Assiut Scientific Nursing Journal
http://asnj.journals.ekb.eg http://www.arabimpactfactor.com
DOI: 10.21608/asnj.2023.220878.1624 http://olddrji.lbp.world/indexedJournals.aspx
https://vlibrary.emro.who.int/journals/assiut-scientific-nursing-journal

Deep Vein Thrombosis Risk factors Assessment for Patients Undergoing Orthopedic Surgery

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Abstract
Background: Deep Vein Thrombosis remains serious and common complication after orthopedic surgeries. The Autar DVT risk assessment scale is used for nursing assessment of all DVT patients. It has a simple scoring system to provide a patient risk category based on Virchow's triad of risk factors. **Aim:** To assess the risk factors of deep vein thrombosis among the patient undergoing orthopedic surgery **Research design:** A descriptive exploratory research design was utilized to conduct this study. **Subjects:** 122 adult patients undergoing orthopedic surgery. **Setting:** This study was conducted in orthopedic department and outpatient clinic at Al Azhar Assuit University Hospital. **Tools: Tool (I)** Patient assessment sheet and **Tool (II)** Autar Scale. **Results:** According to the Autar DVT Risk Assessment Scale, quarter of the studied patient were in the "moderate risk" category in the preoperative period (31.1%) and more than a quarter were in the "low risk"(45.1%) and less than one fifth were in the "high risk" (14.8%) and (9.0%) in the "no risk" category in the preoperative period. **Conclusion:** Based on the results of the present study ,can be concluded that; the orthopedic surgery patients understudy had moderate risk of DVT formation and the great risk factors of developing postoperative DVT after orthopedic surgery were aging, immobility and obesity. **Recommendations:** Nurses should use a standardized scale to identify the risk factors for DVT in patients undergoing surgeries such as **(Autar Scale).**

Keywords: Deep Vein Thrombosis, Risk factors & Orthopedic Surgery.

Introduction:
Deep vein thrombosis (DVT) is a condition when a blood clot develops in a vein. A pulmonary embolism, which is a blockage of the pulmonary circulation and is thought to be life-threatening, can result from their breaking off and entering the bloodstream and then travelling to the lungs **(National institute for health and care excellence, 2020).**

Pain, swelling, redness, enlarged veins, and warmth. however some DVTs is asymptomatic. The most common life-threatening concern with DVT is pulmonary embolism, thrombus travel as an embolus through the right side of the heart, and become lodged in a pulmonary artery that supplies blood to the lungs. DVT and PE comprise the cardiovascular disease of venous thromboembolism **(kruger et al., 2019).**

Venous Thromboembolism (VTE) can explain its formation by Virchow's triad of venous stasis, hypercoagulability, and endothelial damage. The recent onset of DVT is caused by inflammation. Other related causes include activation of immune system components, status of blood particles, hypoxia, and activation of platelets**. (Borgel et al., 2019).**

Orthopedic surgery is an invasive procedure that is an important procoagulant that can produce multiple physiological responses in the body, including endothelial damage, decreased blood flow, and increased blood viscosity. Therefore, patients undergoing major orthopedic surgery are considered to be at very high risk for DVT **(Ren et al., 2021).**

Despite guidelines for VTE prophylaxis, patients who undergo orthopedic surgery face the highest risk among all DVT and VTE patients. The surgery itself can cause a temporary interruption in blood flow, which adds to the chances of developing blood clots. Additionally, the trauma from the surgery increases the risk of VTE thromboplastin. Another factor is the use of polymethylmethacrylate (PMMA) bone cement, which also contributes to blood clotting **(Flevas et al., 2018)**

There are a number of factors that can increase the risk of developing venous thromboembolism (VTE). Some of these factors include having had surgery recently, being older in age, having cancer or being overweight, as well as having infections or inflammatory disorders. It's also worth noting that having a personal or family history of VTE, experiencing trauma, being immobile for prolonged periods, or using oral contraceptives or being pregnant or in the postpartum period can also raise the risk. Additionally, there are genetic factors, such

as having a blood type other than O blood type, or having deficiencies in antithrombin, protein C or protein S, as well as having mutations in factor V Leiden or prothrombin G20210A **(Klarin et al ., 2019)**.

