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A PROSPECTIVE ANALYSIS OF DEEP VEIN THROMBOSIS IN LOWER LIMB FRACTURES USING COLOUR DOPPLER SONOGRAPHY: A STUDY AT RRMCH, BENGALURU

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A B S T R A C T

Background: Few studies which have reported very low incidence of DVT in India have been conducted in patients undergoing elective orthopaedic surgery and used colour duplex for diagnosis.Despite having fewer comorbid conditions, orthopaedic patients with deep vein thrombosis remain particularly vulnerable to calf deep vein thrombosis. Rates of venous thromboembolism prophylaxis were inadequate. With the aforementioned facts, the need of this study is to establish evidence of deep vein thrombosis in patients with lower limb trauma as early as possible, adequately manage it and prevent its complications **Methods:** Total of 83 patients admitted in Orthopaedics department with lower limb fractures satisfying the inclusion criteria and exclusion were included in the study. Thorough history and clinical examination data were obtained, venous doppler ultrasound studies were done clinical scoring for risk of deep vein thrombosis was done using Well's criteria and noted. Post operatively on day 4, another colour venous doppler study of the lower limbs was be performed and clinical scoring for risk of deep vein thrombosis was be done using Well's criteria and noted. For patients who developed symptoms/signs of deep vein thrombosis during their stay at the hospital, appropriate chemoprophylaxis was started for these patients who developed deep vein thrombosis, follow up colour venous doppler study of the lower limbs was done after 3 months to look for re-canalization of the affected venous system **Results:** In our study among 83 subjects, 48.2 % are from 20 to 40 years of old. Male subjects constituted 68.7%. There were no associated comorbidities among 81.9%(n=68) of study subjects. Pertrochanteric fracture constituted common fracture. Majority had closed type of fractures. Pre operative Wells score was 1.5 and 3 among 50.6% (n=42) and 47% (n=39) subjects 15 respectively with mean value of 2.386. The mean post operative Well's score was 2.512 and 61.4% (n=51) and 22.9% (n=19) subjects has Well's score of 1.5 and 3 respectively. The preoperative doppler showed no evidence of DVT among 97.6% while both fat embolism syndrome and DVT was seen in 1.2% (n=1) subjects. While the post operative doppler showed no evidence of DVT among 98.8%(n=82) subjects. One subject out of 7 with hypertension suffered from DVT. **Conclusion:** In our study among 83 subjects, 48.2 % are from 20 to 40 years of old. Male subjects constituted 68.7%. There were no associated comorbidities among 81.9%(n=68) of study subjects. Pertrochanteric fracture constituted common fracture. Majority had closed type of fractures. Pre operative Wells score was 1.5 and 3 among 50.6% (n=42) and 47% (n=39) subjects respectively with mean value of 2.386. The mean post operative Well's score was 2.512 and 61.4% (n=51) and 22.9% (n=19) subjects has Well's score of 1.5 and 3 respectively. The preoperative doppler showed

no evidence of DVT among 97.6% while both fat embolism syndrome and DVT was seen in 1.2% (n=1) subjects. While the post operative doppler showed no evidence of DVT among 98.8%(n=82) subjects. One subject out of 7 with hypertension suffered from DVT

Keywords: Deep vein thrombosis, lower limb fractures, Well's criteria.

