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Evaluation of incidence of phlebitis in tertiary care hospital.

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Abstract:

BACKGROUND: The study was conducted to reduce the cost burden on patients and also it can reduces the further incidences of phlebitis and negative impact on patient.

MATERIALS AND METHODS; A prospective observational study was carried out in the inpatient of a tertiary care hospital. Total 208 patients were studied over period of 6 months.

RESULTS: The study was conducted in 208 patients in a tertiary care hospital (124 males and 84 females) being prescribed with 104 IV drugs. 136 patients developed phlebitis within 1-5 days of Intracath insertion, 53 patients developed it in 6-10 days, and 9 developed phlebitis after 10 days. Cannula size used was 22 in 145 patients, 20 in 60 patients, 18 in 2 patients, 24 in 1 patients. Suspected drugs resulting in phlebitis were Meropenem in 33 cases, Ceftriaxone in 27 cases, Cefuroxime in 26 cases, Piperacillin+Tazobactam in 18, Tramadol in 11, Cefoperazone+Salbactam in 10, Ceftazidine+Avibactam in 8, Frusemide in 8, Levetiracetam in 8, Mannitol in 8 and other drugs involving 59 cases. According to ATC classification the maximum numbers of antibiotics resulting in phlebitis. The severity and causality assessment was done using VIP score and WHO causality assessment scale. 162 cases had causality of possible, 34 had causality of probable and 12 cases were certainly related to the suspect drug. According to VIP score, 139 patients had score 1, 69 had score 2. To avoid incompatibility associated phlebitis, flushing is required. Appropriate flushing was done in 124 cases.

CONCLUSION: Most of the cases of phlebitis were due to antibiotics. There were underlying causes such as nursing error which further increased the incidences. They were associated with wrong administration techniques, unawareness about incompatibilities etc. Although the VIP score was just 1 and 2. Many cases were preventable and so an attempt was made to educate the nursing staff in order to minimize incidences of phlebitis. The number of instances were less but this needs consult monitoring.

KEYWORDS: Phlebitis, VIP score, Incompatability, Flushing, Dwell time etc.

Introduction:-

Phlebitis is an inflammation of the vessel wall and it manifest as localized pain, redness, edema and palpable venous cord and venous cell inflammation. This occurs because of endothelial cells becoming rough thereby facilitating platelets adhesion leading to vasodilation, increased permeability, and fluid leaking into interstitial space. The whole process causes pain and mild discomfort, clotting, thrombophlebitis and infections resulting in interruption of treatment. Phlebitis may results in leaking, obstruction and accidental removal of devices. [1, 2]

The Incidence of phlebitis in case of elderly people is common because of less active immune response. The physiology of the vein is affected by the characteristics of cannula and its size and insertion techniques resulting in varying degrees of phlebitis. For example, choosing a cannula diameter that is too large can increase the risk of phlebitis whereas proper stabilization of the insertion site significantly reduce the risk of phlebitis. [2, 3]

There are many factors that contribute to development of phlebitis which can be divided into four groups such as:

1. Patient factors such as age, gender and underlying conditions.
2. Chemical factors such as type of drugs and fluids (Chemical Phlebitis).
3. Mechanical factors such as catheter material, size, duration of cannulation and Health professional practices (Mechanical Phlebitis).
4. Biological Factors (Bacterial Phlebitis)
5. Post Infusion Phlebitis.[4,5]

Patient-related factors take account of age, gender, nutritional status, immunosuppression and co-existing comorbidities. Those with malnutrition, immunosuppression, co-morbidities, and elderly (age > 65 years) are vulnerable to phlebitis. [6]

The chemical factor which includes type of intravenous drugs (irritant,) and solution characteristics (PH+, osmolality) ,Hypertonic solutions with an osmolality greater than 450mOsm/l and those with a pH of less than 5.0 are associated with occurrence of phlebitis The use of antibacterial medications, primarily from the beta-lactam group, may also increase the risk of chemical phlebitis. [2]

Mechanical phlebitis consists of cannula size, site of catheter placement, catheter dwell time and type of catheter such as large catheter inserted in a small vein, vein trauma during catheter insertion, or movement of an improperly secured catheter within the vein. Large cannula size, near joint-catheter placement, and catheter dwell time > 96 h predispose the patient to phlebitis. The phlebitis occurs due to the improper practice of the nurses and healthcare professionals such as pricking more than one time, improper selection of instruments like cannula and its size. It is preventable type of phlebitis by avoiding the wrong practices and prevent the diluting the drug to concentrate. [5, 7, 8]

Biological factors produce bacterial colonization (Bacterial phlebitis) that means when bacteria penetrates the vein, starting as an inflammatory response caused by contamination of the I.V system during catheter insertion or manipulation, or by poor skin antisepsis.