Certain infections like sepsis, COVID-19, HIV, and active tuberculosis can increase risk of developing DVT. Chronic inflammatory diseases and certain autoimmune diseases, such as inflammatory bowel disease, systemic sclerosis, Behçet's syndrome, primary antiphospholipid syndrome, and systemic lupus erythematous (SLE), also increase risk of developing DVT **(Jiménez et al., 2021).**

The surgical nurse plays a vital role in ensuring DVT is prevented. It's important for physicians to evaluate DVT risk factors on initial admission and prescribe blood thinners if needed. During the recovery period, nurses closely monitor any signs or symptoms of DVT. The nurses should guide patients to start moving early, practice deep breathing and coughing, and teach them how to use elastic compression stockings for added comfort **(National Institute for Health and Care Excellence., 2020).**

Intermittent pneumatic compression (IPC) devices are designed to enhance blood circulation in the femoral vein by encouraging blood flow from the superficial veins into the deep veins. This wonderful mechanism helps prevent any stagnant blood or build-up in veins **(Chibbaro et al., 2018).**

Compression stockings help to activate the calf muscles and improve blood flow back to your heart by reducing the size of the central vein. This boost in blood speed and volume is great for overall circulation **(Zhang et al., 2019).**

Range of motion (ROM) exercises and elevating legs are the main treatments that can help improve mobility and stability. They can actually boost the flow of blood back to the heart, which is great for preventing DVT. Plus, regularly doing these exercises can really enhance overall quality of life **(Kisner et al., 2017).**

The Autar DVT risk assessment scale is a helpful tool, nurses use to assess the risk of DVT. It has an easy scoring system that helps determine the patient's risk category, based on the Virchow triad of risk factors **(Zhang et al., 2017).**

Significance of the Study:

From the researcher's clinical experience as a nursing supervisor of orthopedic department at Al-Azhar University Hospital, it has been observed that some patients undergoing orthopedic surgery experience deep vein thrombosis after orthopedic surgery this is life threatening condition. Incidence ranges up to 40% to 60% in major orthopedic surgery **(Flevas., 2018)** , studies show that the severe inflammatory processes manifested by covid-19 can increase the incidence of DVT **(Sebuhyan et al, 2020)** .

Aim of the study: To assess the risk factor of deep vein thrombosis among the patient undergoing orthopedic surgery.

Research questions: What are the risk factors of deep vein thrombosis among the patient undergoing orthopedic surgeries?.

Patients and Method:

Research design:

This study was conducted using an exploratory descriptive research approach. **Setting:**

This study was conducted in orthopedic department (contain of one suite, 16 bed), males and females wards, at Al- Azhar University Hospital.

Sample size: The sample was 122 patients was selected by using the following equation according to **Steven K. Thompson (2012):**

$$n = \frac{N \times p(1-p)}{\left[\left[N-1 \times \left(d^2 \div z^2\right)\right] + p(1-p)\right]}$$

N=total patient population size of 12,101 during year 2020 -2021who attended in orthopedic department and outpatients clinic of Al-Azhar Assiut university hospitals.

Z = confidence levels is 0.95 and is equal to 1.96

D= The error ratio is = 0.05

P= The property availability ratio and neutral = 0.50.

Sample:

This study was conducted on 122 adult patients (males and females) admitted to Al- Azhar University Hospital in orthopedic department their aged ranges from 18 to 65 years and willing to participate in the study, this number selected according to the number of orthopedic operation done in the period of collecting data (1/6/2022 to 30\11\2022).

Inclusion Criteria:

Patients diagnosed with:

- Hip Fracture.
- Hemiarthroplasty.
- Total Hip Replacement.
- Scoliosis.
- Disk Prolapse.
- Spine Fracture.