INTRODUCTION

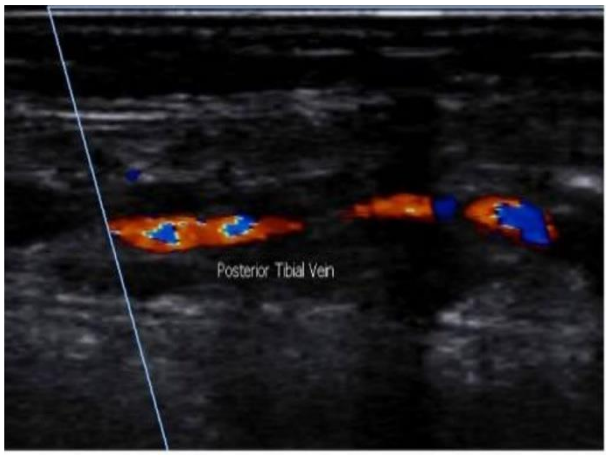
Deep vein thrombosis (DVT), is the presence of a blood clot in the deep venous system of the leg. On its own, deep vein thrombosis is not dangerous, it can become fatal when an embolus forms from the thrombus, enters the pulmonary circulation and is lodged in the lung, thereby requiring an early diagnosis and intervention [1]. Deep vein thrombosis (DVT) is a common complication after trauma, especially after lower extremity fractures [2]. The incidence of preoperative DVT has been reported to be as high as 32% [3]. The incidence of DVT has been considered low in Asia, but the data are based on the general population, not the patients' suffered fractures [4]. As for femoral neck fractures, the incidence of DVT is reported to range from 2.6%2 to 19.5% [5]. However, the actual incidence of DVT after lower limb fracture is underestimated. Three factors, namely, blood flow, hypercoagulability, and endothelial injury play and important role in the process of thrombus formation and they are referred to as Virchow's triad. Notably, major trauma often precipitates one or all of these risk factors [6]. Trauma patients often have all three of these factors, which causes a high risk of thromboembolism. Direct injury to blood vessels can cause intimal damage, leading to thrombosis, prolonged bed rest, immobilization, hypoperfusion, and paralysis, all promoting venous stasis [7]. Patients with unstable lower limb fractures require operative fixation to achieve fracture stability, promoting early mobilization and reduce post-operative hospital stay. Prolonged immobilization is a risk factor to the development of venous thromboembolic diseases [8]. Past studies have shown that DVT in fracture patients is associated with many factors, such as age, sex, the fracture site, and the D-dimer level [9-11]. Williams et al suggested that older age is a risk factor for DVT [12]. In a study of 462 patients, 71.2% of patients with DVT had hip fractures, 11.9% had tibiofibular fractures, and 10.4% had femoral 17 shaft fractures [13]. In another study involving 829 patients, the incidences of DVT in patients with hip fractures were found to be only 16.7% [14]. DVT is difficult to be diagnosed clinically because of the rarity of the classic signs and symptoms, which are present in 23% to 50% of patients [15]. The majority of vessel injuries affect the upper and lower limbs. Vessel injury is a serious problem for physicians, as some vascular lesions may not be initially recognized based on clinical evaluation and vital signs. Thus, imaging and follow-up should be the basis for diagnosis and care [16]. Color Doppler ultrasonography has gradually become the preferred auxiliary examination to confirm DVT with high sensitivity and accuracy [17, 18]. Color flow Doppler is useful for examining residual flow within a thrombosed venous section and for verifying patency of venous segments that are not approachable for compression. An alteration of pulsed Doppler spectral waveform flow pattern might include obstruction proximally to the level of inquiry. Blunted or absences of flow augmentation indicates venous obstruction distally [19,20]. The importance of screening and surveillance for DVT pre-operatively should be emphasized under these circumstances, especially in detecting asymptomatic patients to allow the administration of appropriate treatment and prevent further morbidity and mortality. Therefore, this study was performed to determine the incidence of lower extremity DVT in patients with lower limb fractures and the importance of preoperative screening with color doppler ultrasound prior to surgical intervention

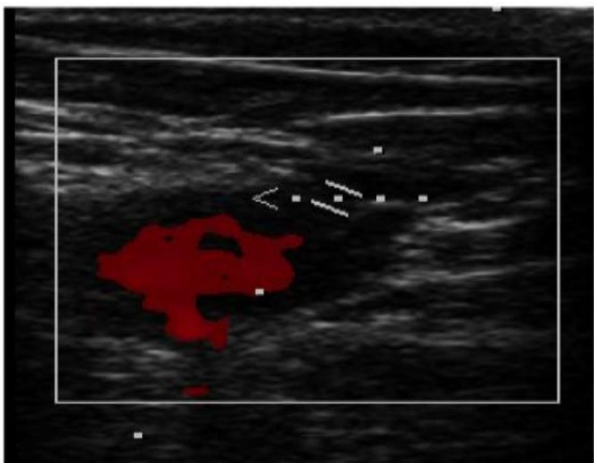
MATERIALS AND METHODS

The patients visiting the orthopedic department Rajarajeswari college, after taking an informed consent and who fulfill both inclusion and exclusion criteria were considered for the study. As a part of preoperative investigations, a colour venous doppler study of the lower limbs was performed, clinical scoring for risk of deep vein thrombosis was done using Well's criteria and noted; post operatively on day 4, another colour venous doppler study of the lower limbs was performed and clinical scoring for risk of deep vein thrombosis was done using Well's criteria and noted. Should any patient develop symptoms/signs of deep vein thrombosis during their stay at the hospital, colour venous doppler study was to be performed and appropriate chemoprophylaxis will be started; for these patients who have developed deep vein thrombosis, follow up colour venous doppler study of the lower limbs will be done after 3 months to look for re-canalization of the affected venous system.

