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Risk Factors of Bleeding among Patients with Acute Leukemia

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Abstract:
Background: Patients with acute leukemia are at high risk for bleeding. Early recognizing these risk factors is crucial for preventing serious complications. **Aim:** To identify the risk factors of bleeding among patients with acute leukemia **Design:** Descriptive exploratory research design. **Subjects and setting:** Seventy-six 76 patients with acute leukemia admitted in Medical Oncology Department at South Egypt Cancer Institute. **Tools**: Tool (I): Patient assessment sheet; (1): Demographic data, (2): Clinical data, (3): Bleeding risk factors, (4): Laboratory investigations and tool (II): WHO bleeding scale. **Results:** Revealed the mean age of studied patients was 40.22 years, (60.5%) were males, (60.5%) diagnosed with AML. Fatigue (73.7%) and fever (71.1%) were the most commonly reported symptoms. According to WHO bleeding scale, The majority of patients categorized as grade 2 (44.7%) followed by grade 0 (32.9%) and grade 3 was (22.4%). Factors such as hypertension, diabetes mellitus, previous history of bleeding, thrombocytopenia, disseminated intravascular coagulation and smoking showed statistically significant relationship with higher WHO bleeding grades ($p<0.5$) **Conclusion:** The bleeding severity in acute leukemia patients was significantly associated with factors such as prior bleeding, hypertension, diabetes, smoking, thrombocytopenia, and disseminated intravascular coagulation, highlighting the importance of early identification and management of these risks. **Recommendations:** The critical importance of early identification and proactive management to prevent bleeding severity in acute leukemia patients and improve patient outcomes.

Keywords: Acute Leukemia, Bleeding & Risk Factors

Introduction:
Leukemia is a group of blood cancers that usually begin in the bone marrow and result in high numbers of abnormal blood cells. These blood cells are not fully developed and are called blasts or leukemia cells. **(Arber et al., 2019).** World Health Organization (WHO) classification of acute leukemia into acute myeloid leukemias and acute lymphoblastic leukemias. Four major groups of acute myeloid leukemia are recognized, acute myeloid leukemias with recurrent genetic abnormalities, acute myeloid leukemia with multilineage dysplasia, acute myeloid leukemias, therapy related, and acute myeloid leukemia not otherwise categorized **(Alaggio et al., 2022).**

Symptoms of acute leukemia usually develop over a few weeks and become worse over time. Symptoms can include: looking pale, feeling tired, breathlessness, frequent infections, unusual and frequent bruising or bleeding, such as bleeding gums or nosebleeds and losing weight **(Isidori et al., 2020).** The first clue to a diagnosis of acute leukemia is typically an abnormal complete blood count. Acute leukemia can also present with isolated decreases in platelets, red blood cells, or even with a low white blood cell count (leukopenia) **(Zhao et al., 2022).**

Bleeding is a loss of blood .It can be external or internal or inside the body **(Bumbea et al., 2021).** Risk factors for bleeding are advanced age, gender, low body weight<60, severe renal dysfunction, prior stroke, uncontrolled hypertension, pressure trauma, antiplatelet, NSAID, ,anemia, DM, smoking, prior stent thrombosis, The low platelet count can cause ecchymoses (bruises) and petechiae. Major hemorrhage also may develop when the platelet count drops to less than 10,000/mm3. The most common bleeding sources include gastrointestinal (GI), pulmonary, vaginal, and intracranial. Disseminated intravascular coagulopathy (DIC) is common, fever and infection also increase the likelihood of bleeding **(Strapatsas et al., 2021).**

Nursing Management should focus on identifying the underlying causes and, where possible, controlling bleeding. A review of concurrent medications and other illnesses may help in identifying the etiology or contributing factors such as the concurrent use of nonsteroidal anti-inflammatory drugs, which may exacerbate or precipitate bleeding through their actions on the gastrointestinal tract and platelet functioning **(Khalifa et al., 2021).**

Significance of the study:

According to statistical reports of hematological malignancy at **South Egypt Cancer Institute, (2022)** documented 138 cases diagnosed with acute leukemia admitted in Medical Oncology Department. It was observed that patients complain of increased bleeding tendency. Bleeding and thrombosis are major risk factors for early death in patients with leukemia; So, this study will help to identify the risk factors of bleeding among patients with acute leukemia at South Egypt Cancer Institute.