Tools of the study:

To collect relevant data for this study, two tools were used.

Tool (I): Patient assessment sheet:

The tool is designed to evaluate patients' personal and medical data. It is divided into two parts:

Part 1: demographic data of the patients:

This part we gathered some personal information about the patients we studied, like their (age, gender, marital status, level of education and occupation.…..etc.)

Part 2: Medical data: This part included:

- Medical history such as (presence of diabetes, hyperlipidemia, and pulmonary problems).
- Cardiac medical history including (previous myocardial infarction, previous heart catheter stent, coronary artery bypass graft, current chest pain, congestive heart failure, family history of coronary heart diseases, cerebrovascular disease, high blood pressure, peripheral vascular disease)
- Investigations: such as (CBC, ABG, HGB, ECG finding, Echo finding, and Ejection Fraction %).

Tool (II): Autar DVT Risk Assessment: (Autar 1994-1996).

Autar created this scale between **(1994 and 1996**) as a way to evaluate the chances of patients developing DVT and help healthcare professionals determine the best preventive measures to use. The Autar scale is commonly used to assess patients who have had surgery during their hospital stay, This scale includes 41 different items grouped into seven specific risk categories. **(1) Age in (years)**: (20 to 30: 0 points -31 to 40: 1 point, 41 to 50: 2 points, 51 to 60: 3 points > 61: 4 points). **(2) Build body mass index(BMI)**:(16 to 19: 0 points; 20 to 25: 1 point; 26 to 30: 2 points; 31 to 40: 3 points; >41: 4 points),(**3**) **mobility** :ambulant: 0 points; limited with self-assistance: 1 point; very limited with assistance: 2 points; wheelchair-bound: 3 points; bed-bound: 4 points), (4)**Special risk category**: (contraceptive pill:20-35 years old, 1 point; >35 years old, 2 points; pregnancy or puerperium: 3 points), **(5)Trauma risk category**: (head: 1 point; chest: 1 point; head and chest: 2 points; spinal: 2 points; pelvic: 3 points; lower limb: 4 points**), (6)Surgical intervention**: (minor: 1 point; major: 2 points; emergency major: 3 points; pelvic: 3 points; thoracic: 3 points; abdominal: 3 points; orthopedic below the waist: 4 points; spinal: 4 points), (**7**) **high-risk disease**: (ulcerative colitis: 1 point; sickle cell anemia: 2 points; polycythemia anemia: 2points; hemolytic anemia: 2 points; chronic heart disease: 3points; myocardial infarction: 4 points; malignancy: 5 points; varicose veins: 6 points; previous DVT or cerebral vascular accident: 7 points.

Age specific group (years).	**Score.**
• 10-30	0
• 31-40	1
• 41-50	2
• 51-60	3
• 61+	4

Build body mass index(BMI) Wt (kg/Ht(m)).		
Build	**BMI**	**Score.**
• Underweight	16-18	0
• Average /desirable	20-25	1
• Over weight	26-30	2
• Obese	31-40	3
• Very obese(morbid)	41+	

Mobility.	**Score.**
• Ambulant	0
• Limited (uses aids, self)	1
• Very limited (need help)	2
• Chair bound	3
• Complete bed rest	4

Special risk category.	**Score.**
• Oral contraceptives:	
• 20-30years	1
• 35+years	2
• Pregnancy/puerperium	3

Trauma risk category.	**Score.**
• Head injury	1
• Chest injury	1
• Spinal injury	2
• Pelvic injury	3
• Lower limb injury	4

Surgical intervention:	**Score.**
• Minor surgery<30 min	1
• Planned major surgery	2
• Emergency major surge	3
• Thoracic	3
• Abdominal	3
• Urological	3
• Neurological	3
• Orthopedic (below waist)	4

High risk disease:	**Score.**
• Ulcerative colitis	1
• Anaemia: sickle cell	2
• Hemolytic	2
• Polycythemia	2
• Chronic heart disease	3
• Myocardial infarction	4
• Malignancy	5
• Varicose veins	6
• Cerebrovascular accident	6
• Previous DVT	7

Assessment	
Score range	**Risk categories**
• < 6	No risk
• 7-10	Low risk
• 11-14	Moderate risk
• >15	High risk

Autar DVT risk assessment Scale (1994).

