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A Review on Chemotherapy Induced Complications in Cancer Patients

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ABSTRACT
Even with the evolution of chemotherapeutic procedures and agents, chemotherapy may cause certain side effects that impair the patients' quality of life. The aim of this review is to isolate and describe the side effects arising only from chemotherapy. This paper comprises an extensive review of the main side effects affecting the health status of patients' undergoing chemotherapy procedures. In addition, Cancer patients experience a variety of symptoms that can be physical or psychological. These symptoms may vary in terms of occurrence, severity and distress and can be the result of the illness or the treatment.

Key words:
Cancer, Alopecia, Complications, Chemotherapy.

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INTRODUCTION

Surgery, radiotherapy and drug therapy are the three main treatment options considered when a treatment plan is formulated for patients undergoing active management of their cancer. The treatment aims are:

1. Eradicate the disease: cure the patient,
2. If eradication is not possible then control the disease: induce a remission and prolong survival,
3. If neither cure nor remission is possible then control symptoms.

The drug therapies used to treat cancer can be classified as:

1. Chemotherapy,
2. Hormone therapy,
3. Biological therapy.

The drugs used to treat cancer are cytotoxic agents, i.e. drugs that kill dividing cells commonly referred to as chemotherapy[14].

Objectives of chemotherapy

For cancers like leukaemia's and lymphomas**,** several phases of chemotherapy are necessary. A cure may be sought with aggressive therapy for a prolonged period to eradicate all disease.

1. **For leukaemias**, this curative approach may consist of the following components:

a. **Remission induction:** Therapy given with the intent of maximizing cell kills.
b. **Consolidation** (also known as intensification or post-remission therapy): therapy to eradicate any clinically undetectable disease and to lower the tumour cell, at which level host immunological defenses may keep the cells in control.
c. **Maintenance**: therapy given in lower doses with the aim of maintaining or prolonging a remission.

2. For solid tumours, one or more approaches to chemotherapy may be used when seeking a cure based on the known utility of chemotherapy in line with other modalities, such as surgery or radiation.

a. **Adjuvant** chemotherapy is given after more definitive therapy, such as surgery, to eliminate any remaining disease or undetected micro-metastasis.
b. **Neoadjuvant** chemotherapy is given to decrease the tumour burden before definitive therapy, such as surgery or radiation.
c. **Palliative** therapy is usually given when complete eradication of the tumour is considered unlikely or the patient refuses aggressive therapy. Palliative chemotherapy may be given to decrease the tumour size, control growth, and reduce symptoms.
d. **Salvage** chemotherapy is given as an attempt to get a patient into remission, after previous therapies have failed[16].

Anti cancer drugs[18]:

1. Antimetabolites:
   - Azacitidine VIDAZA
   - Capecitabine XELODA
   - Cladribine LEUSTATIN
   - Cytarabine CYTOSINE ARABINOSIDE (ARA-C)
   - Fludarabine FLUDARA
   - 5-Fluorouracil ADRUCIL
   - Gemcitabine GEMZAR
   - 6-Mercaptopurine PURINETHOL
   - Methotrexate (MTX) TREXALL
   - Pemetrexed ALIMTA
   - Pralatrexate FOLOTYN
2. **Antibiotics:**
   - Bleomycin BLENOXANE
   - Daunorubicin CERUBIDINE
   - Doxorubicin ADRIAMYCIN
   - Epirubicin ELLENCE
   - Idarubicin IDAMYCIN
   - Mitoxantrone
3. **Alkylating agnts:**
   - Busulfan MYLERAN

- Carmustine BICNU
- Chlorambucil LEUKERAN
- Cyclophosphamide CYTOXAN
- Dacarbazine DTIC-DOME
- Ifosfamide IFEX
- Lomustine CEENU
- Melphalan ALKERAN
- Temozolomide TEMODAR