Aim of the study:

To identify the risk factors of bleeding among patients with acute leukemia.

Research question:

What are the risk factors of bleeding among patients with acute leukemia?

Subjects and method:

Research design:

Descriptive exploratory research design was utilized in this study.

Setting:

The study was carried out in Medical Oncology Department at South Egypt Cancer Institute

Sample:

Subjects of the study were 76 patients with acute leukemia admitted in Medical Oncology Department at South Egypt Cancer Institute.

Sample Size:

The sample was calculated according to the following equation: **Steven, (2012)** The current study will have been conducted on 76 patients with acute leukemia. The sample was calculated according to the following equation:

$$n = \frac{[DEFF * Np(1-p)]}{[(d2/Z21-\alpha/2 * (N-1) + p * (1-p)]}$$

- DEFF (Design effect) = 1
- N (population) = 138
- p (Hypothesized %) = 50%+/-5
- d (tolerated margin of error) = 0.05
- Z (level of confidence) = 1.96
- α (Alpha)= 0.05

$$n = \frac{[1 * 138 * 50\% +/-5\,(1-50\% +/-5)/[(0.05)2}{[(1.96)21-0.05 * (138-1) + 50\% +/-5\,(1-50\% +/-5)]}$$

- **n=** 100 patients

Inclusion criteria:

Seventy-six full conscious adult patients who had definitive diagnosis of acute leukemia by the oncologist, male and female, whose ages ranged from (20 to 65 years old), undergoing different leukemia treatment modalities, suffers from bleeding tendency previously, currently, or up to discharge from the hospital. Patients with chronic leukemia and other bleeding leading diseases were excluded.

Tools of data collection:

Tool (I): Patient assessment sheet:

This tool was developed by the researcher after reviewing related literatures. It was consisted of four parts

Part (1): demographic data: It included the patient's code, age, sex, marital status, educational level**.**

Part (2): Clinical data

This part included the health status of the studied patients as: present and past health history, diagnosis, family history, medications, and vital signs.

Part (3): Bleeding risk factors

This part was developed by the researchers after reviewing the literatures **(Bae et al., 2019; McDermott et al., 2022 &Thu et al., 2020).** This part evaluated risk factors for bleeding among patients with acute leukemia such as; advanced age(<65years), gender, low body weight, severe renal dysfunction, recent bleed (1year), prior stroke, uncontrolled hypertension, pressure trauma, antiplatelet, NSAID, anemia, DM, smoking, prior stent thrombosis….etc

Part (4): Laboratory investigations:

This part assessed laboratory investigations which include complete blood count (HGB level, RBCs, WBCs, HCT, Platelet Count), coagulation parameters; prothrombin time (PT) and concentration, partial thromboplastin time (PTT), international normalized ratio (INR), liver and renal function tests.

Tool (II): WHO Bleeding Scale:

This scale was developed by **Miller et al., (1981)** and adopted by **Gresele et al., (2020).** It was adopted in this study to assess bleeding grades. It contained four grades as shown in next table.

Validity and reliability:

The study's content validity and reliability were evaluated by a jury of five experts from Oncology and Nursing fields, Assiut University. Any necessary revisions were implemented. The reliability was assessed using correlation coefficients and Alpha Cronbach's test. Alpha Cronbach's test values for tools one and two are 0.93 and 0.91, respectively.

A pilot study:

A pilot study was carried out and conducted on 10% of the sample (8 patients) to evaluate the applicability and clarity of tools. Based on the results of the pilot study, needed refinements and modifications were made. patients selected for the pilot study were not included in the main study

Method:

- The study tools were designed after an extensive literature review. An official approval letter was taken from the dean of the Faculty of Nursing at Assiut University to the director of the South Egypt

Cancer Institute to collect data for conducting the study.
- Patient's agreement for voluntary participation was obtained after explaining the purpose and the nature of the study.
- Patients who met the criteria for possible inclusion were approached by the researcher. Data were collected during after noon and night shifts. Data were collected through face-to-face interview.
- The researcher used appropriate personal protective equipment (PPE) during data collection to protect patients from infection.
- The collection of data lasted through the period from April 2023 to January 2025. Each patient was assessed for demographic, clinical data, risk factors, and laboratory investigations using (tool I).
- Each patient was interviewed to fill in the study tools and to be assessed for bleeding grades using (tool II).

