Original Article

Thrombotic risk assessment questionary helps increase the use of thromboprophylaxis for patients with pelvic and acetabular fractures

Haili Wang, Wei Chen, Yanling Su, ZhiYong Li, Ming Li, Zhanpo Wu, Yingze Zhang

Abstract

Background: Pelvic and acetabular fractures have been known as one of the high risk factors for developing deep vein thrombosis (DVT), but thromboprophylaxis for patients with such fractures remains underused despite its widely accepted benefits. Current guidelines have not been universally adopted in clinical practice. The purpose of this study is to introduce a Thrombotic Risk Assessment Questionary (assessment table) according to evidence-based guidelines and evaluate its impact on the use of thromboprophylaxis for patients with pelvic and acetabular fractures.

Materials and Methods: We retrospectively reviewed 305 consecutive patients with pelvic and acetabular fractures from August 1, 2008 through September 30, 2010. The control group without using the assessment table included 153 patients admitted during the first 13 months, and the assessment group using the assessment table included 152 patients admitted during the following months. Data on clinical outcomes of DVT, the number of patients receiving prophylaxis, and the time of the first dose of anticoagulant were collected.

Results: Compared with the control group, Patients using the assessment table were more likely to be given DVT prophylaxis (84.2% vs. 37.3%, $P < 0.05$) and the time of the first dose of anticoagulant was reduced (4.32 days ± 4.78 days vs. 6.6 days ± 5.96 days, $P < 0.05$). Patients in the assessment group had lower risk of developing DVT (8.6% vs. 20.3%, $P < 0.05$).

Conclusion: The assessment table can significantly improve the use of thromboprophylaxis after pelvic and acetabular fractures, which will likely reduce the incidence of DVT. Developing individual hospital prophylaxis strategy is an effective way to determine whether hospitalized patients should receive pharmacologic and/or mechanical prophylaxis or not.

Key words: Deep vein thrombosis, pelvic and acetabular fractures, risk assessment, thromboprophylaxis

Introduction

Deep vein thrombosis (DVT) is a common disorder in trauma patients. From the available literature, the reported incidence of DVT in traumatic patients varies depending upon the injury characteristics, the diagnostic technique, and the study design. Pelvic and acetabular fractures have been identified as a high risk factor for DVT and pulmonary embolism (PE) complications.[1-3] Pelvic trauma patients have DVT rate from 35 to 61%.[4-7] In the event of DVT, nearly half of patients develop postthrombotic syndrome, which can lead to chronic pain and swelling,[8] and dislodged lower extremity thrombi can result in most of PE, which is a disastrous consequence for patients.

Since the first evidence-based guidelines[9] recommended routine use of thromboprophylaxis for most hospitalized patients, there are overwhelming evidences to confirm that thromboprophylaxis can safely and inexpensively reduce the thromboembolic complications.[10,11] Thromboembolism prophylaxis has been identified as an algorism of primary importance to improve patient safety in practice.[12] However, there is still considerable underutilization of appropriate pharmacologic or mechanical prophylaxis across a broad range of patients with known DVT risk.[13,14]

Many improvement strategies have been developed to increase the appropriate use of thromboprophylaxis. The

Department of Orthopaedics, 3rd Hospital, Hebei Medical University, Shijiazhuang, Hebei, PR China

Address for correspondence: Dr. Yingze Zhang,
Department of Orthopaedics, 3rd Hospital, Hebei Medical University, No. 139 Ziqiang Road, Shijiazhuang 050051, PR China.
E-mail: dryzzhang@yahoo.com.cn

Access this article online	
Quick Response Code:	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.98830

American College of Chest Physicians (ACCP)[10] proposed that every hospital should develop a formal strategy that addresses the prevention of venous thromboembolism (VTE), which should be in the form of a written prophylaxis policy, especially for high-risk groups. The Surgical Care Improvement Project (SCIP) in the United States uses the strategy of pay-for-reporting to encourage the hospitals to provide guideline-recommended thromboprophylaxis to the majority of surgical patients in the country. Also, Suman Rathbum[15] issued a "call to action" to spread public knowledge on the signs, symptoms, and risk of venous thromboembolism. The purpose of the study was to assess the impact of our hospital's Thrombotic Risk Assessment Questionary (assessment table) on the use of thromboprophylaxis after pelvic and acetabular fractures.