4. **Microtubule inhibitors:**
   - Docetaxel TAXOTERE
   - Paclitaxel TAXOL
   - Vinblastine
   - Vincristine VINCASAR PFS
   - Vinorelbine NAVELBINE
5. **Steroid hormones and their antagonists:**
   - Anastrozole ARIMIDEX
   - Bicalutamide CASODEX
   - Estrogens VARIOUS
   - Exemestane AROMASIN
   - Flutamide
   - Goserelin ZOLADEX
   - Letrozole FEMARA
   - Leuprolide LUPRON
   - Megestrol acetate MEGACE
   - Nilutamide NILANDRON
   - Prednisone
   - Tamoxifen
   - Triptorelin TRELSTAR
6. **Monoclonal antibodies:**
   - Bevacizumab AVASTIN
   - Cetuximab ERBITUX
   - Rituximab RITUXAN
   - Trastuzumab HERCEPTIN
7. **Tyrosine kinase inhibitors:**
   - Dasatinib TARCEVA
   - Imatinib GLEEVEC
   - Nilotinib TASIGNA
   - Sorafenib NEXAVAR
   - Erlotinib SPRYCEL
   - Sunitinib SUTENT
8. **Others:**
   - Abiraterone ZYTIGA
   - Carboplatin
   - Cisplatin PLATINOL
   - Enzalutamide XTANDI
   - Interferons PEG-INTRON
   - Irinotecan CAMPTOSAR
   - Oxaliplatin ELOXATIN
   - Procarbazine MATULANE
   - Topotecan HYCAMTIN

Chemotherapy is an important component of treatment for many cancers, and new anti-cancer drugs represent one of the largest areas of pharmaceutical development. However, the nature of chemotherapy means that while damaging cancer cells it also damages healthy cells, leading to side effects. The side effects of chemotherapy affect an individual's physical health, quality of life and emotional state. The management of a side effect can include a reduction in the dose intensity of chemotherapy and there is evidence that patients who receive low dose chemotherapy have reduced survival rates.[5]

General toxicity of cytotoxic drugs[17]: Majority of the cytotoxic drugs have more profound effect on rapidly multiplying cells, because the most important target of action are the nucleic acids and their precursors, and rapid nucleic acid synthesis occurs during cell division.

Many cancers (especially large solid tumours) have a lower growth fraction (lower percentage of cells are in division) than normal bone marrow, epithelial linings, reticuloendothelial (RE) system and gonads. These tissues are particularly affected in a dose-dependent manner by majority of drugs; though, there are differences in susceptibility to individual members.

1. **Bone marrow** Depression of bone marrow results in granulocytopenia, agranulocytosis, thrombocytopenia, aplastic anaemia. This is the most serious toxicity; often limits the dose that can be employed. Infections and bleeding are the usual complications.
2. **Lymphoreticular tissue** Lymphocytopenia and inhibition of lymphocyte function results in suppression of cell mediated as well as humoral immunity. Of particular importance are the opportunistic infections due to low pathogenicity organisms. Infections by fungi (*Candida* and others causing deep mycosis), viruses (*Herpes zoster*, cytomegalo virus), *Pneumocystis jiroveci* (a fungus) and *Toxoplasma* are seen primarily in patients treated with anticancer drugs.
3. **Oral cavity**: The oral mucosa is particularly susceptible to cytotoxic drugs because of high epithelial cell turnover. Many chemotherapeutic drugs, particularly:
   - Fluorouracil,
   - Methotrexate,
   - Daunorubicin,

   Doxorubicin May produce stomatitis as an early manifestation of toxicity. The gums and oral mucosa are regularly subjected to minor trauma, and breaches are common during chewing. Oral microflora is large and can be the source of infection. Neutropenia and depression of immunity caused by the drug indirectly increase the chances of oral infections. Thrombocytopenia may cause bleeding gums. Xerostomia due to the drug may cause rapid progression of dental caries.
4. **GIT** Diarrhoea, shedding of mucosa, haemorrhages occur due to decrease in the rate of renewal of the gastrointestinal mucous lining. Drugs that prominently cause mucositis are—
   - Bleomycin,
   - Actinomycin D,
   - Daunorubicin,
   - Doxorubicin,
   - Fluorouracil And
   - Methotrexate.