Ethical considerations:

Research proposal was approved from Ethical Committee in the Faculty of Nursing, Assiut University on (26/3/2023) NO. (1120230598). There was no risk for study subject during the application of the study; confidentiality and privacy of the studied patients were asserted by the investigator. Explanation of the aim and nature of the study was done to studied patients. The right to refuse participation in the study was emphasized to the patients; consent for participation in the study was obtained.

Statistical analysis.

Collected data was analyzed and tabulated. The researcher used an appropriate statistical analysis method and tests for analysis of the result. The statistical package for (SPSS) version (23)was used to analyze data. Descriptive statistics were used for the quantitative data. It included frequencies, percentages, mean ±SD person correlation (correlation is significant at the 0.05 level). The level of significant for this study was set at ($P<0.05$) to detect any indication of differences found in the data available.

Results:

Table (1): Distribution of the studied patients' demographic data No. (76)

Demographic data	No. (76)	%
Age: (years)		
20 - < 30	17	22.4%
30 - < 40	21	27.6%
40 - < 50	18	23.7%
≥ 50	20	26.3%
Mean ± SD	40.22 ± 11.83	
Gender:		
Male	46	60.5%
Female	30	39.5%
Occupation:		
Employed	38	50.0%
Unemployed	38	50.0%
Level of education:		
Illiterate	12	15.8%
Read & write	64	84.2%
Marital status:		
Single	16	21.1%
Married	60	78.9%

Table (2): Distribution of the studied patients' clinical data No. (76)

Clinical data	No. (76)	%
Medication history:		
Yes	10	13.2%
No	66	86.8%
Bleeding before admission:		
Yes	27	35.5%
No	49	64.5%
Bleeding at presentation:		
Yes	51	67.1%
No	25	32.9%

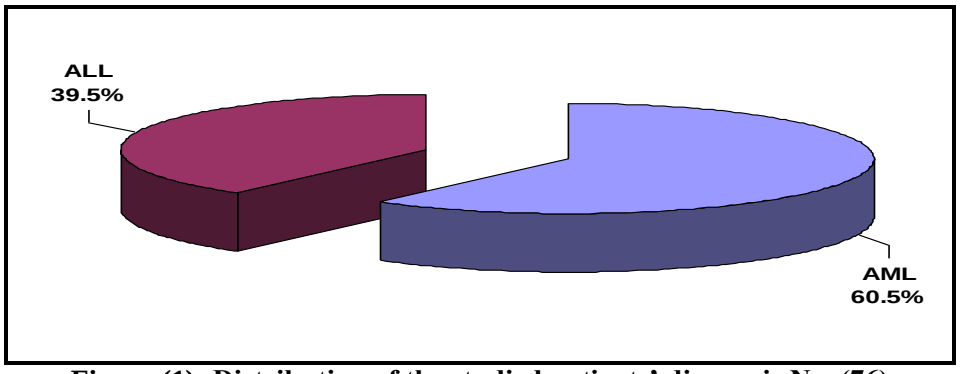

Figure (1): Distribution of the studied patients' diagnosis No. (76)