Materials and Methods

The study was conducted at a level I trauma center from August 1, 2008 to September 30, 2010. The patients with pelvic and/or acetabular fractures were included during the study period. The patients aged below 18 years or who died within 48 h after admission were excluded from this study. The patients admitted to our department from August 2008 to September 2009 were included in the control group. The patients with pelvic and/or acetabular fractures, admitted from October 2009 to September 2010, were included in the assessment group. Patients in both groups received either conservative or surgical treatment based on their indications. In the control group, the assessment of the DVT risk and the appropriate provision of prophylaxis were carried out based upon the surgeons' experience and knowledge of DVT risk. Some surgeons prescribed thromboprophylaxis according to the concomitant presence of risk factors or in the absence of bleeding risk, while some preferred to prescribe anticoagulant prophylaxis to all patients with major trauma irrespective of the level of risk and some even ignored the prevention of DVT. In the assessment group, the prescription of thromboprophylaxis was based on the assessment table [Table 1].

After a thorough literature review of guidelines in current practice, the senior authors of this study developed the paper-based Thrombotic Risk Assessment Questionary according to evidence-based guidelines,[10] the literatures on risk factors,[1,16] and risk assessment strategies.[17-21] Various risk factors were collected and included in the assessment table, and the validity of risk factors has been confirmed or detailed in the relevant literatures.[2,18] The assessment table includes more risk factors than recommended in the guidelines, and they may look the same as ones in other risk assessment strategies such as Caprini VTE risk assessment model.[19,20] Similar to Kahan's study, our assessment table stratified the risks into four levels: low, moderate, high, and very high risk [Table 1].[22] In the clinical settings, surgeons must realize that the predictive values of these risk factors are not the same with respect to whether prescription of prophylaxis should be given or not. That said, they should consider both the strength of individual risk factor and the cumulative weight of all risk factors. Those patients with two or more high risk factors and one high risk factor combined with two or more moderate risk factors were regarded as very high risk patients.

Table 1: The DVT risk assessment table for inpatients at admission

Low risk	Moderate risk	High risk	Very high risk
Age 41–60 years	Age 61–75 years	Age 76 years or older	With two or more high risk factors or
Hypertension, hyperlipemia, or diabetes mellitus	Arthroscopic knee surgery	Fracture (pelvis, hip, or lower extremity)	One high risk factor combined with two or more moderate risk factors
Obesity (BMI > 25)	Central venous access	Hip or knee replacement	
Pregnancy or postpartum within 4 weeks	Malignancy	Major general surgery (>45 minutes)	
Varicose veins	Confined to bed for more than 3 days	Major trauma within 4 weeks	
Major surgery within 12 weeks	Previous venous thromboembolism	Spinal cord injury within 4 weeks	
Hormone replacement therapy	Thrombophilia	Stroke within 4 weeks	
Oral contraceptive therapy	Immobilizing plaster cast of lower extremity within 4 weeks		
Congestive heart failure			
Abnormal pulmonary function			

The assessment table has been widely used at our hospital since October 1, 2009, when it was first introduced. Every surgeon at the trauma department was trained and required to develop prophylaxis strategies based on this assessment table. Pharmacologic treatments, such as low molecular weight heparins (LMWHs), were advised for patients without contraindications at moderate or higher risk levels for DVT. The patients with retroperitoneal hematoma or severe concomitant injuries of abdomen or chest were given mechanical prophylaxis. Because of the catastrophic consequences of bleeding which warrant close monitoring, pharmacologic thromboprophylaxis was discontinued after the patient was discharged from the hospital. Patients in both groups were encouraged to continue non–weight-bearing exercise and progress to weight-bearing exercise after getting discharged. Thrombotic complications were defined as the presence of DVT confirmed by ultrasonography during hospitalization or 3 months after discharge. All study subjects underwent bilateral low extremity ultrasonography

while in the hospital by an experienced sonographer to confirm the presence of DVT. Patients with negative ultrasound results were re-tested 1 week later (serial testing). Besides, disappearance and recanalization of the DVT had to be confirmed by ultrasonography before discharge. However, not every one undergone ultrasound examination after getting discharged; only those who were symptomatic and responded had the ultrasound done to confirm the presence of DVT. Sonographic diagnosis of DVT was based on noncompressibility of venous segment of the lower extremity, absent or reduced flow on Doppler imaging with failure to augment on compression of the leg; or the presence of echogenic material compatible with thrombus in the leg. The hospital's Research Ethics Board approved this study.