Post infusion phlebitis is the inflammation of the vein that occurs after infusion and removal of the catheter and it's normally identified within 48 hrs, after removal of the PIC. [4, 7, 8, 9]

Peripheral intravenous (PIV) phlebitis was found to be directly related to the medication or infusate that the patient received via peripheral route and to the duration of dwell time. [8]

The phlebitis may also be classified based on condition of vein which includes,

1) Superficial phlebitis: Veins at the surface of the skin are affected. These are usually not serious and resolve quickly.

2) Deep phlebitis: Deeper and larger veins are affected. This usually happens in the legs but can appear in the arms as well.

3) Superficial thrombophlebitis: A blood clot and vein swelling occurs in a vein near the skin's surface. This may also be called a superficial blood clot.

4) Deep vein thrombophlebitis: A blood clot plus vein swelling in a deep vein, usually in the leg. Deep vein thrombophlebitis is the most serious type of phlebitis. If the blood clot breaks away from its location in the arm or leg and travels to the lungs, it can cause a death this condition called pulmonary embolism. [7]

Phlebitis can be classified according to its grades or scores on the basis of incidence of phlebitis according to its symptoms.

VIP score is the venous infusion phlebitis score. The VIP score is internationally acknowledged as a proven standardized tool for the monitoring of peripheral IV catheter sites. And impact on other peripheral IV catheter problems such as dislodgement, infiltration and infection. [2, 9]

Drug stability and compatibility are critically important in the provision of safe and effective drug therapy. Multiple drugs may be administered simultaneously to a critically ill patients. Characteristics of incompatibilities involves colour change, hazy appearance, white precipitation etc. Intracath size has direct effect on the development of phlebitis. When drugs are incompatible, they form precipitation usually invisible to eyes causing vein blocking at intracath site or whole vein swelling. Here Drip set flushing is important parameter to avoid the incompatibility associated phlebitis. [9]

Result:

The study sample consisted of 208 inpatients in a tertiary care hospital which had 124 (59.62%) males and 84 females (as shown in figure 6.1).

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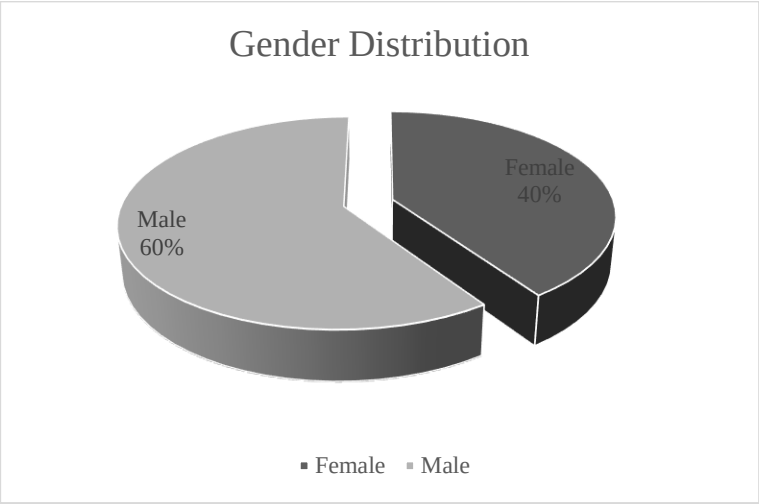
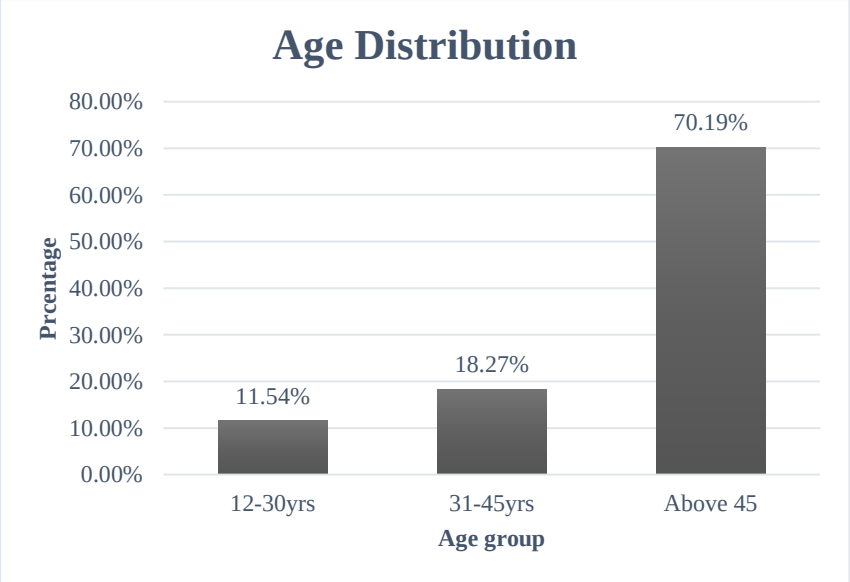
Figure 6.1 Gender Distribution



The age distribution was 146 patients above 45 years (70.19%) of age, followed by 38 patients in age group of 31-45years (18.27%) and 24 patients in age group of 12-30 years (11.54%)(figure 6.2).