Procedure:

This study was carried out in two phases:

Preparatory phase:

Tools development:

Data collection tools was developed based on reviewing the current, past, local and international related literature in the various aspects using books, articles, periodicals, magazines, and references were done.

Content validity and reliability:

- The tools were tested for validity by a jury of five experts in the field of the study and the necessary modifications were done.
- To establish reliability, alpha Cronbach's was used to check the stability of the internal consistency of the study instruments which revealed that the tools of the study were reliable as indicated by the value of (0.87).

Pilot study:

A pilot study was carried out on 10% of the total sample (12 patients) to test feasibility, objectivity, and applicability of the data collection tools & scales. Based on results of the pilot study refinement and modifications was done by the researcher. So that the researcher was found more applicable to current study to use a standardized scale as (Autar DVT Risk Assessment Scale).

Ethical approval:

Approval was obtained from the ethical committee in the faculty of Nursing, the head of Orthopedic department. Oral consents were obtained from subjects, and explanation about the study was given to them included the aim of the study. Confidentiality and anonymity of each subject were ensured through coding of all data and protecting the obtained data.

Implementation phase:

- An official permission was obtained from the head of orthopedic department.
- Patient's agreement for voluntary participation was obtained orally and the purpose and nature of the study was explained.
- The research was conducted during morning and afternoon shifts.
- At the beginning of the interview, the researcher introduced herself to establish a line of contact.
- Patients was assessed for demographic data, and medical data preoperatively using **(tool I.)**
- Patients was assessed for risk factors of deep vein thrombosis using **(tool II)** (Autar Scale).
- This tool was filled by the researcher after asking the patients (through face-to-face interviews) in preoperative period.
- The patients' data were treated with the utmost secrecy and anonymity.
- Data were collected through the period from 1/6/2022 to 30\11\2022.

Statistical analysis:

An appropriate statistical methods & tests were used for analysis of the results. Data collected was analyzed & tabulated using frequency percentage & the suitable statistical tests. We are used a person correlation to appear in the association between scores. All analyses were performed with the IBM SPSS (23) software.

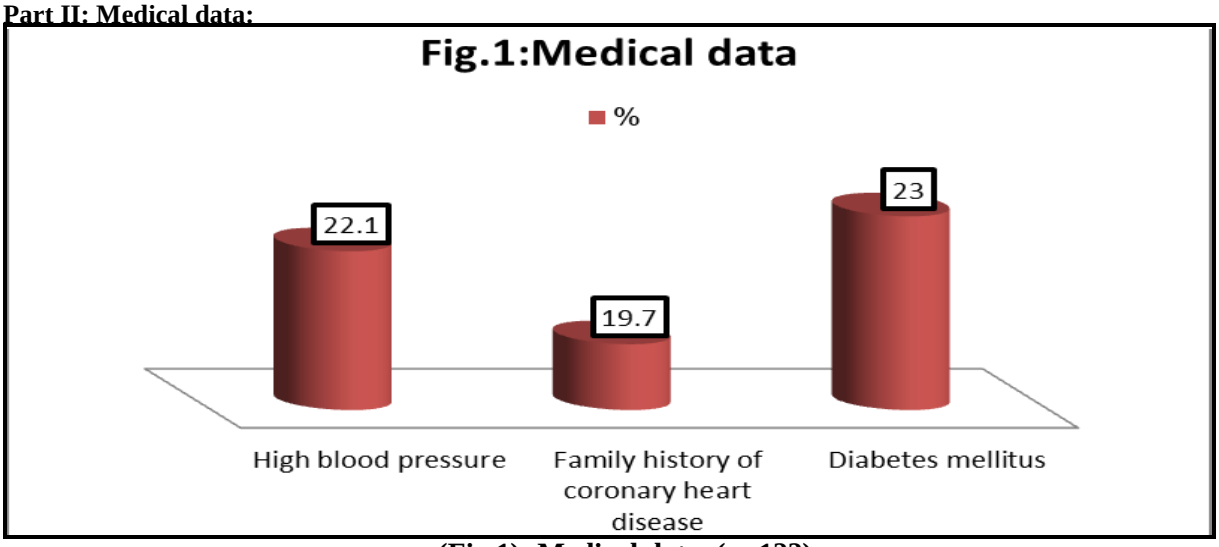
Results:

Part (I): Demographic data.

Table (1): Demographic characteristics of orthopedic surgery patients (n=122).

Demographic characteristics	N	%
Sex:		
Male	56	45.9
Female	66	54.1
Age group:		
18 < 30	15	12.3
30 < 40	24	19.7
40 < 50	50	41.0
50 ≤ 65	33	27
Marital status:		
Single	25	20.5
Married	96	78.7
Divorced	1	0.8
Educational level:		
Illiterate	13	10.7
Read and write	41	33.6
Secondary school	47	38.5
High education	21	17.2
Occupation:		
Manual work	52	42.6
Intellectual work	67	54.9
Others	3	2.5

Part II: Medical data:



(Fig.1): Medical data. (n=122):

Tool II: Autar DVT scale

Table (2): Autar DVT scale. (n=122):

Autar scale	n	%
Type of orthopedic surgery		
traumatic	24	19.7
Non traumatic	98	80.3
Age specific group		
18-30yrs	15	12.3
31-40 yrs.	24	19.7
41-50 yrs.	50	41.0
51-65 yrs.	33	27.0
Mobility		
Ambulate	22	18.0
Limited (uses aids, self)	55	45.1
Very limited (need help)	16	13.1
Complete bed rest	29	23.8
Trauma risk category .		
Spinal injury	6	4.9
Pelvic injury	15	12.3
Lower limb injury	2	1.6
High risk disease score .		
Varicose veins or cerebrovascular accident	2	1.6
Previous DVT	2	1.6
Build body mass index		
Average/desirable (20-25)	24	19.7
Over weight (26-30)	42	34.4
Obese (31-40)	41	33.6
Very obese (morbid)(41+)	15	12.3
Special risk category oral contraceptive.		
35+ Years	10	8.2
Surgical intervention		
Planned major surgery	1	0.8
Emergence major surgery or thoracic or abdominal or urology or neurology	2	1.6
Orthopedic (below waist)	119	97.5
DVT occurence through 14 day postoperatively in orthopedic patients.		
Occur	20	16.4
Don't occur	102	83.6

Table (3): Autar DVT risk category.(n=122)

Assessment protocol	N	%
No risk < 6	11	9.0
7-10 low risk	55	45.1
11-14 moderate risk	38	31.1
High risk >15	18	14.8