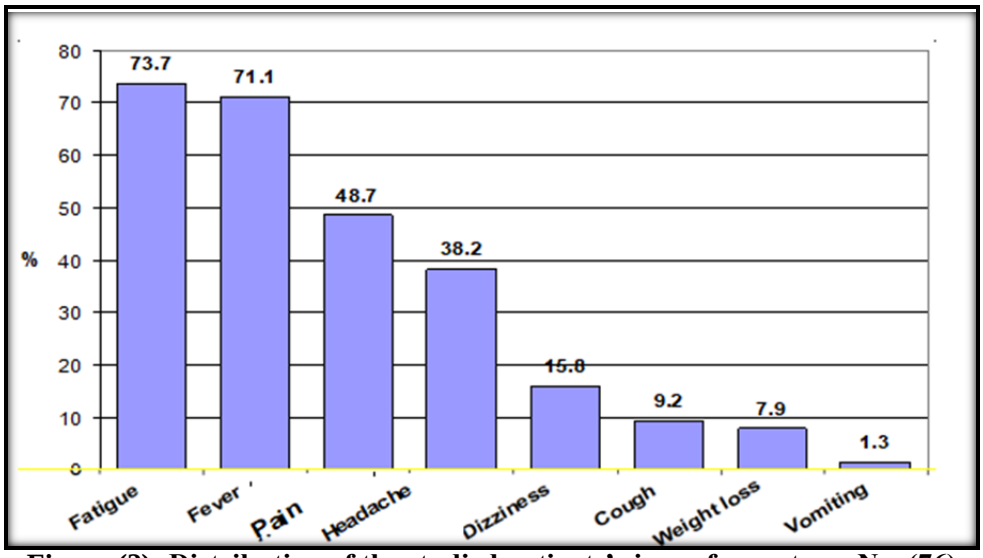

Figure (2): Distribution of the studied patients' signs of symptoms No. (76)

Table (3): Distribution of the studied patients' Bleeding risk factors No. (76)

Bleeding risk factors	No. (76)	%
Advanced age (50- < 65 years)	20	26.3%
Gender:		
Male	46	60.5%
Female	30	39.5%
Weight:		
Mean ± SD	72.29	9.77
Height:		
Mean ± SD	167.18 ± 6.25	
Renal impairment	0	0.0%
Recent bleed	27	35.5%
Prior stoke	0	0.0%
Hypertension	6	7.9%
Stress ulcer	2	2.6%
Antiplatelet	0	0.0%
NSAID	23	30.3%
Anemia	76	100.0%
Thrombocytopenia	68	89.5%
DM	4	5.3%
Smoker	31	40.8%
Anti-coagulant	0	0.0%
DIC	9	11.8%
Hepatic dysfunction	0	0.0%

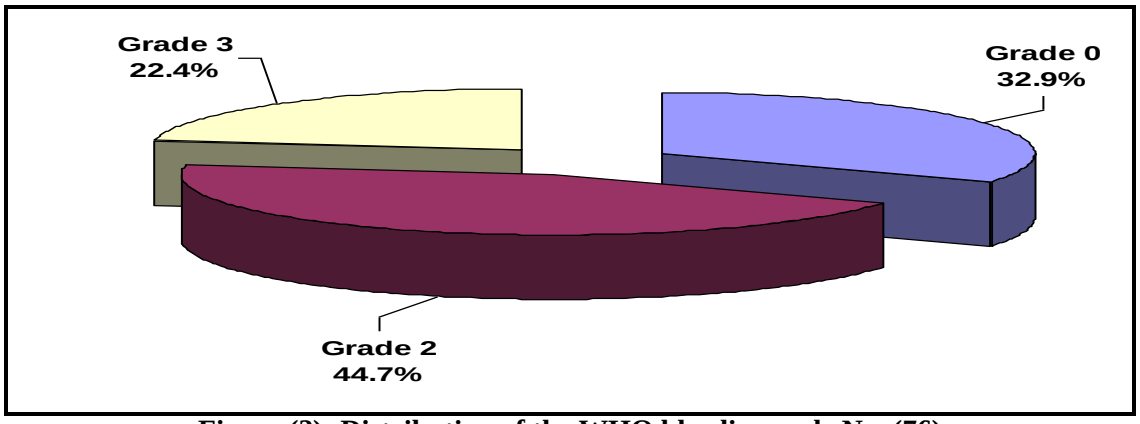

Figure (3): Distribution of the WHO bleeding scale No. (76)

Table (4): Relation between risk factors and WHO No. (76)