Figure 6.2 Age Distribution



Total 104 IV drugs were prescribed in all patients. The most frequently prescribed medications were enlisted in Table 6.3. Other drugs which were less frequently prescribed included Diclofenac Sodium, Cefoperazone+Salbactam, Amikacin, Hydrocortisone, Calcitriol, Mannitol, Doxycycline, Fluconazole, Teicoplanin, Metronidazole, Ceftazadine+Avibactam, Dexamethosone, Dexmedetomidine, Lobetelol, Linezolid, Noradrenaline, Adrenaline, Albumin, Amino acid+Malic acid, Amioderone, Atracurium, Atropine, Brivaracetam, Caspofungin, Cefazolin, Ceftaroline, Ceftriaxone+Tazobactam, Clindamycin, Colistimethate sodium, Cyklikapron, Dabepoetin, Daptomycin, Dabepoetin α, Diclofenac sodium +Thicolchicoside, Efcorlin, Ertapenem, Erythropoietin, Esomeprazole, Fentanyl, Ferric Carboxymaltose, Filgrastim, Flucloxacillin Sodium, Fosphenytoin Sodium, Ganciclovir, Heparin, Hyoscine Butyl bromide, Immunoglobulin, Iron sucrose, Ketorolac Promethazine, L Carnitine, Lacosamide, Levofloxacin, Lorazepam, Magnesium Sulphate,

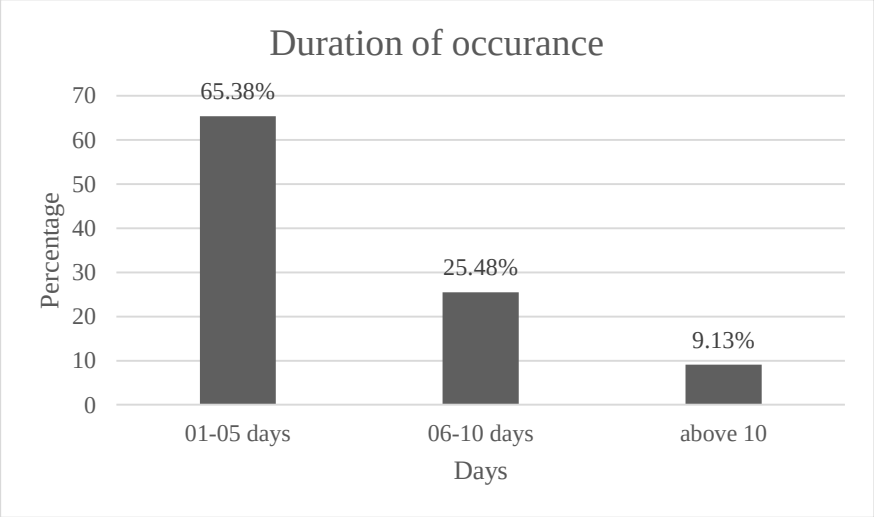
Metoclopramide, Micafungin, Milrinine Lactate, Netilmicin, Nitro glycerine, Pheniramine, Phenobarbital, Piracetam, Plasmolyte IV Fluid, Polymyxin B, Potassium Chloride, Prochlorperazine Mesylate, Promethazine, Propofol, Remdesivir, Sodium valproate, Teriparatide, Thicolchicoside, Tigecycline, TNK-t-PA, Trace elements, Tranexamic acid, Vancomycin, Vitamin K etc.

Table 6.3: Top 10 Frequently Used IV drugs

Sr. No	Drugs	No of Patients	Percentage
1	Pantoprazole	170	13.44%
2	Ondansetron	145	11.47%
3	Paracetamol	97	7.67%
4	Ceftriaxone	49	3.87%
5	Tramadol	45	3.56%
6	Meropenem	43	3.40%
7	Piperacillin+Tazobactam	42	3.32%
8	Cefuroxime	38	3.00%
9	Frusemide	34	2.68%
10	Levetiracetam	31	2.45%