Xray (1) Left per-trochanteric fracture

Xray (2)
POST CLOSED REDUCTION AND INTERNAL FIXATION WITH PROXIMAL FEMORAL NAIL
Image (1) DOPPLERIMAGEON ADMISSION





Image(2) POST OF DOPPLER AFTER 3 MONTHS - RECANALISATION VISUALISED

Clinical picture

RESULTS

TABLE 1: AGE OF THE STUDY PARTICIPANTS:

AGE	Frequency	Percent
18-20	3	3.6
21-30	21	25.3
31-40	19	22.9
41-50	8	9.6
51-60	23	27.7
61-70	9	10.8
MEAN±SD	42.81±15.230	

In our study among 83 subjects, 48.2 % are from 20 to 40 years of old. Also27.7% of participants was in the age group of 51 to 60 years. Mea age of participants was 42.81+15.230.

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GRAPH 1: Age distribution of study participants

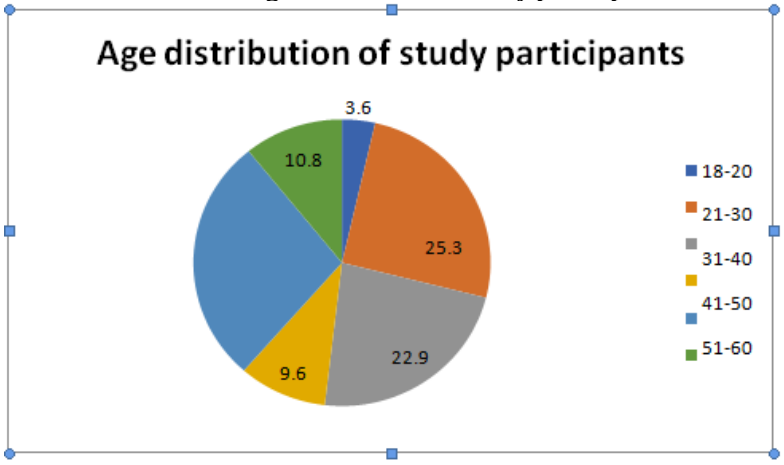

TABLE 2: GENDER DISTRIBUTION OF THE STUDY PARTICIPANTS:

GENDER	Frequency	Percent
MALE	57	68.7
FEMALE	26	31.3

Inpresent study Male subjectsc on stituted6 8.7%.

GRAPH 2: **GENDER DISTRIBUTION OF THE STUDY PARTICIPANTS:**

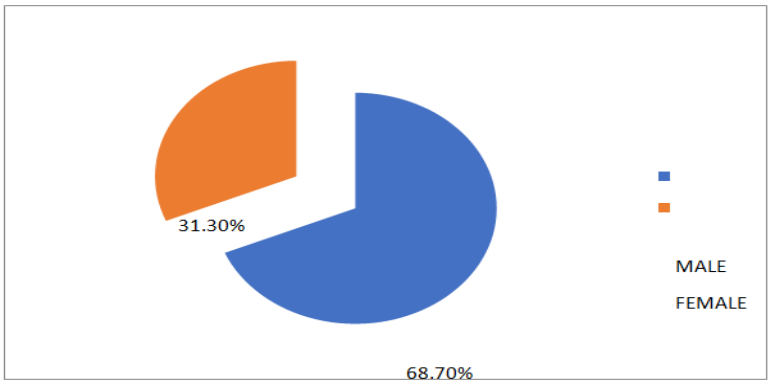

TABLE 3: DISTRIBUTION OF CO-MORBIDITIES AMONG THE STUDY PARTICIPANTS

CO-MORBIDITIES		Frequency	Percent
NO		68	81.9
YES	**HTN**	8	9.6
	HYPOTHYROIDISM	1	1.2
	T2DM	6	7.2

There were no associated comorbidities among 81.9%(n=68) of study subjects. Among remaining 15 subjects, hypertension and diabetes was seen among 8 (09.65) and 6 (07.2%) subjects respectively.