Data collection

The charts of all patients in both groups were reviewed. Information such as age, gender, pelvic fracture type according to AO classification, injury mechanism, comorbidity, associated injuries, anesthesia, and hospitalized days was collected and analyzed. Medical records on detection of DVT and prescription of DVT prophylaxis were extracted as well.

Statistical analysis

Data were presented as mean ± standard deviation (SD) for continuous variables and as percentages for incidence rates. Statistical analyses were performed using SPSS 13.0 for Windows (SPSS, Chicago, IL, USA). The characteristics and clinical data were compared between the groups using the *t*-test for normally distributed continuous variables and the Chi-square test for categorical variables. A P value <0.05 was considered as statistically significant.

Results

The study subjects consisted of 305 patients with pelvic and/or acetabular fractures. The most common mechanism of injury was injuries associated with car accident in 226 patients, followed by fall from height in 59, and bruises in 20. There were 153 patients (50.16%) in the control group and 152 patients (49.84%) in the assessment group. The two groups were similar and comparable in baseline characteristics [Table 2] such as risk level, diagnostic means, and prophylactic methods. There were no significant differences between the two groups with respect to age, gender, injury site, pre-existing comorbidities and associated injuries, mechanism of injury, the average preoperative time, and the duration of hospitalization ($P > 0.05$). There were 71.7% (109 out of 152) patients in the assessment group and 69.3% (106 out of 153) in the control group treated surgically, with no significant difference ($P = 0.22$). According to the assessment table, there were 115 patients (75.7%) identified as high risk and 37 (24.3%) identified as very high risk in the assessment group, while 111 patients (72.5%) were at high risk and 42 (27.5%) at very high risk in the control group. There was no significant difference in the risk level between the two groups ($P = 0.54$).

Table 2: Demographic and clinical characteristics of the patients in both groups

Parameter	Control group	Assessment group	Value	*P*-value
n	153	152		
Age (years) mean ± SD	40.7 ± 12.9	38.1 ± 13.2	1.55	0.12
Age				
≥40(years),*n* (%)	77 (50.3%)	63 (41.4%)	2.42	0.12
Gender			1.45	0.23
Male, *n* (%)	101 (66.0%)	110 (72.4%)	0.04	0.98
Female, *n* (%)	52 (34.0%)	42 (27.6%)		
Pelvic fracture	59 (38.5%)	58 (38.2%)		
Acetabular fracture	76 (49.7%)	75 (49.3%)		
Both pelvic and acetabular fractures	18 (11.8%)	19 (12.5%)		
Pelvic AO classification				
Type A, *n* (%)	50 (84.7%)	49 (84.5%)	0.24	0.89
Type B, *n* (%)	6 (10.2%)	5 (8.6%)		
Type C, *n* (%)	3 (5.1%)	4 (6.9%)		
Injury mechanism				
Traffic accident, *n* (%)	112 (73.2%)	114 (75%)	0.17	0.92
Fall from a height, *n* (%)	31 (20.3%)	28 (18.4%)		
Bruise injury, *n* (%)	10 (6.5%)	10 (6.6%)		
Comorbidity, *n* (%)	18 (27.6%)	19 (27.6%)	0.04	0.84
Associated injuries, *n* (%)	73 (27.6%)	60 (27.6%)	2.10	0.15
Anesthesia				
General, *n* (%)	58 (27.6%)	72 (27.6%)	2.89	0.09
Epidural or subarachnoid	48 (27.6%)	37 (27.6%)		
Preoperative days (mean ± SD)	5.96 ± 4.85	5.94 ± 3.96	0.03	0.98
Hospital stay (days) mean ± SD	19.69 ± 18.47	21.23 ± 21.09	−0.99	0.33