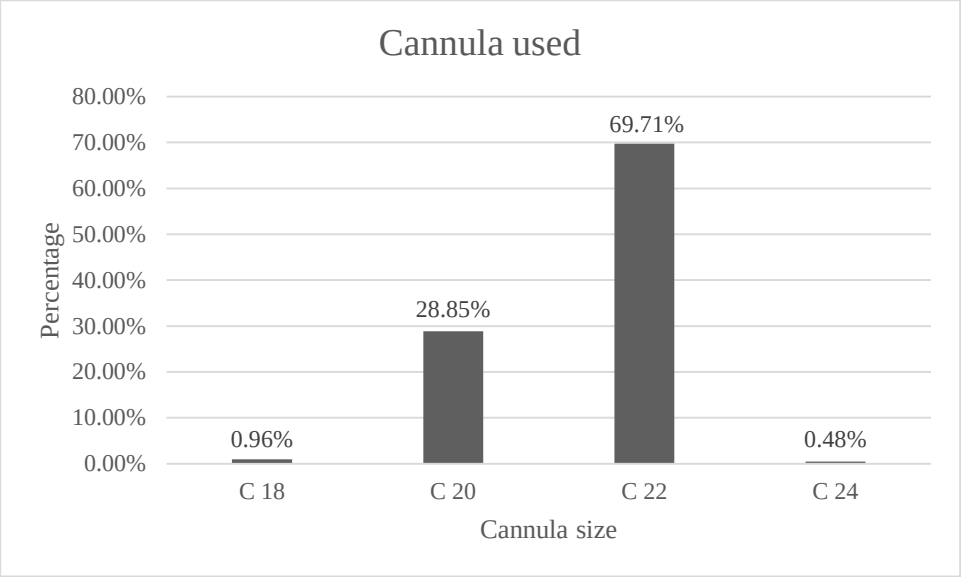
136 patients developed phlebitis within 1-5 days of Intracath insertion, 53 patients developed it in 6-10 days, and 9 developed phlebitis after 10 days. (Figure 6.4)

Figure 6.4 Duration of Occurrences of Phlebitis (in Days)



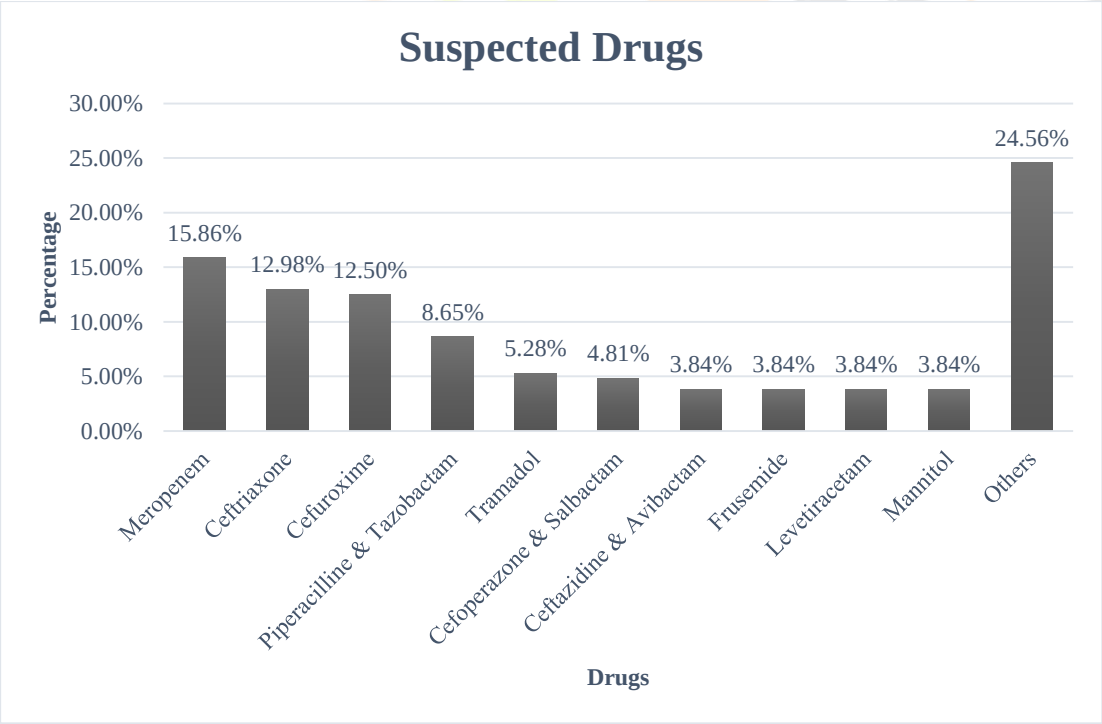
Cannula size used was maximum use of cannula size was 22 in 145 (69.71%) patients, 20 in 60 (28.85%) patients, 18 in 2 (0.96%) patients, 24 in 1 (0.48%) patients (Figure 6.5).