GRAPH3: DISTRIBUTION OF CO-MORBIDITIES AMONG THE STUDY PARTICIPANTS

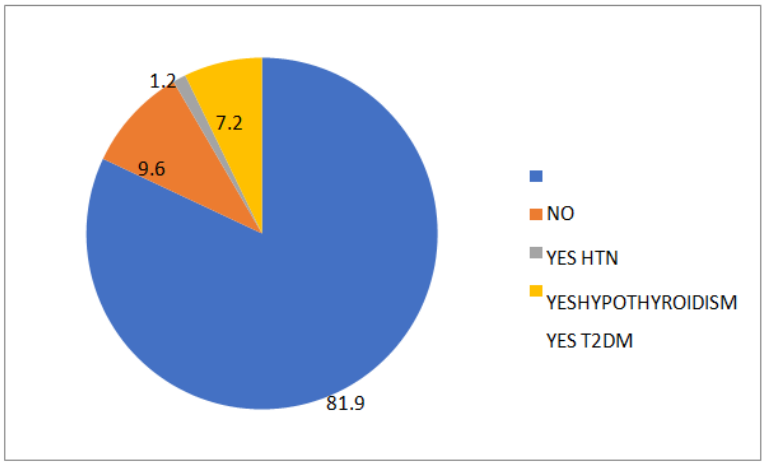

TABLE 4: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON WELL'S SCORE PREOP

WELL'SSCORE PREOP	Frequency	Percent
1.5	42	50.6
3.0	39	47.0
6.0	1	1.2
12.0	1	1.2
MEAN±SD	2.386±1.36	

Preoperative Wels score was 1.5 and 3 among 50.6%(n=42) and 47%(n=39) subjects respectively with mean value of 2.386.

TABLE 5: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON INJURY- OPERATION INTERVAL (DAYS)

INJURY-OPERATIONINTERVAL(DAYS)	Frequency	Percent
1	2	2.4
2	15	18.1
3	19	22.9
4	9	10.8
5	8	9.6
6	5	6.0
7	9	10.8
8	6	7.2
9	4	4.8
>10	6	7.2
MEAN±SD	4.96±2.911	

They had taken 1 day to more than 10 days to get operated from the day of injury to operation, but 51.8% (n=42) of subjects were operated with in 2 to 4 days post injury..

TABLE 6: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON ADMISSION DOPPLER

ADMISSION DOPPLER	Frequency	Percent
NOEVIDENCEOF DVT	81	97.6
FATEMBOLISM SYNDROME	1	1.2
POSTERIORTIBIALVEIN DVT	1	1.2

The preoperative doppler showed no evidence of DVT among 97.6% while both fat embolism syndrome and DVT was seen in 1.2% (n=1) subjects. While the post operative doppler showed no evidence of DVT among 98.8%(n=82) subjects.

GRAPH 4: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON ADMISSION DOPPLER

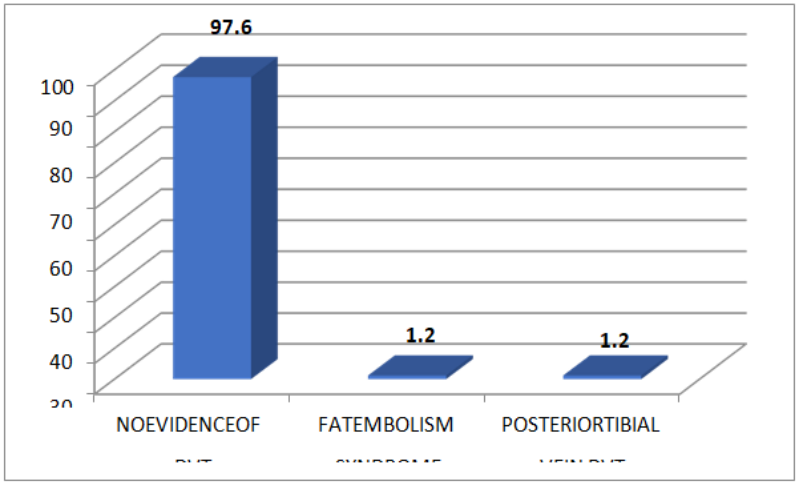

TABLE 7: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON WELL'S SCORE POST-OP

WELL'SSCORE POST-OP	Frequency	Percent
1.5	51	61.4
3.0	19	22.9
4.5	6	7.2
6.0	6	7.2
12.0	1	1.2
2.512+1.71	MEAN+SD	

The mean post operative Well's score was 2.512 and 61.4% (n=51) and 22.9% (n=19) subjects has Well's score of 1.5 and 3 respectively.