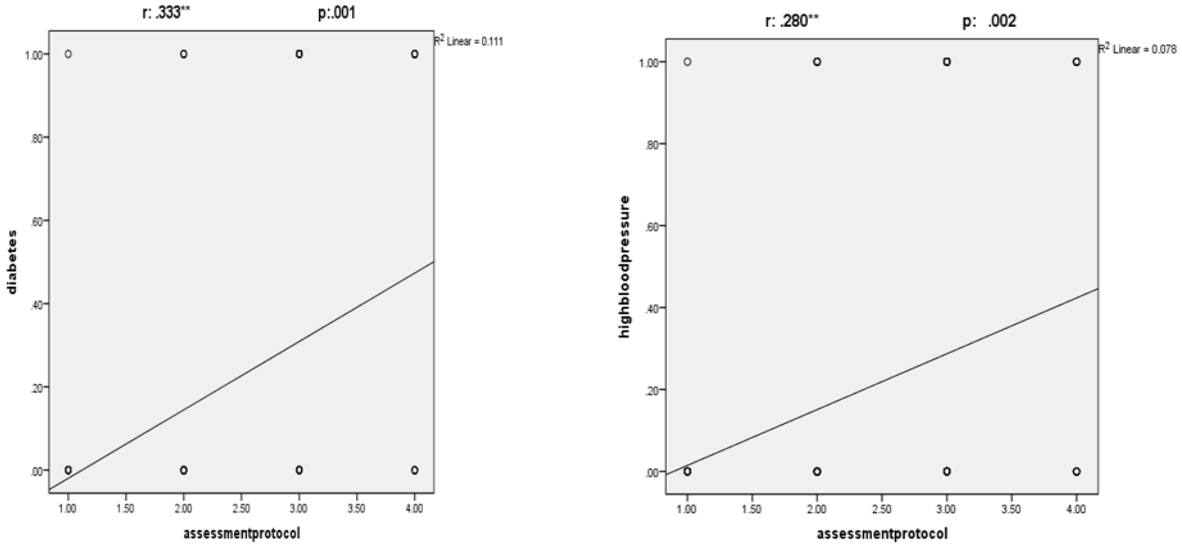


Fig (4): Relationship between diabetes mellitus, high blood pressure and high risk DVT formation (n=122):

Table (1): This table demonstrates that the average range of patient's age was 41-50 yrs.(41.0%) and with predominant female (54.1%) , married (78.7%) and with intellectual occupation (54.9%).one third of studied patients had secondary education (38.5%) ,while most of them live with others (98.4%). (96.7%) of patients their monthly income was enough.

Fig. (1): This fig demonstrates that more than fifth of the studied patients had diabetes mellitus (23.0%) and High blood pressure (22.1%) while (19.7%) had Family history of coronary heart disease.

Table (2): This table demonstrates that vast majority of risk factors for deep vein thrombosis formation were orthopedic surgery below waist (97.5%) and non-traumatic orthopedic surgery (80.3%) followed by mobility limitation (45.1%).while more than one third of studied patients age was (41.0%) with overweight and obesity (34.4%, 33.6 % respectively).

Table (3): This table demonstrates that around one third of the studied patient were at moderate risk for DVT and last were at low and high risk of DVT formation.

Fig (4): This fig demonstrates that there was a statistical significant between diabetes mellitus and high blood pressure with high risk for DVT formation.

Discussion:

DVT remains a serious and common complication after orthopedic surgery. The development of DVT can be caused by one or a combination of three underlying factors, also called the Virchow triad. Vascular trauma, venous congestion, hypercoagulability. Orthopedic surgery can result in significant changes in blood composition, the use of tourniquets, and temporary postoperative mobility limitations. Unfortunately, these factors can increase the risk of deep vein thrombosis (DVT). When blood clots form, symptoms such as pain and swelling in the lower extremities may occur. Worse, blood clots can cause a potentially life-threatening condition called pulmonary embolism **(Matharu et al., 2020).**

Nurses have a significant role in keeping patients safe from DVT during orthopedic surgery. It's crucial to assess a patient's risk factors for DVT, take necessary precautions before, during, and after the surgery, and effectively manage DVT. DVT is a common complication among orthopedic patients, so it's important to determine the patient's risk level and factors before the surgery **(Galsklint et al., 2022).** Therefore, the current study was conducted to assess risk factors for deep vein thrombosis in patients undergoing orthopedic surgery.

Regarding the personal data of the studied patients, the study found that the vast majority of the studied patients were females and more than one third of the studied patients aged from forty to fifty years this result disagree with **(Tramujas., 2022**) They reported that "the most commonly studied patients were male, with a mean age was fifty three years."**,** This finding is in a line with **(Hussein et al., 2020)** who mentioned in their study that the majority of the studied patients in the age range of forty to fifty years**.**

Regarding to medical data the current study found that more than one fifth of the studied patients had diabetes (23.0%) and hypertension (22.1%) while (19.7%) had a family history of coronary heart disease, This result is consistent with (**Wang et al., 2019).** as they reported that in their study " most DVT patients had one or more other high-risk conditions. Common comorbidities include hypertension, coronary artery disease, and diabetes". From researcher's point of view, patients with hypertension, coronary heart disease, diabetes were undergoing orthopedic surgeries at risk to have DVT. Because accumulation of cells and lipids in the blood causes the lining of the vein walls to thicken.

