicka J, Krska J, Tosowsky J, et al.: Increase in fibrinogenemia in postoperative period of open heart surgery. *Cor Vasa* **35:**194–199, 1993
10. Davie EW, Ichinose A, Leytus SP: Structural features of the proteins participating in blood coagulation and fibrinolisis. *Cold Spring Harb Symp Quant Biol* **51:**514–519, 1996
11. De Stefano V, Leone G, Mastrangelo S, Tripodi A, et al.: Thrombosis during pregnancy and surgery in patients with congenital deficiency of ATIII, protein C, protein S. *Thromb Haemost* **71:**799–802, 1994

12. Emsin CT: Protein C: Biochemistry, physiology, and clinical implications. *Blood* **62:**1155–1158, 1983
13. Evarts CM, Alfidi RJ: Thromboembolism after total hip reconstruction: Failure of low doses of heparin in prevention. *JAMA* **225:**515–519, 1973
14. Fagerhol MK, Abildgaard U: Immunological studies on human ATIII. *Scand J Haemat* **7:**10–15, 1970
15. Flageul G, Elbaz JS, Karcenty B: Complications of plastic surgery of the abdomen. *Ann Chir Plast Esthet* **44:**497–505, 1999
16. Gibbs NM, Crawford GP, Michalopoulos N: Post-operatory changes in coagulant and anticoagulant factors following abdominal aortic surgery. *J Cardiothorac Vasc Anesth* **6:**680–685, 1992
17. Grace R: Thromboprophylaxis. *Br J Hosp Med* **49:**720–726, 1993
18. Griffin JH, Evatt B, Zimmerman TS, et al.: Deficiency of protein C in congenital thrombotic disease. *J Clin Invest* **68:**1370–1373, 1983
19. Lowry JC: Thromboembolic disease and thromboprophylaxis in oral and maxillofacial surgery.. *Br J Oral Maxillofac Surg* **33:**101–106, 1995
20. Handerson FA, Wheeler HB, Goldberg RJ: Physician practices in the prevention of venous thromboembolism. *Ann Intern Med* **115:**591–596, 1991
21. Harper PL, Jarvis J, Jannings I, Luddington R, et al.: Changes in natural anticoagulants following bone marrow transplantation. *Bone Marrow Transplant* **5:**39–42, 1990
22. Kakka W, Murray WJG: Efficacy and safety of low-molecular-weight heparin in preventing postoperative venous thromboembolism: A operative study. *Br J Surg* **72:**786–791, 1985
23. Mannucci PM, Boyer C, Tripodi A, et al.: Multicenter comparsion of five functional and two immunological assay for protein C. *Thromb Haemost* **57:**44–49, 1987
24. Nicolaides AN, Irving D: *Clinical factor and the risk of deep vein thrombosis: Advances in prevention and management* MTP, Lancaster, pp 193–204, 1974
25. Pabinger I, Schneider B: Thrombotic risk in hereditary antithrombin III, protein C or protein S deficiency: A cooperative, retrospective study:. *Arteriscler Thromb Vasc Biol* **16:**742–748, 1996
26. Rhoders EG: Thrombophilia and the surgeon. *Ann R Coll Surg Eng* **78:**331–335, 1996
27. Sellam P, Trevidic P: The thromboembolic risk of abdominal plastic surgery: a randomized statistical study of 190 cases. *Ann Chir Plast Esthet* **44:**545–548, 1999
28. Glantz SA: *Statistica per discipline biomediche* Mc Graw-Hill, New York, NY, 1997
29. Testa G, Borzomati V, Rossi A, Riccini T., Giuliani A, Battista L, Pizziconi E, Capelli O, De Bellus M, Morelli A: Monitoring of antithrombin III in general surgery. *Minerva Chir* **49:**949–952, 1994
30. THRIFT Consensus Group:Risk of and prophylaxis for venous thromboembolism in hospital patients. . *Br M J* **305:**567–574, 1992
31. Westling A, Bergqvist D, Bostrom A, Karacagil S: Incidence of deep venous thrombosis in patients undergoing obesity surgery. *World J Surg* **26:**470–473, 2002