TABLE 8 : DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON POST- OP DOPPLER

POST-OP DOPPLER	Frequency	Percent
NOEVIDENCEOF DVT	82	98.8
DVT	1	1.2

GRAPH 5: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON POST- OP DOPPLER

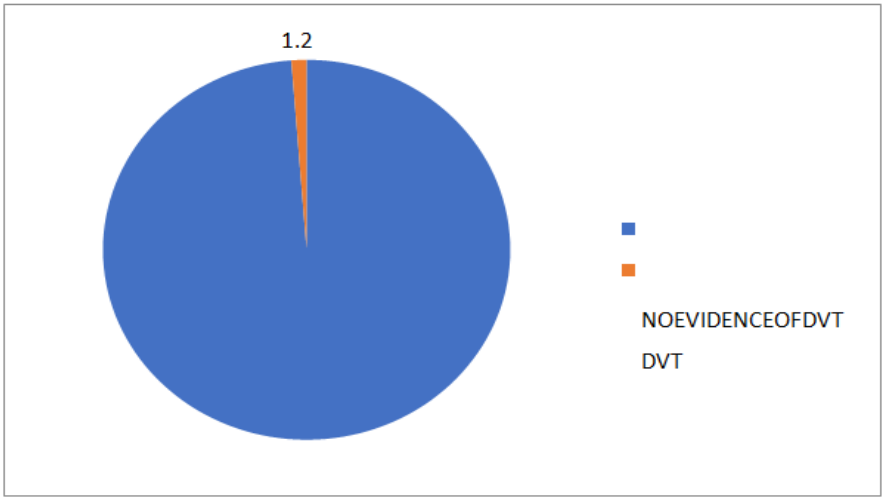

TABLE 9: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON POST- OP DOPPLER & TYPE OF FRACTURE

CO MORBIDITIES		POST OP DOPPLER		P VALUE
		NO DVT	DVT	
CLOSED	**Count**	69	1	

	%	84.1%	100.0%	
OPEN GA 1	**Count**	12	0	1.000
	%	14.6%	0.0%	
OPEN GA 2	**Count**	1	0	
	%	1.2%	0.0%	

In the present study DVT was observed among those who had closed fracture. Open GA1 ad open GA2 patients did not show any DVT.

TABLE 10: DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON POST- OP DOPPLER & WELL'S SCORE

POST OP DOPPLER		**WELL'SSCORE PREOP**	**INJURY- OPERATION INTERVAL(DAYS)**	**WELL'SSCORE POST OP**
NOEVIDENCE OF DVT	**Mean**	2.378	4.98	2.396
	N	82	82	82
	S. D	1.3734	2.927	1.3715
DVT	**Mean**	3.000	4.00	12.000
	N	1	1	1
	S. D	.	.	.
P VALUE		0.654	0.741	**0.000**

In present study mean value of well's score preop among those without DVT is 2.378±1.37 versus well's score post op is 2.396±1.37. Difference observed between DVT and NON DVT group is found to be statistically significant

TABLE 11: DISTRIBUTIONOFTHESTUDYPARTICIPANTSBASEDONPOST- OP DOPPLER & SITE OF FRACTURE

SITE OF FRACTURE		**POST OP DOPPLER**		**P VALUE**
		NO EVIDENCE OF DVT	**DVT**	
BIMALLEOLAR	**Count**	4	0	
	%	100.0%	0.0%	
CALCANEUS	**Count**	2	0	
	%	100.0%	0.0%	