Nausea and vomiting are prominent with many cytotoxic drugs. This is due to direct stimulation of CTZ by the drug, as well as generation of emetic impulses/mediators from the upper G.I.T. and other areas.

5. **Skin** Alopecia occurs due to damage to the cells in hair follicles. Dermatitis is another complication.
6. **Gonads** Inhibition of gonadal cells causes oligozoospermia and impotence in males; inhibition of ovulation and amenorrhoea are common in

females. Damage to the germinal cells may result in mutagenesis.

7. **Foetus** Practically all cytotoxic drugs given to pregnant women profoundly damage the developing foetus → abortion, foetal death, teratogenesis.
8. **Carcinogenicity** Secondary cancers, especially leukaemias, lymphomas and histocytic tumours appear with greater frequency many years after the use of cytotoxic drugs. This may be due to depression of cell mediated and humoral *blocking factors* against neoplasia.
9. **Hyperuricaemia** This is secondary to massive cell destruction (uric acid is a product of purine metabolism) and is especially likely to occur in leukaemias and bulky lymphomas. Acute renal failure, gout and urate stones in the urinary tract may develop. Allopurinol is protective by decreasing uric acid synthesis. In addition to these general toxicities, individual drugs may produce specific adverse effects, e.g. neuropathy by vincristine, cardiomyopathy by doxorubicin, cystitis and alopecia by cyclophosphamide.

GENERAL ADVERSE REACTIONS

1. **Nausea and vomiting** may be severe with many, although not all, drugs and are related to the direct actions of cytotoxic drugs on the chemoreceptor trigger zone. Anticipatory vomiting can, rarely, be a problem in patients after repeated treatments. The selective 5-HT3 receptor antagonists, often in combination with steroids, are highly effective in preventing acute emesis.
2. **Alopecia** is a common adverse effect of some, but not all, cytotoxic drugs. Hair re-grows after the course of chemotherapy has been completed.
3. **Hyperuricaemia,** with precipitation of clinical gout or renal failure, may complicate the treatment of highly chemo-sensitive tumours when there is rapid tumourlysis, e.g. leukaemia's and lymphomas. Allopurinol, the xanthine oxidase inhibitor, may be used to prevent gout but care should be taken when azathioprine or mercaptopurine are given at the same time.
4. **The gastrointestinal tract** from mouth to anus has a fast turnover and thus can be susceptible to side effects. Mucositis can occur with some drugs, causing ulceration in the mouth or oesophagus. When there is co-existent neutropenia, there is increased risk of opportunistic infections: thrush, indigestion, abdominal cramps and diarrhoea all may occur.
5. **Bone marrow suppression**. The bone marrow is particularly sensitive to many cytotoxic drugs. Neutropenia is common, and opportunistic infections occur as a result of impaired humoral and cell-mediated responses. It is crucial that the patient is warned that this may occur so that they can seek specialist medical help immediately if they become unwell while on chemotherapy. Prompt treatment of neutropenic sepsis (usually in the inpatient setting) is essential as this complication can be fatal. Unusual infection with fungi and protozoa, in addition to more common pathogenic bacteria and viruses, may occur. Thrombocytopenia may result in an increased risk of haemorrhage.
6. **Neuropathy.** Typically, the greatest effect is on the longest nerves, and thus peripheral neuropathy can occur. This is classically seen with cisplatin and the spindle poisons (taxanes and vinca alkaloids). Most common effects are sensory, but can be motor and autonomic.
7. **Infertility**. Many cytotoxic agents cause sterility; this must be discussed prior to starting treatment and appropriate action undertaken. Conversely, treatment with chemotherapy is not a guarantee of birth control.
8. **Hypersensitivity reactions.** Can vary in severity from a mild itch or rash to anaphylaxis. Mild reactions can be managed by the use of steroid and chlorpheniramine premedications and/or infusing the chemotherapy more slowly (in the specialist environment).
9. **Fluid retention.** Mostly an issue with taxane-based chemotherapy (paclitaxel and docetaxel). Can be minimised by using steroid (dexamethasone) premedication.
10. **Secondary cancers.** The incidence of this is hotly debated, but certainly is a real effect. Typically, they occur 10–15 years after treatment. The risks vary between agents but are the highest with alkylating agents.
11. **Teratogenicity**. Cytotoxic therapies are generally highly teratogenic and therefore should be avoided during pregnancy unless absolutely unavoidable and following full discussion with the patient. Therefore patients (and partners of patients) of childbearing potential who are receiving chemotherapy should be counselled on the use of robust contraceptive practices during their treatment[14].

