Review Article

An overview of critical care in cancer patients

Atul P. Kulkarni

Abstract

Intensivists often refuse admission to cancer patients needing critical care, which may result in denial of effective care for some deserving patients. A cancer patient may need admission to intensive care units for a variety of reasons. The outcomes of patients with hematological malignancies, previously dismal, have improved over last 10 years. The previously known indicators of poor outcome are no longer valid in view of recent advances in intensive care. A select group of patients with hematological malignancies may be offered aggressive therapy for a limited duration and then prognosis can be reassessed.

Cancer chemotherapy can produce toxicities affecting all major organ systems. Such patients may be admitted with acute organ dysfunction or years afterwards for incidental illnesses. Knowledge of these toxicities is essential for early diagnosis, management and prognostication in such patients.

The post-surgical cancer patient has unique problems, the problems of these groups are discussed. The post-surgical cancer patient may need care ranging from only monitoring; in view of supra-major surgery in some patients; to fully aggressive intensive care for post-surgical anastomotic dehiscence, mediastinitis, septic shock and multiorgan dysfunction in others. The metabolic and mechanical complications commonly seen in non-surgical cancer patients are also discussed. Intensive care should be offered to all cancer patients who have a reasonable chance of cure or palliation of their disease.

Key words: Critical care, cancer patients, chemotherapy, complications, prognosis

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

Intensivists are often reluctant to offer critical care to cancer patients as a general rule, the main concern being a potential waste of scarce resources. It is imperative to understand that such a policy may lead to a denial of effective care in some patients, as all cancer patients are not the same. The improving outcomes, particularly in patients with hematological malignancies, means that the decision to provide intensive care should be based on chances of meaningful survival after discharge from intensive care with good quality of life. Patients with cancer may need intensive care for varying reasons such as:

1. Postoperative care following major surgery
2. Treatment of complications after surgery, such as anastomotic dehiscence, peritonitis, mediastinitis, hemorrhage
3. Management of underlying medical comorbidity, such as chronic obstructive pulmonary diseases, ischemic heart disease
4. Management of new medical conditions, e.g., myocardial ischemia, pulmonary embolism, diabetic ketoacidosis, respiratory failure, sepsis
5. Complications related to progression of disease, including airway obstruction, respiratory distress due to pleural effusions, cardiac tamponade, pulmonary leucostasis, etc.
6. Complications related to cancer therapy, including chemotherapy and radiotherapy
7. Infections and sepsis developing in immunosuppressed

From:
Department of Anaesthesiology, Critical Care and Pain, Tata Memorial Hospital, Mumbai, India

Correspondence:
Dr. AP Kulkarni, Tata Memorial Hospital, Parel, Mumbai - 400 012. India.
E-mail: kaivalyaak@yahoo.co.in

Free full text available from www.ijccm.org

patients, with febrile neutropenic sepsis being the commonest.

Intensive care in many of these categories is rewarding, with acceptable mortality and return to a reasonable quality of life in survivors. The prospect of survival of hematological malignancy patients admitted to intensive care was dismal.[1-4] Recent articles,[5-10] however report much lower mortality (50-60%) which, though high, is remarkably less than that reported 10 years ago. Some of the factors responsible for this improvement include earlier referral to the ICU, earlier antibiotic therapy, better management of sepsis, hemodynamics and ventilation and the use of non-invasive ventilation.[11] However neutropenia, septic shock and renal dysfunction are still poor prognostic factors and in such patients, mortality still exceeds 80%. Thus with the possible exception of patients with severe, prolonged neutropenia with septic shock and respiratory and renal failure, many cancer patients can be offered a reasonable chance of survival. Patients who have worsening organ failure scores after three days have a poor prognosis;[11] it is therefore a reasonable strategy to offer intensive care to patients with hematological malignancies for three to four days and to reassess the prospects of survival at that stage.

A modification of the Australian classification[12] of patients with cancer, offers a reasonable starting point on deciding admission policies for patients with cancer:

1. Those undergoing diagnostic and other procedures to establish a diagnosis
2. Those undergoing treatment which will result in cure or significant control of disease that will prolong life
3. Those in whom treatment has failed or no treatment is likely to be offered, except symptom control and palliative care.