There were 57 patients (26 high risk and 31 very high risk) in the control group who received pharmacologic and/or mechanical prophylaxis at an average of 6.6 days (range 1–24 days) after initial trauma, including 19 patients with pelvic fractures, 27 with acetabular fractures, and 11 with pelvic fractures combined with acetabular fractures. Of these 57 patients, 41 were on pharmacologic prophylaxis, 11 on mechanical prophylaxis, and 5 on combination of both. Ninety six patients did not receive thromboprophylaxis, among whom 12 patients had high bleeding risk and the reason was not clear for not giving thromboprophylaxis

in the remaining 84 patients who should have been given the same according to the current practice guidelines. Of the 96 patients, 67 were at high risk and 29 at very high risk. Ultrasound results showed that DVT to be present in 31 patients (20.3%, 31/153), including 6 (3 high risk and 3 very high risk) patients who received thromboprophylaxis and 12 high risk patients and 13 very high risk patients who did not have prophylaxis. Of the 31 patients with DVT, 19 were identified before they got discharged from the initial treatment and 12 during the 3 months followup. Of these 31 patients, 8 had Type A with ipsilateral fractures of the lower extremities, 3 Type B fractures of pelvis, 2 Type C fractures, 16 acetabular fractures, and 2 had pelvic combined with acetabular fractures.

In the assessment group, a total of 128 patients (91 high risk and 37 very high risk) received prophylaxis at an average of 4.3 days (range 1–14 days) after the initial injury. Of the 128 patients, there were 47 patients with pelvic fractures, 69 acetabular fractures, and 12 with pelvic combined with acetabular fracture. Also, there were 107 patients who were prescribed pharmacologic prophylaxis, 10 were given mechanical prophylaxis, and 11 were prescribed a combination of both. In this group, there were 24 patients who did not receive prophylaxis, including 8 patients with high risk of bleeding and 16 for no clear reasons. Of these 24 patients, 18 patients were at high risk and 6 at very high risk. Ultrasound results showed the presence of DVT in 13 patients (8.6%, 13/152), of whom 8 patients had it detected before getting discharged from the initial treatment and 5 during the 3 months followup. Of the 13 patients with DVT, 11 patients (7 high risk and 4 very high risk) were given thromboprophylaxis and 2 very high risk patients did not receive thromboprophylaxis. The fracture types of these 13 patients are as the follows: 4 were Type A with ipsilateral fractures of the lower extremities, 2 Type B fractures of pelvis, 1 Type C fracture, and 6 acetabular fractures.

The use of prophylaxis and clinical outcomes of DVT were compared between the two groups [Table 3]. The assessment table improved the prescription of DVT prophylaxis from 37.3% in the control group to 84.2% in the assessment group ($P < 0.05$). The number of patients who did not receive prophylaxis without a clear reason was greatly reduced by using the assessment table (84 vs. 16, $P < 0.05$). The incidence of DVT confirmed by ultrasonography reduced from 20.3% in the control group to 8.6% in the assessment group ($P < 0.05$). The time of the first dose of anticoagulant administered in the assessment group was much earlier than that in the control group (4.3 days vs. 6.6 days, $P < 0.05$).

Discussion

The current study demonstrated that the assessment table improved the use of thromboprophylaxis in the assessment group compared with that in the control group, especially for high risk patients who should have been given thromboprophylaxis but did not receive. We also found that the first administration time of thromboprophylaxis was earlier in the assessment group than that in the control group. Our study results showed that adequate thromboprophylaxis against DVT during hospital stay has the potential to minimize the risk of DVT.

Hospitalized patients recovering from major trauma have high risk of developing venous thromboembolic events. Besides, most patients with DVT have no clinical symptom and the surgeons may not realize its existence until fatal PE happens. The key to reduce mortality and morbidity from venous thromboembolism is the appropriate prophylaxis, which should be conducted as early as possible for those with high risk of thrombosis, even for those who had experienced a bleeding event and had prophylaxis temporarily withheld.[23] The application of thromboprophylaxis can decrease the risk of venous thromboembolism significantly in a broad spectrum of patients with a very low risk of adverse effects.[24] For orthopedic patients, prophylaxis reduces DVT risk by more than two thirds.[25] It is a disappointing fact that the use of prophylaxis is far from ideal despite the overwhelming evidence supporting thromboprophylaxis for most hospital patients. A cohort study reported that nearly 17% cases of DVT could have been prevented by appropriate thromboprophylaxis.[13]

Numerous risk factors for DVT have been highlighted by the current literature, whereas the values of these factors are not the same. The assessment table included more risk factors than that recommended in the current guidelines.