Risk factors	WHO grade						P-value
	Grade 0		Grade 2		Grade 3		
	No.	%	No.	%	No.	%	
Advanced age:							
Yes	6	30.0%	9	45.0%	5	25.0%	0.926
No	19	33.9%	25	44.6%	12	21.4%	
Gender:							
Male	15	32.6%	23	50.0%	8	17.4%	0.365
Female	10	33.3%	11	36.7%	9	30.0%	
Weight:							
Mean ± SD	71.40 ± 9.11		72.35 ± 10.77		73.47 ± 9.03		0.800
Height:							
Mean ± SD	167.92 ± 5.24		165.82 ± 5.85		168.82 ± 7.99		0.211
Recent bleed:							
Yes	1	3.7%	16	59.3%	10	37.0%	0.000*
No	24	49.0%	18	36.7%	7	14.3%	
Hypertension:							
Yes	0	0.0%	1	16.7%	5	83.3%	0.001*
No	25	35.7%	33	47.1%	12	17.1%	
Stress ulcer:							
Yes	0	0.0%	2	100.0%	0	0.0%	0.281
No	25	33.8%	32	43.2%	17	23.0%	
NSAID:							
Yes	10	40.0%	7	20.6%	6	35.3%	0.242
No	15	60.0%	27	79.4%	11	64.7%	
DM:							
Yes	0	0.0%	0	0.0%	4	100.0%	0.001*
No	25	34.7%	34	47.2%	13	18.1%	
Anemia:							
Yes	25	32.9%	34	44.7%	17	22.4%	0.271
No	0	0.0%	0	0.0%	0	0.0%	
Thrombocytopenia:							
Yes	17	25.0%	34	50.0%	17	25.0%	0.013*
No	8	100.0%	0	0.0%	0	0.0%	
DIC:							
Yes	0	0.0%	4	44.4%	5	55.6%	0.015*
No	25	37.3%	30	44.8%	12	17.9%	
Smoker:							
Yes	13	41.9%	16	51.6%	2	6.5%	0.020*
No	12	26.7%	18	40.0%	15	33.3%	

Table (1): Shows the demographic data of 76 studied patients and shows a diverse sample with a mean age of 40.22 years, and a relatively balanced distribution across different age groups. More males (60.5%) participated compared to females (39.5%). The sample is equally split between employed and unemployed individuals (50% each). A high percentage (84.2%) are literate, with only 15.8% being illiterate. Most participants are married (78.9%), while a smaller group is single (21.1%).

Table (2): Reveals that the majority of patients (86.8%) had no prior medication history, while 13.2% reported using medications. Regarding bleeding history, 35.5% of patients experienced bleeding before admission, while 64.5% did not. At the time of presentation, a significant portion of patients (67.1%) were already bleeding, compared to 32.9% who had no bleeding symptoms at that point.

Figure (1): Shows that the majority of patients (60.5%) diagnosed with Acute Myeloid Leukemia (AML), while 39.5% had Acute Lymphoblastic Leukemia (ALL). Among the AML patients, the most common subtypes were M4 (30.4%) and M5 (21.7%), followed by M2 (17.4%) and M3 (10.9%). A smaller number had subtypes M0 (8.7%), M4 M5 (8.7%), and M1 M2 (2.2%). In the ALL group, more than half of patients (63.3%) had B-cell ALL, while 36.7% had T-cell ALL.

Figure (2): Shows the distribution of signs and symptoms in the studied patients (73.7%) had fatigue and fever (71.1%). A significant proportion also experienced pain (48.7%), headache being reported by 38.2% of patients. Other symptoms were less common, with 15.8% reported dizziness, 9.2% have cough, and 7.9% experienced weight loss. Vomiting was the least reported symptom, with only 1.3% of patients experienced it.

Figure (3): Reports the distribution of the WHO bleeding scale in the studied patients ; the majority of patients were categorized as Grade 2 (44.7%), followed by Grade 0 (32.9%) and Grade 3 (22.4%). Among those with Grade 2 bleeding common symptoms included distinct purpuric lesions (41.2%), epistaxis (23.5%), unexpected vaginal bleeding (14.7%), and fresh blood in the stool (5.9%). Additionally, patients had mild bleeding symptoms with oropharyngeal bleeding, multiple bruises and hematemesis occurred in very few individuals (5.9% ,5.9% and 2.9%, respectively). Grade 3 patients experienced more severe symptoms, with soft tissue bleeding being the predominant sign (94.1%), while vaginal bleeding was less common (5.9%).

Table (3): Shows the distribution of bleeding risk factors in the studied. A significant portion of the patients were of advanced age (26.3%) and male (60.5%). The mean weight of the patients was 72.29 kg, with a standard deviation of 9.77, and the mean height was 167.18 cm (SD = 6.25). A considerable number of patients had a history of recent bleeding (35.5%) and were smokers (40.8%). While there was no recorded renal impairment ,anticoagulant using, or prior stroke, other risk factors such as hypertension (7.9%), stress ulcers (2.6%), NSAID use (30.3%), and anemia (100%) were noted. A smaller proportion of patients had diabetes mellitus (5.3%), disseminated intravascular coagulation (DIC) (11.8%), and hepatic dysfunction (none).