Regarding Risk factors for deep vein thrombosis (DVT) in patients undergoing orthopedic surgery (age): A current study found that more than one-third of patients aged from forty to fifty years this result agree with (**Kaya et al., 2023).** They reported that "lifetime risk of thromboembolism increases after age of forty five years." from researcher's point of view ,deep vein thrombosis can occur at any age, but the risk increases with age because aging causes muscle weakness, venous insufficiency, endothelial dysfunction, limited mobility, and systemic disease, the risk increases, increases with age.

Regarding immobility; this study shows that the majority of studied patients experience very limited and complete bed rest **(Kaya et al., 2023)** were supporting the study as they reported that "After surgery, most patients become very dependent and need help. Immobilization significantly increases the risk of DVT, especially in patients undergoing major surgery". From researcher's point of view, immobility causes blood stasis and increases the formation of blood clots, increasing the risk of DVT.

Regarding the trauma risk of injury; the majority of studied patients had pelvic injury **(Weiguang et al., 2022**) were in the same line as findings showed that "patients with pelvic and acetabular fractures are at significantly increased risk of developing DVT and pharmacologic prophylaxis should be recommended in preoperative and inpatient DVT management". from researcher's point of view, the Pelvic injuries increase the risk of developing DVT from intraoperative manipulations, which can lead to increased vascular injury and thrombus formation in patients with pelvic injuries.

Regarding body mass index; the study found that the vast majority experience over weight and obesity **(Weitz et al. 2021)** "Obese people are about twice as likely to develop both DVT and PE compared to normal-weight people". From researcher's point of view, the obesity increased risk of developing DVT due to unbalanced activation of coagulation and inflammatory cascades and obesity impairs venous return in obese patients.

Regarding the relationship between diabetes mellitus and high blood pressure and risk for developing DVT ; this study found that a statistically significant relationship between diabetes mellitus , hypertension and a higher risk of developing DVT. This finding was in agreement with **(Wang et al., 2019).** As they reported that in their study" Most DVT patients had one or more other high-risk diseases. The most common comorbidities included hypertension, coronary artery disease and diabetes". From researcher's point of view, the patients with hypertension, coronary heart disease, diabetes were undergoing orthopedic surgeries at risk to have DVT due to the lining of the veins wall becomes enlarged, as cells from the blood, along with lipids accumulate. Furthermore (**Heit et al., 2016).** Agreeing with the present study that "Risk factors include age, heart failure, immobility, major trauma, obesity, previous DVT, recent surgery, and smoking."

Conclusion:

DVT remains a common complication after orthopedic surgery. Based on the results of this study, the orthopedic patients had a moderate risk of developing DVT, and the greatest risk factors for developing postoperative DVT after orthopedic surgery were aging, immobility (<72 hours), and obesity according to the Autar scale.

Recommendations:

Based on the results of current research, the following recommendations were made:

- Nurses should use a standardized scale to identify the risk factors for DVT in patients undergoing surgeries such as (Autar Scale).
- A continuous educational and training program for staff nurses planned and offered on regular basis for patients undergoing orthopedic surgery, including post orthopedic surgery discharge instructions and home care.
- In health care settings, it would be great to have handy booklets or brochures in Arabic that provide information about post orthopedic surgery discharge instructions. These helpful resources should be

readily given to both orthopedic surgical patients and their care giver.
- We should definitely consider conducting multicenter research on DVT risk assessment and prophylaxis.
- Replication of the same study on a larger probability sample at different geographical locations for data generalizability.

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