List of common complications in chemotherapy:

1. Lack of appetite
2. Nausea and vomiting
3. Hair loss
4. Fatigue
5. Constipation
6. Fever
7. Constipation
8. Somatitis
9. Burning micturation
10. Infection
11. Skin rashes
12. Gum bleeding
13. Tooth aches
14. Cough
15. Jaundice
16. Swelling
17. Dizziness[4].

DISCUSSION

Therapeutic strategies for cancer continue to evolve, and chemotherapy regimens continue to play important roles in cancer treatment[8].

Toxicity of chemotherapy

The extent of toxicity upon normal tissues seems to be correlated to the dose of the anti-neoplastic drug used, and it is also related to the frequency of the agent's administration. Many drugs target rapidly proliferating cells; however, they have the same action upon rapidly proliferating normal tissues

such as bone marrow, intestinal mucosa, oral mucosa, hair follicles, and gonads[6].

- The GIT side effects of cancer chemotherapy are also common and can be both distressing and potentially fatal for patient.
- Oral and GIT Mucositis may cause local ulceration and pain, which it may leads to anorexia, malabsorption, weight loss, anaemia, fatigue and increased risk of sepsis.
- Central and peripheral neurotoxicity caused anti-cancer drugs can dramatically reduced functional capacity and quality of life in cancer survivors[3].
- **Impact of side effects of chemotherapy:** the most traumatic side effect is hair loss, the 2nd most traumatic side effect is fatigue and other were nail changes and nausea/ vomiting
- **Re growth of scalp hair:** 98% of patients respond to the re growth of hair.
  99.9% of patients explained hair loss in breast cancer patients. Hair loss due to chemotherapy was been thought to, generally, be completely reversible.
- **Eye brows and eye lashes:** 90% of hair fells out among the cancer patients.
- **Nails:** severe/ moderate finger nails changes in 78% of patients, toenails changes in 64% of patients[1].

General side effects of chemotherapy:

There are more than 100 different chemotherapy drugs which cause different general side effects such as

1. Bone marrow suppression, (leucopenia appears the 10th day of the chemotherapeutic course while thrombocytopenia after 10-14 days),
2. Anemia (not a common adverse effect of chemotherapy),
3. Alopecia (common manifestation of chemotherapy).

Cardiotoxicity (commonly observed after chemotherapy) (associated with both older and newer therapies which may lead to:

1. Left ventricular impairment or congestive heart failure (CHF),
2. Hypertension.
3. Thrombo-embolism,
4. Pericardial thickening or cardiac arrhythmias.

Neurologic complications: neurotoxicity after chemotherapy includes

1. seizures,
2. peripheral and cranial neuropathy,
3. Myelopathy,
4. Aseptic meningitis,
5. Cerebellar syndrome,
6. Stroke and
7. Encephalitis.
8. Chemotherapy-induced peripheral neuropathy (CIPN).

Neurotoxicity can appear in up to 97% of patients treated with oxaliplatin, which is manifested in an acute or chronic form. There are several types of drugs that cause neurotoxicity. These drugs are:

- DNA alkylating agents (platinum derivatives such as cisplatin, carboplatin, and oxaliplatin),
- Microtubule-targeting (taxanes such as docetaxel and paclitaxel, epothilones such as ixabepilone),
- Vinca alkaloids such as vincristine and podophyllin analogs) and
- Other drugs such as proteasome inhibitors.

Other side effects are:

1. Defects in spermatogenesis (frequently observed in chemotherapy),
2. Nausea and vomiting (two of the most frequent side effects of chemotherapy),
3. Fatigue (common symptom present during chemotherapy),
4. Diarrhoea,
5. Hand-foot syndrome (Palmar-plantar erythrodysesthesia, acral erythema or Burgdorf reaction) Reactivation of hepatitis B, [6].