Table (4): Highlights significant associations between certain risk factors and the severity of bleeding in patients, as classified by WHO grade. Factors such as recent bleeding, hypertension, diabetes mellitus, thrombocytopenia, DIC, and smoking showed statistically significant relationships with higher WHO grades. Notably, recent bleeding, hypertension, and DM were strongly associated with increased bleeding severity. On the other hand, age, gender, weight, height, stress ulcers, and NSAID use did not exhibit significant correlations with WHO grades.

Discussion:

Patients with acute leukemia are at high risk for bleeding due to factors such as thrombocytopenia, coagulation abnormalities and chemotherapy side effects. Recognizing these risk factors early is crucial for preventing serious complications **(Wang et al., 2022).** So, this study aimed to identify the risk factors of bleeding among patients with acute leukemia.

Regarding the demographic data: the present study found the majority of the studied patients with a mean age of forty years, indicating that acute leukemia in this sample primarily affects middle-aged adults. The distribution across different age groups reflects a diverse and representative sample, which strengthens the generalizability of the findings. Moreover, the predominance of male patients is consistent with several epidemiological reports suggesting that acute leukemia tends to occur more frequently in males than females.The researcher opinion that these findings as indicative of a slight gender predisposition, possibly due to hormonal, genetic, or environmental factors that warrant further investigation. The age distribution also suggests that awareness, early detection, and intervention should not be limited to the elderly, as middle-aged individuals appear equally vulnerable in this context. These demographic characteristics are important when tailoring nursing instructions, coping strategies, and patient education—as age and gender may influence both the perception of illness and adherence to care. This was supported by, **Siegel et al., (2021)** reported that acute myeloid leukemia (AML)

incidence increases with age, but a significant number of cases are still diagnosed in middle adulthood, aligning with the mean age found in this study. **Deschler & Lübbert, (2023)** observed a higher prevalence of AML in males, especially in younger and middle-aged adults. **Döhner et al., (2024)** in their clinical practice guidelines also noted a male predominance in AML incidence.

On the other hand, **Zhang et al., (2022)** found no significant gender differences in the incidence of acute lymphoblastic leukemia (ALL) in their cohort of adult patients in China, suggesting regional or subtype variability in demographic patterns. A study by **Kantarjia, (2023)** on acute leukemia treatment outcomes emphasized that socioeconomic factors and access to care may influence diagnosis age more than biology alone, potentially confounding the observed mean age.

The present study showed that the sample is evenly split between employed and unemployed participants, and married which may reflect a balance between individuals with different levels of daily stress, healthcare access, and lifestyle routines. The relatively high literacy rate was encouraging, as literacy is often associated with better health awareness, treatment compliance, and coping strategies in chronic illnesses like acute leukemia. As the researcher opinion, this demographic mix as beneficial for exploring how employment status, literacy, and marital status affect patients' ability to understand their condition, engage with education sessions, and adopt coping strategies during their treatment journey.

In this line, **Schulz & Sherwood (2020)** emphasized the importance of family and spousal support in improving outcomes among cancer patients. **Hinz et al., (2024)** reported that employment status is a strong indicator of perceived well-being and functional health in cancer patients, supporting the idea that work engagement may buffer psychological stress. Disagreeing this, **Nakata et al., (2021)** argued that literacy level alone may not ensure better health outcomes, as emotional readiness and trust in the healthcare system can sometimes outweigh formal education in influencing patient behavior. **Bettencourt et al., (2023)** found that unmarried patients can have similar or even better psychological outcomes compared to married ones when they have strong non-spousal social support systems, challenging the assumption that marriage always implies better coping.

Regarding the medical data, the present study indicated that a significant majority of patients had no prior medication history, suggesting that medication-induced bleeding was likely not a contributing factor in most cases. This highlights the importance of internal disease processes—such as thrombocytopenia or coagulopathies—as primary contributors to bleeding in acute leukemia. Furthermore, around the third of patients reported a history of bleeding prior to admission, while an even higher percentage were actively bleeding at the time of presentation.