Table 3: Patients receiving thromboprophylaxis intervention and clinical outcomes of DVT

Group	*n*	Main intervention, *n* (%)	Initial time (days)	Duration (days)	No prophylaxis given for no clear reasons, *n*	DVT, *n* (%)
Control	153	57 (37.3)	6.6 ± 5.96	10.44 ± 5.37	84	31 (20.3)
Assessment	152	128 (84.2)	4.32 ± 4.77	13.27 ± 10.65	16	13 (8.6)
Value	-	70.45	−2.23	0.85	86.27	8.47
P-value	-	0.000	0.028	0.195	0.000	0.004

Some risk factors are the same as those reported in other risk assessment strategies. The validity of those risk factors has been confirmed or detailed in the relevant literature.[2,18] The DVT risk assessment table considers the pelvic and acetabular fractures as high risk for DVT and classified various factors into 1–4 levels, similar to other studies.[1-3] To assess whether prophylaxis is indicated, clinicians should consider both the strength of individual risk factors and the cumulative weight of all risk factors. Those patients with two or more high risk and one high risk combined with two or more moderate risk factors were regarded as very high risk patients in the study. Presumably, a pelvic or acetabular fracture patient aged 41 years or with a history of VTE was classified as high risk, which depended on the overall condition of the patient. The patients with a history of VTE were usually regarded as very high risk; however, the clinicians were prone to regard it as high risk if the pelvic fracture was simple. Regardless of the risk level defined, the outcomes would be the same with respect to the prescription of pharmacologic or mechanical prophylaxis.

The assessment table can increase the surgeons' awareness of potential risk factors and increases the frequency of prescribing appropriate methods of DVT prophylaxis.[23] Through application of the assessment table, those high risk patients who should be given thromboprophylaxis obtained their prevention from anticoagulant or mechanical prophylaxis. The frequency of the use of thromboprophylaxis increased from 37.3% in the control group to 84.2% in the assessment group. In addition, the average first dose time to administer prophylaxis was greatly advanced in the assessment group. However, we did not find significant differences in prophylaxis duration between the two groups, which may be due to decreasing lengths of hospital stay and also nearly all the patients discontinued anticoagulation after discharge.

In our study, all the patients received LMWHs and compression devices as the tools of thromboprophylaxis. The LMWHs have emerged as the most effective pharmacologic prophylaxis option for the greatest spectrum of patients.[26] Mechanical methods of thromboprophylaxis have also been demonstrated to reduce the incidence of DVT in one or more patient groups.[27] The study showed that the incidence of DVT confirmed by ultrasonography in the assessment group was lower than that in the control group (8.6% vs. 20.3%). DVT was diagnosed in 7.8% cases (12/153) of the control group and 3.3% cases (5/152) of the assessment group during the 3 months followup. Because there was no difference in the risk level and basic characteristics between the two groups and all patients discontinued prophylaxis after discharge, the decrease in the incidence of DVT may be attributed to the improved use of pharmacologic or mechanical prophylaxis.[28]

As reported in the literature, there are many clinical guidelines, whereas there continue to be large gaps in the provision of pharmacological and mechanical thromboprophylaxis. It should also be noted that only 84% of our patients received pharmacologic or mechanical prophylaxis despite the fact that the patients enrolled in our study were in the high or very high risk category. In the present study, it was mandatory for the surgeons to give the appropriate thromboprophylaxis based on the assessment table, and all the surgeons assessed and recorded the patients' risk level; however, there is still lack of adequate thromboprophylaxis in practice. Improving the surgeons' awareness and providing motivation for appropriate pharmacologic or mechanical prophylaxis is very important. In addition, since all patients in both groups underwent ultrasonography, the negative outcomes distracted the clinician's attention to thromboprophylaxis.

In the current study, pharmacologic prophylaxis was not ordered for patients with isolated Type A pelvic ring fractures in the control group. However, no asymptomatic or symptomatic DVT was reported during the hospitalized stay and followups. Pharmacologic prophylaxis was acquired for some Type A patients in the assessment group, DVT was not detected during the hospital stay, and symptomatic DVT was also not reported at followups. Therefore, those patients' risk levels of DVT may be overestimated, and it is not appropriate to classify all types of pelvic fractures in the same risk level. Severity scale of the pelvic fractures should be taken into consideration when the individual risk level is assessed. More accurate evaluation of risk level and avoiding unnecessary thromboprophylaxis can prevent patients without the risk of thrombosis from exposure to the risk of bleeding.