Figure 6.5 Cannula Size



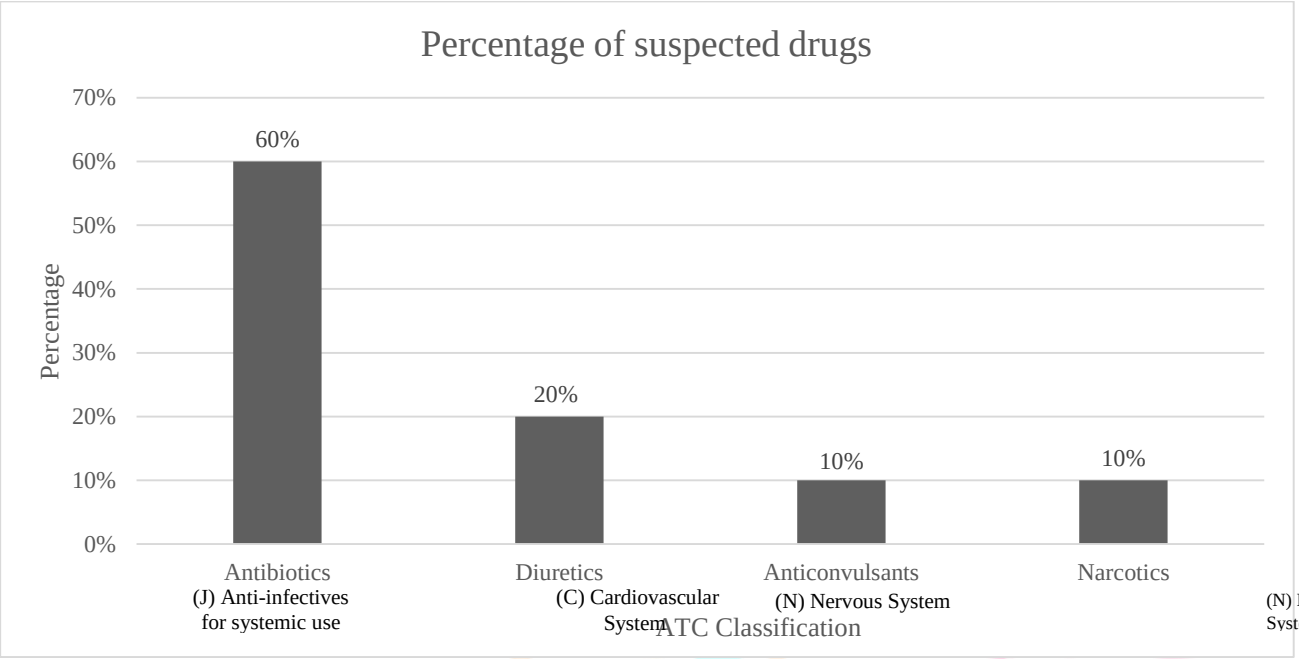
Suspected drugs resulting in phlebitis were Meropenem in 33 cases, Ceftriaxone in 27 cases, Cefuroxime in 26 cases, Piperacillin+Tazobactam in 18 cases, Tramadol in 11 cases, Cefoperazone+Salbactam in 10 cases, Ceftazidine+Avibactam in 8 cases, Frusemide in 8 cases, Levetiracetam in 8 cases, Mannitol in 8 cases and other drugs involving 59 cases (Figure 6.6).

Figure 6.6 Percentage of Top 10 Suspected drugs



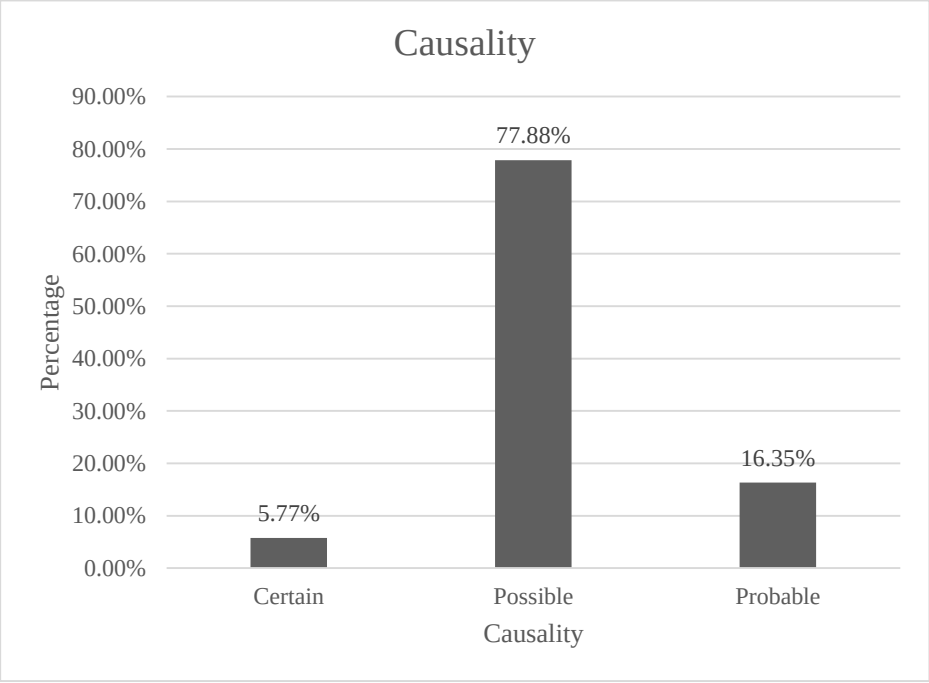
According to ATC classification the various categories resulting in phlebitis are mentioned below (Figure 6.7):