This sharp increase emphasizes the rapid progression of bleeding risk in acute leukemia, likely due to disease advancement or treatment delays. As a researcher, these findings underscore the need for early screening and preventive nursing education, even in patients who present without a history of bleeding. The data also reflect a potential gap in early detection or referral systems, suggesting that patients may not seek care until significant symptoms arise, increasing their risk of complications.

Ng et al., (2020) found that bleeding at presentation is a common and potentially life-threatening symptom among patients with acute leukemia, particularly in those who have developed coagulopathies or thrombocytopenia during the course of the disease. **Wang et al., (2021)** highlighted that platelet count and disease stage are strongly associated with bleeding at presentation in acute leukemia, supporting the idea that a significant portion of these patients develop active bleeding during hospitalization due to progressive hematologic abnormalities.

In the opposite side, **Chang et al., (2021)** found that acute leukemia patients without prior bleeding history often present with less severe symptoms initially and that prior medication use (especially anticoagulants) was more significant in determining early bleeding complications. Their study did not support the idea that acute onset bleeding is as prevalent in the absence of prior bleeding or medication history. **Hellou et al., (2023)** reported that while active bleeding at presentation is common, it may not necessarily correlate with the severity of the underlying leukemia, suggesting that early therapeutic interventions and medical management can control bleeding regardless of the patient's initial bleeding symptoms.

Regarding signs and symptoms, patients in this study, majority was with fatigue and fever. These findings are consistent with the typical presentation of acute leukemia, where systemic symptoms, such as fever and fatigue, are often early indicators of disease progression. The high prevalence of headaches and pain suggests that patients may be experiencing complications related to cytopenias (low blood cell counts) or bone marrow infiltration, which can lead to anemia and neutropenia, respectively. While, Vomiting being the least common symptom might suggest that gastrointestinal involvement is less

pronounced in this cohort, though chemotherapy and other treatments might contribute to gastrointestinal symptoms over time.

The researcher suggested that fatigue, fever, pain, and headaches should be prioritized in early symptom screening and nursing interventions, particularly for palliative care and pain management. Additionally, monitoring for fever may serve as a critical indicator of potential infection risk, given the immunocompromised state of leukemia patients.However, **Castaño-Díez et al., (2022)** supporting that fatigue and fever are among the most common systemic symptoms in leukemia patients and are linked to inflammatory processes and bone marrow failure. **Pui & Evans, (2024)** confirmed that pain and headaches are common in acute leukemia patients due to central nervous system involvement and bone marrow infiltration. They recommended proactive pain management strategies for such symptoms.

On the other hand, **Schoenbeck, & Flynn (2021)** noted that fatigue is one of the most significant quality of life impairments in patients with leukemia, often caused by anemia or chronic inflammation. While, **Pemberton-Whiteley et al., (2023)** urged that while fever is common, fatigue was significantly less prevalent among their cohort of leukemia patients, suggesting that cultural differences, geographic factors, or treatment protocols could result in variations in symptom presentation. **Granroth et al., (2022)** found that in their study, pain and headaches were less frequent in comparison to fever and fatigue, highlighting a potential regional or demographic variation in symptom prevalence.

Regarding, the WHO bleeding scale distribution in the studied leukemia patients highlights the severity of bleeding manifestations among different grades. The majority of patients were categorized as Grade 2, indicating that a significant proportion of the sample experienced moderate bleeding. The most common symptoms in this category included purpuric lesions, epistaxis and unexpected vaginal bleeding. The distribution of these grades highlights the variability in bleeding manifestations among leukemia patients, ranging from mild symptoms such as epistaxis and purpura in Grade 2, to severe bleeding such as soft tissue bleeding in Grade 3, which requires immediate and aggressive management.

In this line, **Bhatia et al., (2020)** explored the relationship between thrombocytopenia and bleeding manifestations in leukemia patients. They found that Grade 2 and Grade 3 bleeding symptoms, such as purpura and soft tissue bleeding, were commonly seen in patients with severe platelet deficiency. **Deng et al., (2022)** examined gastrointestinal bleeding in leukemia patients and found a significant association between chemotherapy-induced microsites, thrombocytopenia, and increased gastrointestinal hemorrhage. **Fujita et al., (2019)** discussed the severe soft tissue bleeding observed in Grade 3 bleeding patients, noting that this was often related to coagulation abnormalities and aggressive leukemia treatment regimens such as chemotherapy.