Ultrasonography has gained widespread application in detecting DVT in clinics. There is clear evidence that ultrasound approach is feasible and safe to detect DVT. The sensitivity of sonography in detecting DVT ranges from 80 to 100% and the specificity ranges from 96 to 100%.[29] Weitz[30] held the opinion that ultrasound can replace the venography in diagnosing DVT. This finding can warrant routine application of ultrasonography for the evaluation and diagnosis of lower extremity DVT. Accordingly, ultrasonography was applied to detect the DVT in both groups of this study. However, it is difficult to followup patients who were asymptomatic and usually refused to pay a visit to the clinicians. As a result, those patients' information can be obtained only through telephone. If there was any indication of DVT, such as swelling, pain, and other clinical

symptoms, ultrasound was needed to confirm the diagnosis. So, among the discharged patients, only those who were symptomatic had the ultrasound done to investigate the presence of DVT, which probably underestimated the real incidence of the DVT to a certain extent. In addition, we did not order venography to test the sensitivity and specificity of sonography, which was a limitation of the study.

This study has a few limitations. First, patients who were included in the study were only with one type of traumatic injury and one center was involved. Injury types other than pelvic and acetabular injuries were excluded. Multiple center studies on a broad spectrum of patients should be conducted to validate the assessment table. Second, patients without symptoms were not routinely examined with ultrasonography in both groups after discharge. Therefore, the asymptomatic DVTs were not included in the data, which would underestimate the incidence of the DVT in the current study. Third, we did not include PE in this study because only a few patients had pulmonary CT to rule out PE as indicated.

Conclusion

With the current clinical guidelines, prophylaxis was underused for patients with pelvic and/or acetabular injury. This assessment table can significantly improve the use of thromboprophylaxis after pelvic and acetabular fractures, which will likely reduce the incidence of DVT. Developing individual hospital prophylaxis strategy is an effective way to determine whether hospitalized patients should receive pharmacologic and/or mechanical prophylaxis or not.