DISTALFEMUR	**Count**	2	0	1.000
	%	100.0%	0.0%	
FEMUR SEGMENTALSHAFT	**Count**	2	0	
	%	100.0%	0.0%	
FEMUR SHAFT	**Count**	10	0	
	%	100.0%	0.0%	
FEMURSHAFT+ ACETABLUAR	**Count**	1	0	
	%	100.0%	0.0%	
FOOT FRACTURE	**Count**	2	0	
	%	100.0%	0.0%	
LATERAL MALLEOLUS	**Count**	1	0	
	%	100.0%	0.0%	
MEDIAL MALLEOLUS	**Count**	1	0	
	%	100.0%	0.0%	
NOF	**Count**	9	0	
	%	100.0%	0.0%	
PATELLA	**Count**	2	0	
	%	100.0%	0.0%	
PERTROCHANTERIC	**Count**	13	1	
	%	92.9%	7.1%	
PILON	**Count**	2	0	
	%	100.0%	0.0%	
TIB-FIBSHAFT	**Count**	12	0	
	%	100.0%	0.0%	

TIBIAPLATEAU	**Count**	7	0	
	%	100.0%	0.0%	
TIBIAPLATEAU+ DISTALFEMUR	**Count**	1	0	
	%	100.0%	0.0%	
TIBIASHAFT	**Count**	11	0	
	%	100.0%	0.0%	

In present study DVT was found among pertrochanteric fracture. DVT was not observed among other forms of fracture.

DISCUSSION

The study was conducted to assess the incidence of deep vein thrombosis using venous Doppler study and to assess the risk factors favouring its development in patients with lower limb fractures admitted to an orthopaedic ward.

DEMOGRAPHIC PROFILE OF THE STUDY PARTICIPANTS:

A total of 83 subjects with lower limb fractures were included in the study. The subjects were distributed across different age group from 18 years to 70 years. As the study was conducted in the tertiary care center that is present next to the National highway, more number young male subjects under working group across different age group was expected as they were more prone to road traffic accidents. Similarly in the study done by Mohamed Yousef et al [1] out of 176 fractured lower limb patients, 129 males and 47 females were included with distribution of study subjects across all age group. Our study demographic profile of patients is comparable to others studies. [2,3]

DISTRIBUTION OF THE STUDY PARTICIPANTS BASED ON SITE OF FRACTURE AND DVT:

The doppler was done in the injured limb as the previous studies found that there is higher incidence of DVT in the injured leg comparing to an uninjured leg even though the DVT can occur in both the injured and uninjured leg. 1 In a study done by Zhang et al [4] concluded that the rate of DVT in the injured limb for pre and postoperative patients was higher than the rate of DVT on the uninjured limb.

DOPPLER AND DIAGNOSIS OF DVT:

A reliable diagnostic investigation is very necessary to diagnose DVT. The available tests for diagnosis of DVT are contrast venography, Colour Doppler ultrasonography, MR venography, D-dimer assays. Colour Doppler is the most simple and safe non-invasive inexpensive, widely available objective test that can be used as a screening method which can be easily repeated. That is why we selected Colour Doppler ultrasonography as a diagnostic tool for our study. 5 Pertrochanteric fracture constituted 16.9%, fracture in shaft of tibia or tibia and fibula constituted 27.8% followed by femur shaft fracture was seen in 12% of subjects. In CS Kapoor et al [5] study 47 (37.6%) patients were having peri-acetabular fractures followed by fractures around knee 20 (16%) and floating knee injury 8 (6.4%)

COMORBIDITIES AND DVT:

Regarding the patient's comorbidities and occurrence of DVT, there was no significant difference found but 1 subject out of 7 with hypertension suffered from DVT. A study done by Huang et al, [6] concluded that hypertension may be an important risk factor of DVT occurrence after orthopaedic surgery. Study done by Zhang et al 7 suggested that, among DVT patients, DM is associated with a poor prognosis, possibly due to thrombotic inflammation. In a study done by Roald Auer et al. [23] Analysis of comorbidities showed that hypertension, smoking history, diabetes, respiratory disease, alcoholism, impaired sensorium, obesity, bleeding disorder, dependent status, steroid use and angina were significantly associated with an increased incidence of DVT