Miscellaneous Drug-Specific Toxicities[15]:

1. **Hemorrhagic Cystitis Induced by Cyclophosphamide or Ifosfamide**: Patients receiving cyclophosphamide must maintain **a high fluid intake** prior to and following the administration of the drug and be counseled to empty their bladders frequently. Early symptoms suggesting bladder toxicity include dysuria and increased frequency of urination. Should microscopic hematuria develop, it is advisable to stop the drug temporarily or switch to a different alkylating agent, to increase fluid intake, and to administer a urinary analgesic such as **phenazopyridine.** The neutralizing agent, **mesna**, can be used for patients in whom cystitis develops. With severe cystitis, large segments of bladder mucosa may be shed, resulting in prolonged gross hematuria. Such patients should be observed for signs of urinary obstruction and may require cystoscopy for removal of obstructing blood clots. The cyclophosphamide analog ifosfamide can cause severe hemorrhagic cystitis when used alone. However, when its use is followed by a series of doses of the neutralizing agent mesna, bladder toxicity can be prevented.
2. **Neuropathy Due to Vinca Alkaloids** and Other Chemotherapy Drugs: Neuropathy is caused by a number of different chemotherapy drugs, the most common being vincristine. The peripheral neuropathy can be sensory, motor, autonomic, or a combination of these types. In its mildest form, it consists of paresthesias of the fingers and toes. Occasionally, acute jaw or throat pain can develop as a form of trigeminal or glossopharyngeal neuralgia. With continued vincristine therapy, the paresthesias extend to the proximal interphalangeal joints, hyporeflexia appears in the lower extremities, and significant weakness can develop. Other drugs in the vinca alkaloid class as well as the taxane drugs (docetaxel and paclitaxel) and agents to treat myeloma (bortezomib and thalidomide) cause similar toxicity. The presence of neurologic symptoms is not in itself a reason to stop therapy; the severity of the symptoms must be balanced against the goals of therapy. Usually, though, the development of moderate to severe paresthesias or motor impairment results in the decision to discontinue the drug. Constipation is the most common symptom of autonomic neuropathy associated with the vinca alkaloids. Patients receiving these drugs should be

started on mild cathartics and other agents; otherwise, severe impaction may result from an atonic bowel. More serious autonomic involvement can lead to acute intestinal obstruction with signs indistinguishable from those of an acute abdomen. Bladder neuropathies are uncommon but may be severe. These two complications are absolute contraindications to continued vincristine therapy.