Figure 6.7: Percentage of suspected drugs



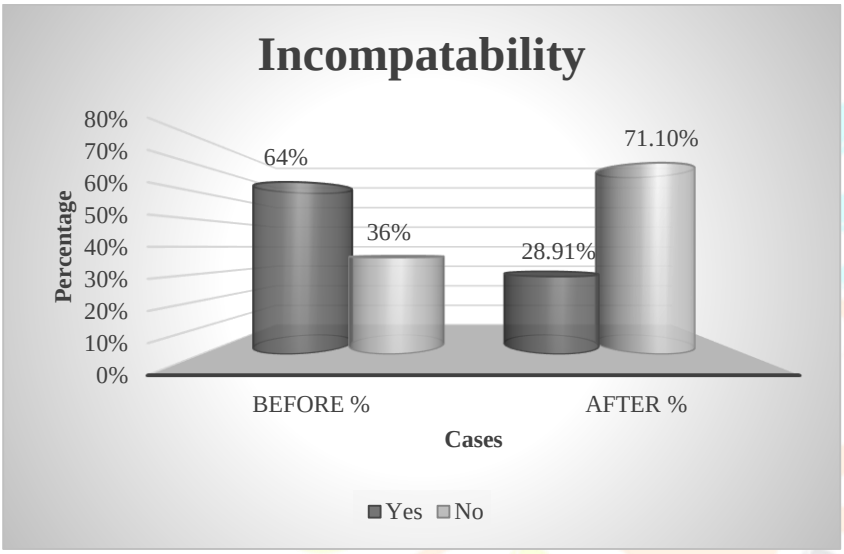
The severity and causality assessment was done using VIP score and WHO causality assessment scale. 162 cases had causality of possible, 34 had causality of probable and 12 cases were certainly related to the suspect drug as shown in Figure 6.8. According to VIP score, 1 score indicates slight pain near the i.v. site or slight redness near the i.v. site, 2 score indicates redness near i.v site, Erythema and swelling (needs treatment), 3 score indicates redness near i.v site, Erythema, swelling and induration and so on. In the study, only first two scores were observed. Out of total 208 patients, 139 (66.82%) had VIP score 1, 69 (33.17%) had VIP score 2.

Figure 6.8 WHO causality applied for suspected drugs



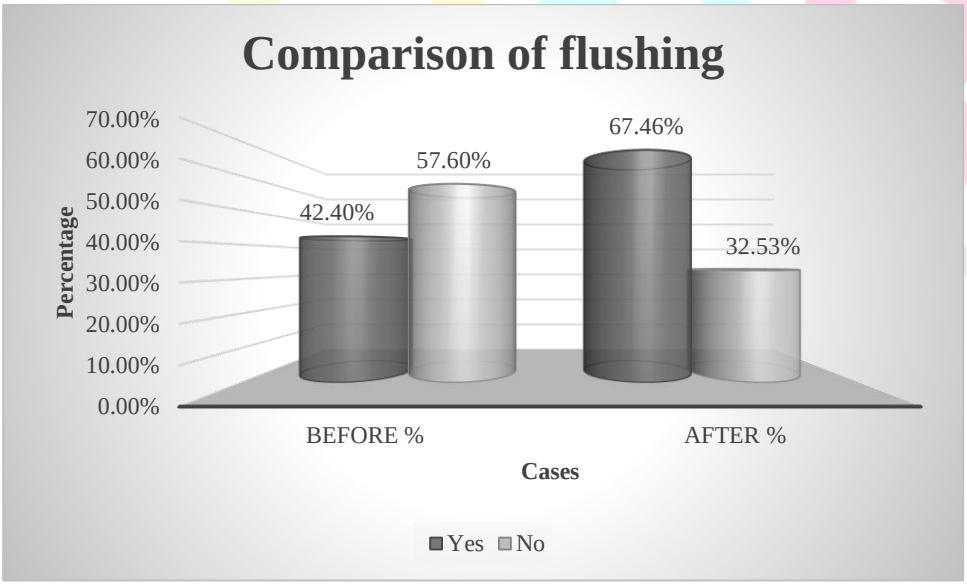
The study included 208 patients, and 125 cases were collected before and 83 cases collected after the awareness program. Multiple drugs may be administered simultaneously to a critically ill patients which may be incompatible. When drugs are incompatible, they form precipitation usually invisible to eyes causing vein blocking at intracath site or whole vein swelling causing phlebitis. Here flushing is important parameter to prevent this along with the separation of intervals between the medicines which are incompatible (Figure 6.9).

Figure 6.9 Comparison of drugs incompatibility between before and after data



Each and every drug requires flushing before and after administration to avoid incompatibility. Appropriate flushing was done in 124 (59.61%) cases and in 84 (40.38%) cases flushing was not properly done. The awareness regarding the incompatibilies can prevent such events from happening (Figure 6.10).

Figure 6.10 Comparison of flushing



Discussion:

Phlebitis is the most common complication of intravenous catheter insertion and in-turn causes further complications to patients. This was prospective observational study conducted in tertiary care hospital with 208 inpatient, 124 males and 84 females having phlebitis.