TYPE OF FRACTURE AND DVT

Deep vein thrombosis (DVT) and pulmonary embolism (PE) are known complications after trauma and lower extremity fracture, which carry significant morbidity and mortality. The incidence of venous thromboembolic events (VTE) varies based on the level of injury and inherent patient factors. Multiple studies have investigated the incidence and risk factors associated with VTE (i.e. PE and DVT) after lower extremity fracture. [21] In our study only one subject with pertrochanteric fracture suffered from DVT. The study by Fu et al [8] found incidence rates of pre and postoperative DVT in the patients with neck of femur fracture were high. Few studies are involving only specific types of fracture of lower

limb. Sharma et al. [9] reported 19.6% DVT rate in 112 hip fracture patients ; Bhan et al. [10] had 0% DVT with mechanical prophylaxis in 15 lower limb fractures and 10 spinal injuries, Sen et al. [11] showed that 28.6% of patients had DVT in 56 pelvi-acetabular fracture patients and Mohamad Yousuf et al 1 showed 10 out of 73 periacetabular fracture, 5 out of 35 femur fractures, 5 out of 26 distal knee fracture and 2 out of 7 multiple fractures patients affected by DVT. So reported incidence among Indian patients with lower limb trauma has ranged from 0% to 28.6%.

PREOPERATIVE DOPPLER AND DVT:
A study by Wang et al1 [2] concluded that the preoperative incidence of overall DVT is high and the majority of this DVT were located distally. The highest incidence of proximal DVT occurs in cases of femoral shaft fractures and the lower in distal femoral fractures. The study done by Zhang et al [4] concluded that the real occurrence of DVT after fracture of the hip may be underestimated.

DURATION OF FRACTURE AND DVT:
DVT can occur up to six weeks after hospital discharge17 and some studies suggest that most DVT occur after discharge from hospital. [18,19] We evaluated all our patients for minimum up to 6 months [average follow up is 8.5 months (6–11 months)].

TIME OF SURGERY AND OCCURRENCE OF DVT:
There was not difference with respect to time of surgery and occurrence of DVT. As we found only one case of DVT it is difficult to correlate between duration of injury and surgery. Previous studies by Sharma et al. [13] , Bagaria et al.1 [4] , Montgomery et al. [15] Stannard et al. [16] found significant association between delay in surgery and the development of DVT. In our study the only subject with DVT had the DVT before surgery itself. Wang et al [12] study also reported that the postoperative patients diagnosed with DVT had symptoms of DVT before orthopedic surgery. The 9th edition of the American College of Chest Physicians guidelines strongly recommends for the use of thromboembolic prophylaxis after major orthopaedic surgery including hip and knee arthroplasty and hip fracture surgery but recommends against the routine use of chemical prophylaxis in patients with isolated injuries distal to the knee. [22]
Limitation: The sample size is inadequate to conclude as only one case of DVT was found. The time frame was fixed for the study; we could not extend the timelines. Even Kapoor CS et al, [2] concluded that DVT and PE in Indian patients with lower limb trauma is a fairly low-incidence problem.
Strengths: A very few Indian study was done with the similar objectives. So this study will assist in planning for a better study design. A multi centric study involving a larger number of patients with lower limb trauma is required to confirm and establish Incidence of DVT and to assess risk factors for developing DVT to aid in taking precautionary measures.

CONCLUSION
In our study among 83 subjects, 48.2 % are from 20 to 40 years of old. Male subjects constituted 68.7%. There were no associated comorbidities among 81.9%(n=68) of study subjects. Pertrochanteric fracture constituted common fracture. Majority had closed type of fractures. Pre operative Wells score was 1.5 and 3 among 50.6% (n=42) and 47% (n=39) subjects respectively with mean value of 2.386. The mean post operative Well's score was 2.512 and 61.4% (n=51) and 22.9% (n=19) subjects has Well's score of 1.5 and 3 respectively. The preoperative doppler showed no evidence of DVT among 97.6% while both fat embolism syndrome and DVT was seen in 1.2% (n=1) subjects. While the post operative doppler showed no evidence of DVT among 98.8%(n=82) subjects. One subject out of 7 with hypertension suffered from DVT

ETHICAL AND HUMANE CONSIDERATIONS
All patients gave written informed consent to be included in this study, and the study was authorized by the local ethical committee carried out in accordance with the World Medical Association Declaration of Helsinki.

CONFLICT OF INTERESTS
The authors declare that there is no conflict of interests regarding the publication of this paper. No financial support was taken from any organizations.

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