REVIEW ARTICLE

Venous Thromboembolism in Patients Undergoing Laparoscopic and Arthroscopic Surgery and in Leg Casts

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The risk of venous thrombosis and need for prophylaxis in patients having undergone minimally invasive procedures and in patients immobilized in a leg plaster are poorly defined. We performed a literature search to evaluate the risk of developing venous thromboembolism after 2 minimally invasive procedures, laparoscopic surgery and arthroscopy, and in patients with lower limb plaster casts. Despite problems of "contamination" because some surgeons use prophylaxis in some of these patients, we were able to determine that (1) laparoscopic cholecystectomy can be considered a low-risk procedure and therefore routine use of prophylaxis is probably not justified; (2) patients undergoing arthroscopic knee surgery are at low to moderate risk and thus prophylaxis is optional; and (3) patients with plaster cast immobilization because of trauma have a moderate risk of thrombosis and should receive prophylaxis. *Arch Intern Med. 2002;162:2173-2176*

Most surgeons agree in principle that thromboprophylaxis should be used in moderate- and high-risk patients who undergo surgery or who are exposed to trauma. Opinions differ, however, on the definition of moderate and high risk. When developing guidelines for prophylaxis, expert panels usually omit 2 important groups: patients undergoing several new types of minimally invasive surgical procedures (specifically laprascopic and arthroscopic surgery) and patients with lower limb plaster casts. Establishing the true incidence of deep vein thrombosis (DVT) in these groups is problematic for the following reasons: First, choice of diagnostic technique. For safety reasons, fibrinogen uptake test cannot be used any longer and its clinical relevance has been questioned. Duplex ultrasonography lacks sensitivity and has only moderate specificity as a surveillance method for asymptomatic DVT. Bilateral phlebography is becoming increasingly difficult to justify in potentially low-risk situations. The use of clinical end points would require very large population samples.

Second, the true thromboembolic rates in unprotected patients are difficult to obtain because of "contamination" as a result of use of prophylaxis in patients who are considered to be at high risk, thereby producing falsely low estimates of thromboembolic rates.

With these caveats in mind, we sought to summarize contemporary information about the incidence of venous thromboembolism in patients undergoing laparoscopic and arthroscopic surgery as well as in patients with lower limb plaster casts.

LAPAROSCOPIC SURGERY

Potential risk factors for thromboembolism during laparoscopic surgery include the long duration of the procedure and reduced venous emptying when the abdomen is inflated and the vena cava compressed and from activation of coagulation related to surgery.[1,2] These risk factors are counterbalanced by the fact that these patients are exposed to minimal trauma, are mobilized rapidly, and discharged from the hospital early. Prospective studies on postoperative DVT after laparoscopic cholecystectomy are summarized in **Table 1**. As already stated, these data are limited by the diagnostic method used and the potential for the random use of prophylaxis. In addition, the accuracy of the

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Table 1. Prospective Studies on the Frequency of Deep Vein Thrombosis (DVT) After Laparoscopic Cholecystectomy

Source	No. of Patients	No. of DVTs	Frequency of DVT, %	Diagnostic Method
Bounameaux et al,[3] 1996	40*	0	0	Venography
Caprini et al,[4] 1995	74*	1	1.3	Duplex ultrasonography
Kopanski et al,[5] 1996	101	19	19	Fibrinogen uptake test
Krasinski et al,[6] 1998	40	11	47	Duplex ultrasonography
Lord et al,[7] 1996	27	0	0	Duplex ultrasonography
Lord et al,[8] 1998	59	1	1	Duplex ultrasonography
Patel et al,[9] 1996	20*	11	55	Duplex ultrasonography

*Various types of thromboprophylaxis in some of the patients.

Table 2. Frequency of Deep Vein Thrombosis (DVT) After Elective Knee Surgery*

Type of Surgery	No. of Patients	Frequency of DVT, %	
		Calf	Proximal
Total arthroplasty	55	56.4	9.1
Open meniscectomy	151	24.5	2.0
Arthroscopy	48	4.2	0
Others (arthrotomy, arthrodesis, patellectomy, synovectomy)	58	31.0	5.2

*Phlebographic diagnosis performed on the operated-on leg on postoperative days 7 through 10.[16]

results are questionable because the studies are small, the confidence intervals around the observed rates are wide, and the variation in rates of thrombosis are large. A high frequency of thrombosis was reported by Patel et al.[9] In contrast, Lord et al[7] reported no DVT with duplex ultrasound after 27 laparoscopic cholecystectomies; it is noteworthy that all of the patients received prophylaxis. The same group of authors found a 1% incidence of DVT after laparoscopic cholecystectomy, which was the same low frequency as after minilaparotomy cholecystectomy.[8] Lindberg et al[10] reviewed the published series on laparoscopic cholecystectomy in which thromboembolic complications were mentioned. These data, based on 153832 patients in 60 published series, reveal the following frequency of complications: DVT, 0.02%; pulmonary embolism, 0.06%; fatal pulmonary embolism, 0.02%; and mortality, 0.1%. Accepting the problem of "prophylactic pollution," it appears that the risk of symptomatic thromboembolic events is very low and the frequency of fatal pulmonary embolism is extremely low, although pulmonary embolism does occur.[11]

Data on thromboembolic complications after other types of laparoscopic procedures are sparse and limited to case reports.[12,13] In one report, no postoperative thrombi were diagnosed with duplex scanning during unspecified laparoscopic procedures in 61 patients, all of whom did not receive prophylaxis.[14] In another report of 32 patients undergoing laparoscopic colorectal resections who received low-molecular-weight heparin combined with intermittent pneumatic compression, no thrombi were found by duplex ultrasonography, with a 95% confidence interval of 0% to 9%.[15]