A study conducted by Abhijit Mandal et.al. [4]Showed 150 patients, 89 were male (59.33) and 61 were female (40.7%). They observed greater percentage of phlebitis in female than males. Another study by Mulugeta Lulie et.al. [6] Had 384 study participants. Phlebitis was found to occur in females 70% less frequently than in males. The gender wise variation in occurrences of phlebitis can be because of random collection of data.

The age group distribution revealed 146 patients above 45 years of age (70.19%), 38 patients between age group of 31 to 45 years.(18.27%) and 24 patients between age group of 12 to 30 (11.54%). Incidence of phlebitis was maximum inpatients above 45 years.

Majority of the patients were aged less than 60 yrs. in the study by Abhijit Mandal et.al. [4] In another study by Dragana Milutinović. et al. [7],the incidence of phlebitis increased with age; with most studies showing that obvious signs of phlebitis were present in approximately 50% of patients over the age of 60. Phlebitis is more common in people older than 45 years due to the prevalence of co-morbidities, immunosuppression, malnutrition etc.

Total 104 IV drugs were prescribed in all patients. The most frequently prescribed medications were Ondansetron, Paracetamol, Ceftriaxone, Tramadol, Meropenem, Cefuroxime, Piperacilline+Tazobactam, Frusemide, Levetiracetam. Maximum number of patients who were receiving antibiotics were also administered Pantoprazole and Ondansetron prophylactically for nausea and vomiting respectively. Other drugs that prescribed frequently in tertiary care hospital included Diclofenac, Cefoperazone+Salbactam, Amikacin, Hydrocortisone,Calcitriol, Mannitol, Doxycycline, Fluconazole, Teicoplanin, Metronidazole, Ceftazadine+Avibactam, Dexamethosone, Dexmedetomidine, Lobetelol, Linezolid, Noradrenaline, Adrenaline, Albumin, Amino acid infusions+Malic acid, Amioderone, Atracurium, Atropine, Brivaracetam, Caspofungin, Cefazolin, Ceftaroline, Ceftriaxone+Tazobactam, Clindamycin, Colistimethate, Cyklikapron, Dabepoetin, Daptomycin, Dabepoetin α, Diclofenac +Thicolchicoside, Efcorlin, Ertapenem, Erythropoietin, Esomeprazole, Fentanyl, Ferric Carboxymaltose, Filgrastin, Flucloxacillin, Fosphenytoin, Ganciclovir, Heparin, Hyoscine Butylbromide, Iron, Sucrose, Immunoglobulin, Ketorolac Promethazine, L Carnitine, Lacosamide, Levofloxacin, Lorazepam, Magnesium Sulphate, Metoclopramide, Micafungin, Milrinine Lactate, Netilmicin, Nitro glycerine, Pheniramine, Phenobarbital, Piracetam, Plasmolyte IV Fluid, Polymyxin B, Potassium Chloride, Prochlorperazine Mesylate, Promethazine, Propofol, Remdesivir, Sodium valproate, Teriparatide, Thicolchicoside, Tigecycline, TNK-t-PA, Trace elements, Tranexamic acid, Vancomycin, Vitamin K, etc.

Cannula size used was 22 in 145 (69.71%) patients, size 20 in 60 (28.85%) patients, size 18 in 2 (0.96%) patients, and 24 in 1 (0.48%) patient.

Cannula can cause phlebitis when movement of the cannula inside the vein causes friction and inflammation, or when the cannula is too wide for the vein. [10]

The occurrence of phlebitis was determined on the basis of cannula dwell time inside the body. There were 135 (65.38%) patients who developed phlebitis within 1-5 days of intracath insertion, 53(25.48%) patient developed in 6-10 days and 9(9.13%) developed phlebitis after 10 days.

Matthew McGrail, [10] reported post-infusion phlebitis within 2 days in 59 (1.8%) patients. Another study conducted by Mulugeta lulie et.al [6] found that phlebitis significantly occurred among those with catheter dwell time > 4 days as compared to catheter-in situ less than 3 days. A study done by Tadios Lidetu et.al [2] reported cannula dwelling time (length time) of 4 days with the range of 2-8 days. It showed that 50% of the patients acquired phlebitis within 6 days from intravenous cannula insertion. Prolonged catheter dwell time predisposes for continued trauma by the catheter itself, longer contact to irritant drugs and infusates, and higher chance of exposure to bacterial colonization and infections. CDC guideline recommended routine replacement of PIVC no later than 4 days.

There were total 104 IV drugs out of which, 10 drugs resulted in more frequent events of phlebitis which included, Meropenem in 33 cases, Ceftriaxone in 27 cases, Cefuroxime in 26 cases, Piperacilline+Tazobactam in 18 cases, Tramadol in 11 cases, Cefoperazone+Salbactam in 10 cases, Ceftazadine+Avibactam in 8 cases, Furosemide in 8 cases, Levetiracetam in 8 cases, Mannitol in 8 cases and other drugs involving 59 cases. The incidence of phlebitis according to ATC classification in a descending order of Antibiotics (Anti-infectives for systemic use) >Diuretics (Cardiovascular System) >Anticonvulsants (Nervous System) > Narcotics (Nervous System) etc. was observed.