3. **Methotrexate Toxicity**: Methotrexate, a folate antagonist, is a commonly used component of regimens to treat patients with leptomeningeal disease, acute lymphoblastic leukemia, and sarcomas. Methotrexate is almost entirely eliminated by the kidney. Methotrexate toxicity affects cells with rapid turnover, including the bone marrow and mucosa resulting in myelosuppression and mucositis. Methotrexate can also damage the liver and kidney manifesting as elevated serum liver enzymes and creatinine. High-dose methotrexate, usually defined as a dose of 500 mg/m2 or more given over 4–36 hours, would be lethal without "rescue" of the normal tissues. **Leucovorin,** a form of folate, will reverse the toxic effects of methotrexate and is given until serum methotrexate levels are in the safe range (less than 0.05mmol/L). It is crucial that high-dose metho-trexate and leucovorin are given precisely according to protocol as deviations of the timing of methotrexate delivery or delay in rescue can result in patient death. The dose used in intrathecal therapy is 12 mg. Lower doses of methotrexate can be problematic in patients with kidney disease who cannot clear the drug normally or in patients with effusions in which the drug distributes itself and leaks out continuously, exposing normal tissue to the drug. In a patient with kidney disease or an effusion, prolonged rescue with leucovorin is necessary. Vigorous hydration and bicarbonate loading can help prevent crystallization of high-dose methotrexate in the renal tubular epithelium and consequent nephrotoxicity. Daily monitoring of the serum creatinine is mandatory. If possible, drugs impairing methotrexate excretion, such as **aspirin, nonsteroidal anti-inflammatory drugs, amioda-rone, omeprazole, penicillin, phenytoin, and sulfa**, should be stopped before methotrexate administration.
4. **Cardiotoxicity from Anthracyclines** and Other Chemotherapy Drugs: A number of cancer chemotherapy drugs are associated with cardiovascular complications including traditional drugs such as anthracyclines as well as new targeted agents. The anthracycline drugs, including doxorubicin, daunomycin, epirubicin, and idarubicin, can produce acute (during administration), subacute (days to months following administration), and delayed (years following administration) cardiac toxicity. The most feared complication is the delayed development of heart failure. Risk factors for this debilitating toxicity include the anthracycline cumulative dose, age over 70, previous or concurrent irradiation of the chest, preexisting cardiac disease, and concurrent administration of chemotherapy drugs such as trastuzumab. Changes in cardiac dynamics occur in most patients by the time they have received a total dose of 300 mg/m2 of doxorubicin. In general, patients should not receive doses in excess of 450 mg/m2; the dose should be lower if prior chest radiotherapy has been given. The appearance of a high resting pulse may herald the appearance of overt cardiac toxicity. Unfortunately, toxicity may be irreversible and frequently fatal at total dosage levels above 550 mg/m2. At lower doses (eg, 350 mg/m2), the symptoms and signs of cardiac failure generally respond well to medical therapy and discontinuation of the anthracyclineAs molecular mechanisms for cancer have been increasingly delineated, therapies have been developed that better target these mechanisms.

   Therapies targeting oncogenesis pathways include
   - HER2 inhibitors (lapatinib, pertuzumab, trastuzumab);
   - VEGF signaling pathway inhibitors (afilbercept, axitinib, bevacizumab, carozantinib, lenvatinib, pazopanib, ramucirumab, regorafenib, sorafenib, sunitinib, vandertanib);
   - multitargeted tyrosine kinase inhibitors (dasatinib, nilotinib, ponatinib);
   - proteasome inhibitors (bortezomib, carfilzomib); and immune checkpoint inhibitors (ipilimumab, nivolumab, pembrolizumab).

   Many of the pathways targeted by these drugs share a common biologic pathway in cardiac tissue. Untoward cardiac events are being increasingly reported with these agents, including arrhythmias, cardiac ischemia, myocarditis, thrombosis, and heart failure. It is important to carefully monitor patients on these drugs and aggressively manage any modifiable cardiac risk factors (smoking, hyperlipidemia, diabetes mellitus, and sedentary lifestyle).
5. **Cisplatin nephrotoxicity** and Neurotoxicity: Cisplatin is effective in treating testicular, bladder, head and neck, lung, and ovarian cancers. With cisplatin, the serious side effects of nephrotoxicity and neurotoxicity must be anticipated and aggressively managed. Patients must be vigorously hydrated prior to, during, and after cisplatin administration. Both kidney function and electrolytes must be monitored. Low serum magnesium, potassium, and sodium levels can develop. The neurotoxicity is usually manifested as a peripheral neuropathy of mixed sensorimotor type and may be associated with painful paresthesias. Development of neuropathy typically occurs after cumulative doses of 300 mg/m2. Ototoxicity is a potentially serious manifestation of neurotoxicity and can progress to deafness.
6. **Amifostine**, given intravenously at a dose of 910 mg/m2 over 15 minutes prior to cisplatin, is used to protect against nephrotoxicity and neuropathy. Use of amifostine does not appear to compromise its antineoplastic effect. The second-generation platinum analog, carboplatin, is non-nephrotoxic, although it is myelosuppressive. In the setting of preexisting kidney disease or neuropathy, carboplatin is occasionally substituted for cisplatin.