In contrast, **Lee et al., (2020)** suggested that soft tissue bleeding and vaginal bleeding may not always correlate with the severity of leukemia itself but could be more related to secondary factors, such as medication side effects and underlying infections, which can alter bleeding risk. **Miller et al., (2022)** argued that Grade 2 bleeding symptoms such as epistaxis and purpura may be less indicative of severe disease progression and more a result of chemotherapy-induced thrombocytopenia, suggesting that such symptoms should be considered more carefully in the context of treatment regimens.

Regarding, the distribution of bleeding before and after treatment, the present study indicates a significant increase in the frequency of bleeding events following treatment. Before treatment, one third of patients experienced bleeding, while this number rose dramatically to more than half (51 out of 76) after treatment. This increase, accompanied by a P-value of 0.000, confirms that the difference is statistically significant and suggests that the treatment regimen used in this cohort may have contributed to the higher occurrence of bleeding.The researcher point of view, that several factors could contribute to this observed increase in bleeding events post-treatment, including the cytotoxic effects of chemotherapy, which often leads to thrombocytopenia (low platelet count), bone marrow suppression, and coagulation disturbances. This match with **Bhatia et al., (2020)** conducted a study that found a strong correlation between chemotherapy treatments and increased bleeding risk due to bone marrow suppression and thrombocytopenia.

They reported that post-treatment bleeding events were higher in patients with leukemia. **Fujita et al., (2019)** observed a similar phenomenon in their study, where post-treatment bleeding events significantly increased, particularly among patients treated with high-intensity chemotherapy regimens, highlighting the importance of proactive bleeding risk management in these patients. **Miller et al., (2022)** suggested that not all treatment regimens result in increased bleeding risks. Their study on targeted therapies found that these treatments had a lower incidence of bleeding events, possibly due to their specificity in targeting cancer cells without significantly affecting platelet counts. Likewise, **Johnson et al., (2018)** argued that bleeding events may be more closely related to underlying

comorbidities or infection-related complications rather than the chemotherapy itself. They found that while acute leukemia treatment can increase bleeding risk, pre-existing conditions such as renal dysfunction or liver disease might exacerbate bleeding more significantly.

Regarding, the risk factors associated with the severity of bleeding in patients with acute leukemia, as classified by the WHO bleeding grade. The present study found, recent bleeding, hypertension, diabetes mellitus (DM), thrombocytopenia, disseminated intravascular coagulation (DIC), and smoking were found to have statistically significant relationships with higher WHO bleeding grades.

These factors, especially recent bleeding, hypertension, and diabetes, appear to contribute to the exacerbation of bleeding severity. The strong association between recent bleeding and severe bleeding indicates that patients with a history of prior bleeding may be at an elevated risk for recurrent or worsened bleeding episodes. Additionally, hypertension and diabetes mellitus, both of which are known to affect vascular integrity and immune response, may worsen bleeding due to compromised vascular health or impaired platelet function.

Limitation:

Although the required sample size was originally calculated to be 100 patients based on a power analysis, only 76 participants were recruited during the data collection period due to the unavailability of additional eligible cases. Despite this, the study was conducted according to approval ethical standard, and all collected data were rigorously analyzed. While the smaller sample size may have reduced the statistical power and limited the generalizability of the results, the findings still provide valuable insights within the context of the studied population.

Conclusion:

The bleeding severity in acute leukemia patients was significantly associated with factors such as prior bleeding, hypertension, diabetes, smoking, thrombocytopenia, and disseminated intravascular coagulation, highlighting the importance of early identification and management of these risks.

Recommendations:

Based on the findings, it is recommended to:

1. Implement routine bleeding risk assessments using the WHO scale, monitor platelet counts regularly, control comorbid conditions (DM, hypertension)
2. Provide patient-specific nursing instructions to minimize bleeding complications.
3. Develop and deliver individualized nursing instructions on bleeding precautions (e.g., fall prevention, soft toothbrush use, avoiding IM injections).
4. Provide daily reinforcement of education, particularly for patients with DIC or thrombocytopenia.

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