The research conducted by Janete de Souza Urbanetto et.al [1] on "Incidence of phlebitis associated with the use of peripheral IV catheter and following catheter removal use" reported more phlebitis incidences associated with Ceftriaxone, Clarithromycin, and Oxacillin all belonging to class of antibiotics. The study differs than our study but this finding was similar. The exact reason so as to why antibiotics has higher instances of phlebitis are unexplainable but the chemical properties/change in bacterial flora or incompatibility may have contributed to the phlebitis.

The severity and causality assessment was done using Jackson's VIP score and WHO causality assessment scale. Maximum cases of phlebitis (162) had causality of Possible, 34 had causality of Probable and 12 cases were certainly related to the suspect drug. According to VIP score, 1 score indicates slight pain near the i.v. site or slight redness near the i.v site, 2 score indicates redness near i.v site, Erythema and swelling (needs treatment), 3 score indicates redness near i.v site, Erythema, swelling and induration and so on. In the study, only first two scores were observed. Out of total 208 patients, 139 (66.82%) had VIP score 1(Intracath out, pain and redness), 69 (33.17%) had VIP score 2(Intracath out, pain redness and swelling).

Mulugeta Lulie, et.al conducted a study and the incidence of phlebitis was 70%. Mid-stage (grade 3) and advanced-stage (grade 4) phlebitis were noticed in 136/268 (51%) and 89/268 (33%) respectively. Dwell time in others study was maximum hence they observed grade 3 and grade 4. In our study we only observed 1 and 2 score because of less dwell time.

The study included total 208 patients, and 125 cases were collected before and 83 cases collected after the awareness program. Multiple drugs may be administered simultaneously to a critically ill patients which may be incompatible. Drug interactions can result in a precipitation that is normally imperceptible to the eye, which might obstruct a vein at the site of an intracath or cause an entire vein to enlarge, resulting in phlebitis. Here, flushing is a crucial element to avoid this, along with the different time interval between incompatible medications. Out of 10 suspects, Pantoprazole and Ondansetron were two most commonly administered medicines and majority of the patients received them at the same time, but we discovered their incompatibility resulting in white precipitation right away after mixing. [11] The situation results in phlebitis due to incorrect dilution and washing, and interactions with other medications. Additionally, lack of knowledge about flushing techniques was also observed within the nurses.

Intracath pricking attempts, poor flushing, drug incompatibility, cannula size, and drip set flushing issues were the main causes of incompatibility among the 125 cases of phlebitis that were collected before the awareness program. These incompatibilities generally occurred between drugs and inappropriate diluents, rate of infusion, interaction with the drip set material and administration techniques. This can be explainable with an example observed during the study: Pantoprazole and Meropenem when administered using Y site, it results in precipitate formation at the junction of the cannula leading to blockage and inflammation or phlebitis. As these errors were happening by the nurses there was need to conduct awareness program and
the nursing staff was conveyed about drug dilution in NS, RL, 5% D, DNS, and other media along with correct technique of administration of Pantoprazole and Ondansetron as they were not being administered as per the guidelines (standandard rate of infusion of pantoprazole was over a period of approximately 15 minutes at rate of approximately 7ml/min and for ondansetron was not less than 30 seconds or as short time over 15 minutes). [11] Additionally, cannula size of 20 was suggested instead of 22 to minimize the incidences of phlebitis.
Following the awareness program, 83 incidences of phlebitis were recorded which were lesser as compared to before (n=125).

Conclusion:

Most of the cases of phlebitis were due to antibiotics. There were underlying causes such as nursing error which further increased the incidences. They were associated with wrong administration techniques, unawareness about incompatibilities etc. Although the VIP score was just 1 and 2. Many cases were preventable and so an attempt was made to educate the nursing staff in order to minimize incidences of phlebitis. The number of instances were less but this needs consult monitoring.

Methodology:

A prospective observational study was carried out in the inpatient with PIC who are being administered with IV medications and having phlebitis in a tertiary care hospital. Total 208 patients except paediatrics and OPD patients were studied over period of 6 months. Using customized data collection form relevant details were obtained and factors contributing to phlebitis were studied. The severity and causality assessment was done using Jackson's VIP score and WHO causality assessment scale. An attempt was made to educate the nursing staff in order to minimize such incidences of phlebitis.

Limitations:

1) Outpatient, Oncology, Haematology, LICU, paediatrics ward were not studied.
2) The study was limited to only one setting with limited sample size and duration and didn't cover other tertiary care hospitals which can have variation in prescribing pattern.
3) This study didn't focus on the knowledge and attitude of healthcare practitioners while treating patients.

Future scope:

1. The study can be done in other hospitals and other departments
2. The attitude of healthcare professional while prescribing the medications can be studied further.
3. Cost wise analysis of the incidences of phlebitis on the patient is a part of future scope.

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