Preventive Strategies:

Cardio toxicity could be life threatening, and thus several attempts have been made to attenuate and minimize such toxicity induced by chemotherapy, Clinical practice suggests close monitoring and evaluation of patient risks for developing complications after treatment. Early detection and immediate proper medication could reverse the condition in time that minimizes cardiotoxic with some changes in molecular structures, including:

1. Epirubicin,
2. Idarubicin, and
3. Mitoxantrone, have been developed and became another appealing alternative as studies in cancer patients showed comparable drug efficacy with lower cardiotoxicity to conventional.

- Liposomal DOX is another strategy to reduce the drug toxicity as encapsulating DOX was restricted to the site with tight capillary junction like in the heart's wall, while readily penetrating through the more fragile tumor vasculature.
- Dexrazoxane is the only FDA-approved cardioprotective agent against cardiotoxicity induced by anthracyclines. Due to the potential risk of developing secondary tumors and interfering effect of dexrazoxane towards anticancer activity,
- Dexrazoxane clinical use is limited only to some certain groups of patients, namely, adult patients with breast cancer who have received cumulative dose of at least 300mg/m2 doxorubicin or 540mg/m2 epirubicin[11].
- Some of the side effects of chemotherapy have a specific pharmacological basis. Haemorrhagic cystitis with cyclophosphamide is a consequence of urinary excretion of the irritant metabolites, e.g. acrolein.
- Maintaining a high-fluid output can prevent this or by giving the drug mesna (mercaptoethone sulphonate) that conjugates these metabolites to promote safe excretion[14].
- Therapy with G-CSF was associated with faster bone marrow recovery, with a significant negative correlation between G-CSF and duration of neutropenia. Likewise, reported a significant shortening of CIN and FN, as well as of the mean duration of hospitalization. These advantages have been documented by other researchers. A recent study on urological cancer patients reported a good outcome when G-CSF was administered[8].
- For alopecia, it was suggested in the study 24, the cooling technique of use of the scalp. It was effective in 52% of cases, contributed to the improvement of well-being and quality of life[9].
- Use of zolpidem, a hypnotic agent, improves sleep and quality of life of breast cancer survivors with hot flashes associated with sleep disorder, but treatments for sleep may be important to improve strategies to improve well-being[9].
- To alleviate hot flashes, studies encouraging use of a variety of drugs including clonidine, gabapentin, inhibitors of serotonin and norepinephrine selective. SGB (Stellate ganglion block) has emerged as a new technique to reduce this toxicity. Other alternatives include hormone replacement therapy. The authors emphasize the option to use hormones only for patients in post menopause with breast cancer with hormone receptor positive[9].
- This has led to the development of a new class of antiemetic agents, such as aprepitant, an antagonist of the neurokinin-1 (NK-1) receptor.

The addition of aprepitant to 5-HT3 receptor antagonist and dexamethasone in cisplatin-based chemotherapy markedly reduces acute and delayed emesis. This three-drug combination has also been investigated, with favorable results, in patients receiving a combination of an anthracycline and cyclophosphamide-based regimen, and these studies were funded by pharmaceutical companies[13].

CONCLUSION

Receiving chemotherapy treatment was not easy, and the side effects experienced had a negative impact on their bodies and moods. Dealing actively with discomfort and accepting negative impacts in hope of a cure helped to manage the acute complications of their chemotherapy[7]. Cancer patients undergoing chemotherapy experience a variety of symptoms. These can be interesting for nurses and other health care professionals wishing to enhance their knowledge of such symptoms. The assessment of symptoms experienced by cancer patients is essential for nurses, since it allows them to provide individualized nursing care. Their nursing care plan should include appropriate measures aimed at alleviating the most distressing symptoms. Furthermore, assessments should evaluate frequency, severity and distress, as well as helping patients to recognize if the symptom is a result of cancer or its treatment[10].The chemotherapy-related side effects commonly experienced by local cancer patients. Though these symptoms have been well characterized, their high prevalence and impact on patients' QOL and psychosocial aspects were of concern.. Pharmacists were well-accepted as patient educators in this aspect. In fact, findings of patients' perceptions and informational needs may serve as a valuable guide for clinical pharmacists to help in side effect management[12].The prophylactic treatment has to be encorporated to overcome the chemotherapy induced complications in cancer patients.

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