ARTHROSCOPIC SURGERY

As with laparoscopic surgery, only a few studies have focused on the incidence of venous thromboembolism in this group of patients. Stringer et al[16] performed an incidence study analyzing various types of knee surgery without prophylaxis. Phlebography of the operated-on leg was used for diagnosis. The results are summarized in **Table 2**, with other types of knee surgery shown for comparison. Demers et al[17] found a DVT frequency of 17.9% when unilateral phlebography was performed 1 week after arthroscopy in 184 patients. Of the 33 DVTs, 20 were symptomatic (9 [49%] of which were proximal). The risk was significantly increased if a tourniquet had been applied for 60 minutes or longer. In another study, a frequency of 3.5% was reported using compression ultrasonography (3 of 85, all asymptomatic[18]). Based on these data, arthroscopy can be considered as a moderate risk if the tourniquet is applied for an extended duration and low risk under other circumstatnces. The low risk of this procedure is further supported by a recent publication by Dahl et al,[19] in which the frequency of clinically symptomatic thrombosis diagnosed by means of compression ultrasonography or phlebography was analyzed during a 10-year period (1989-1998). Of 1335 arthroscopies in which prophylaxis was not used, there were 8 patients with thromboses (0.6%), 7 of which were in the calf veins and 1 extending to the popliteal vein. The clinical symptoms appeared at a median of 1 day after arthroscopy (range, 1-6 days). A similar low incidence was reported by Jaureguito et al.[20] Using clinical symptoms with thrombosis confirmed by duplex ultrasound as the end point, the incidence of thrombosis was 0.24% in a retrospective study of 2050 arthroscopies and 2.9% in a prospective study of 239 patients. An even lower incidence of clinically suspected thromboembolic disease was reported by Small[21]; 6.9% after 10262 arthroscopies. Schippinger et al[22] performed a clinical follow-up 14 days after arthroscopic knee surgery and a follow-up by duplex ultrasonography and ventilation-perfusion scan after 5 weeks. Of the 101 consecutive patients, 8 developed DVT (4 symptomatic) and 9 developed pulmonary embolism (1 symptomatic). The overall frequency of thromboembolism was 12%. All patients received prophylaxis with dalteparin but this was limited to the time of discharge which, on average, occurred on the second day. In a randomized study of 239 pa-

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Table 3. Frequency of Deep Vein Thrombosis (DVT) (Phlebographic Diagnosis) After Lower Limb Fracture (Tibial)

Source	No. of Patients	No. of DVTs	Frequency of DVT, %	Diagnostic Method
Hjelmstedt and Bergvall,[25] 1968	74	34	45	Phlebography
Spieler et al,[26] 1972	12	7	58	Phlebography, day 28
Nylander and Semb,[27] 1972	15	11	73	Phlebography, days 1-3
Geerts et al,[28] 1994	86*	66	77	Phlebography, days 14-21
Abelseth et al,[29] 1996	90	25	27	Phlebography, day 9

*Patients were multiply injured with an Injury Severity Score of at least 9.

Table 4. Frequency of Deep Vein Thrombosis (DVT) in Patients Wearing Lower Limb Plaster Casts

Source	No. of Patients	No. of DVTs	Frequency of DVT, %	Diagnostic Method	No. of Fractures	No. of Soft Tissue Injuries	No. of Unclear
Kujath et al,[30] 1993	127	21	16.5	Compression ultrasonography	38	89	0
Reilmann et al,[31] 1993	100	3	3.0*	Ultrasonography and venography	0	100	0
Kock et al,[32] 1995	163	7	4.3	Duplex ultrasonography	38	132	6
Giannadakis et al,[33] 2000	178	2	1.1	Duplex ultrasonography	0	178	0

*There were no DVT events in patients with ankle distorsion and 3 (5.2%) in those with rupture of the Achilles tendon.

tients, Wirth et al[23] found a 4.1% rate of DVT with compression ultrasonography with no prophylaxis vs 0.85% when reviparin was used.

PLASTER CAST

The indications for plaster casts vary. Here, we discuss casts used to immobilize the lower leg because of a traumatic fracture or soft tissue injury. Three factors contribute to the risk of thrombosis after a fracture: the trauma causing the fracture, treatment with surgical fixation of the fracture, and immobilization in the cast. In a series of 200 patients followed up clinically for 3 months, 9 (4.5%) developed symptomatic venous thromboembolism, which was objectively verified with phlebography or lung scintigraphy.[24] The frequency of venous thrombosis detected by phlebography, after crural fractures, usually tibial fractures, is summarized in **Table 3**. This is a high-risk group and although most of the thrombi are localized to the calf veins, they can be complicated by pulmonary embolism, including fatal embolism. The risk of thrombosis appears to be low when there is no fracture. **Table 4** shows results of studies in which patients with fractures or soft tissue injuries wore a plaster cast. In a recent study, the low-molecular-weight heparin reviparin was compared with placebo in 440 patients with lower extremity fracture or rupture of the Achilles tendon who were immobilized for 42 days in a cast or brace.[34] Phlebography at cast removal showed thrombosis in 34 (18%) of the patients who received placebo, 10 of which were proximal. In the reviparin group the frequency of DVT was 9% ($P=.014$).

CONCLUSIONS

Laparoscopic cholecystectomy and simple knee arthroscopic surgery can be considered low-risk situations for venous thromboembolism. Knee arthroscopic surgery that requires prolonged tourniquet time is a moderate-risk procedure. Data on the risk of thrombosis with other laparoscopic procedures are too sparse to allow comment. The routine use of prophylaxis is probably not justified in these groups of patients, but should be considered in higher-risk patients who have knee arthroplasty. Patients requiring immobilization in a plaster cast because of trauma have a moderate risk of thrombosis and probably should receive prophylaxis.

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