References

1. Anderson Jr F, Spencer F. Risk factors for venous thromboembolism. Circulation 2003;107:I9-16.
2. Bahl V, Hu HM, Henke PK, Wakefield TW, Campbell DA Jr, Caprini JA, *et al.* A validation study of a retrospective venous thromboembolism risk scoring method. Ann Surg 2010;251:344-50.
3. Slobogean GP, Lefaivre KA, Nicolaou S, O'Brien PJ. A systematic review of thromboprophylaxis for pelvic and acetabular fractures. J Orthop Trauma 2009;23:379-84.
4. Montgomery KD, Geerts WH, Potter HG, Helfet DL. Thromboembolic complications in patients with pelvic trauma. Clin Orthop 1996;329:68-87.
5. Geerts WH, Code KI, Jay RM, Chen E, Szalai JP. A prospective study of venous thromboembolism after major trauma. N Engl J Med 1994;331:1601-6.
6. Grady-Benson JC. High risk factors and diagnostic challenges associated with venous thromboembolic disease. Orthop Rev 1994; 23:10-6.
7. Gearhart MM, Luchette FA, Proctor MC, Lutomski DM, Witsken C, James L, *et al.* The risk assessment profile score identifies trauma patients at risk for deep vein thrombosis. Surgery 2000;128:631-40.
8. Kahn SR, Ducruet T, Lamping DL, Arsenault L, Miron MJ, Roussin A, *et al.* Prospective evaluation of health-related quality of life in patients with deep venous thrombosis. Arch Intern Med 2005;165:1173-8.
9. Roberts H, Adel S, Bernstein E. Prevention of venous thrombosis and pulmonary embolism. JAMA 1986;256:744-9.
10. Geerts W, Bergqvist D, Pineo G, Heit JA, Samama CM, Lassen MR, *et al.* Prevention of venous thromboembolism: the eighth ACCP Conference on Antithrombotic and Thrombolytic Therapy. Chest 2008;133:381S -453S.
11. Samama MM, Cohen AT, Darmon JY, Desjardins L, Eldor A, Janbon C, *et al.* A comparison of enoxaparin with placebo for the prevention of venous thromboembolism in acutely ill medical patients. Prophylaxis in Medical Patients with Enoxaparin Study Group. N Engl J Med 1999;341:793-800.
12. Geerts W. Prevention of venous thromboembolism: a key patient safety priority. J Thromb Haemost 2009;7:1-8.
13. Arnold DM, Kahn SR, Shrier I. Missed opportunities for prevention of venous thromboembolism: an evaluation of the use of thromboprophylaxis guidelines. Chest 2001;120:1964-71.
14. Imberti D, Ageno W. A survey of thromboprophylaxis management in patients with major trauma. Pathophysiol Haemost Thromb 2005;34:249-54.
15. Rathbun S. The Surgeon General's call to action to prevent deep vein thrombosis and pulmonary embolism. Circulation 2009;119:e480-2.
16. Paffrath T, Wafaisade A, Lefering R, Simanski C, Bouillon B, Spanholtz T, *et al.* Venous thromboembolism after severe trauma: incidence, risk factors and outcome. Injury 2010;41:97-101.
17. Cohen AT, Alikhan R, Arcelus JI, Bergmann JF, Haas S, Merli GJ, *et al.* Assessment of venous thromboembolism risk and the benefits of thromboprophylaxis in medical patients. Thromb Haemost 2005;94:750-9.
18. Samama MM, Dahl OE, Mismetti P, Quinlan DJ, Rosencher N, Cornelis M, *et al.* An electronic tool for venous thromboembolism prevention in medical and surgical patients. Haematologica 2006;91:64-70.
19. Caprini JA, Arcelus JI, Reyna JJ. Effective risk stratification of surgical and nonsurgical patients for venous thromboembolic disease. Semin Hematol 2001;38:12-9.
20. Caprini JA. Risk assessment as a guide for the prevention of the many faces of venous thromboembolism. Am J Surg 2010;199:S3-10.
21. Motykie GD, Zebala LP, Caprini JA, Lee CE, Arcelus JI, Reyna JJ, *et al.* A guide to venous thromboembolism risk factor assessment. J Thromb Thrombolysis 2000;9:253-62.
22. Kahan JP, Cornelis M, de Vries H, van Beusekom I, Wietlishbach V. Preventing venous thromboembolism: prophylactic options for patients at different risk levels. Leiden: RAND-EVIDIS, MR-1689. 2003.
23. Anderson Jr FA, Wheeler HB, Goldberg RJ, Hosmer DW, Forcier A, Patwardhan NA. Changing clinical practice: prospective study of the impact of continuing medical education and quality assurance programs on use of prophylaxis for venous thromboembolism. Arch Intern Med 1994;154:669-77.
24. Dentali F, Douketis JD, Gianni M, Lim W, Crowther MA. Meta-analysis: anticoagulant prophylaxis to prevent symptomatic venous thromboembolism in hospitalized medical patients. Ann Intern Med 2007;146:278-88.
25. Collins R, Scrimgeour A, Yusuf S, Peto R. Reduction in fatal

pulmonary embolism and venous thrombosis by perioperative administration of subcutaneous heparin. Overview of results of randomized trials in general, orthopedic, and urologic surgery. N Engl J Med 1988;318:1162-73.
26. Mismetti P, Laporte S, Darmon JY, Buchmuller A, Decousus H. Meta-analysis of low molecular weight heparin in the prevention of venous thromboembolism in general surgery. Br J Surg 2001;88:913-30.
27. Roderick P, Ferris G, Wilson K, Halls H, Jackson D, Collins R, *et al*. Towards evidence-based guidelines for the prevention of venous thromboembolism: Systematic reviews of mechanical methods, oral anticoagulation, dextran and regional anaesthesia as thromboprophylaxis. Health Technol Assess 2005;9:1-78.
28. Spencer FA, Lessard D, Emery C, Reed G, Goldberg RJ. Venous thromboembolism in the outpatient setting. Arch Intern Med 2007;167:1471-5.
29. Atri M, Herba M, Reinhold C, Leclerc J, Ye S, Illescas FF, *et al*. Accuracy of sonography in the evaluation of calf deep vein thrombosis in both postoperative surveillance and symptomatic patients. Am J Roentgenol 1996;166: 1361-7.
30. Weitz JI. Unanswered questions in venous thromboembolism. Thromb Res 2009;123:S2-S10.

How to cite this article: Wang H, Chen W, Su Y, Li Z, Li M, Wu Z, *et al*. Thrombotic risk assessment questionary helps increase the use of thromboprophylaxis for patients with pelvic and acetabular fractures. Indian J Orthop 2012;46:413-9.

Source of Support: Nil, **Conflict of Interest:** None.