In short, intensive care should be offered to all patients who have a reasonable chance of cure or palliation from their disease. The intensivist must be able to recognize the potentially reversible critical illness among the various groups of cancer patients and discourage admission to terminally sick cancer patients. The intensivist must also be aware that the alleviation of the suffering in the last hours of the life a terminal cancer patient is also one of the functions of intensive care unit (ICU), once a decision to discontinue aggressive therapy has been taken.

Cancer patients presenting to the ICU are different from the average patients in that they may have altered organ function by virtue of cancer itself, chemotherapy or radiotherapy that they may have received or they may have undergone a radical surgery. Over the past few years, cancer treatment has become aggressive and is multi-pronged, often involving aggressive chemotherapy and radiotherapy regimes to limit the extent of surgical resection to preserve limb or organ function (e.g., limb sparing surgery for osteogenic sarcoma, breast conservation surgery for carcinoma breast). Such regimes may induce toxic effects, some of which may require intensive care. Thus the distinction between a surgical patient and a 'chemotherapy' patient is becoming blurred.

It is therefore necessary to know the toxicity of the various commonly used anti-neoplastic chemotherapeutic agents and how it affects the various systems. Table 1 lists

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

Table 1: Toxicity of the chemotherapeutic agents

Therapy	Signs and Symptoms
Alkylating agents	Nausea, emesis, bone marrow depression, agranulocytosis, anemia, thrombocytopenia, hemorrhagic cystitis, alopecia, uric acid nephropathy
Busulfan, chlorambucil, melphalan	Pulmonary toxicity
Antimetabolites	Nausea, emesis, gastrointestinal toxicity, acute and chronic hepatitis
5-Fluorouracil	bone marrow depression, megaloblastic anemia, acute cerebellar syndrome, gastrointestinal and hepatic toxicity, coronary artery spasm
Methotrexate	bone marrow depression, interstitial pulmonary infiltrates, renal tubular necrosis, hepatic toxicity
Antineoplastic alkaloids	Neurotoxicity with peripheral paresthesias, muscle wasting, loss of deep muscle tendon reflexes
Vinblastine	Bone marrow depression, myelotoxicity, ADH secretion
Vincristine	Ventricular tachycardia, hypo /hypertension, peripheral neuropathies, bronchospasm
Paclitaxel	Arrhythmias, atrio-ventricular block, bone marrow depression,
Anthracycline antibiotics	bone marrow depression, myelotoxicity, cardiomyopathies with CHF, reduced LVEF, biventricular failure
Bleomycin	Pulmonary toxicity, interstitial fibrosis, renal parenchymal damage
Miscellaneous agents	
Cisplatinum	Renal damage with decreased clearance, neuropathies, areflexia, ocular and ototoxicity, bronchospasm, arrhythmias

the toxicity of common chemotherapeutic agents. Effects of chemotherapeutic agents on the cardiorepsiratory system are of particular importance to the Intensivist and will be discussed in detail here. Effects on other organ systems will be briefly discussed.

Cardiovascular Complications of Chemotherapy

Anthracyclines, i.e., doxorubicin (adriamycin), daunorubicin, epirubicin, idarubicin, mitoxantrone (synthetic anthraquinone) are the commonest agents implicated in the development of cardiac toxicity after cancer chemotherapy.[13,14] Cardiac toxicity can manifest at various times during and following the course of chemotherapy. Three types, depending on their appearance in relation to timing of therapy, have been identified.

Acute and subacute cardiotoxicity can occur immediately after a single dose or a course of anthracycline therapy. A variety of arrhythmias, including sinus tachycardia, ventricular, supraventricular and junctional tachycardia, atrioventricular and bundle-branch block have also been seen. Sudden death may also occur, due to ventricular fibrillation. Rare cases of subacute cardiotoxicity resulting in acute failure of the left ventricle, pericarditis or a fatal pericarditis-myocarditis syndrome, particularly in children, have been reported. Chronic or late cardiotoxicity after anthracycline classically takes the form of cardiomyopathy. Patients who have survived cancer in childhood may come several years later with cardiac failure or cardiac failure may be precipitated during a surgical or other procedure undertaken years after the primary cancer has been treated. Classic anthracycline cardiotoxicity is a cumulative dose-related phenomenon. The rapid increase in incidence of congestive cardiac failure (CCF) after a dose of 550 mg/m^2 has made it a popular empiric-limiting dose for doxorubicin-induced cardiotoxicity. Occult ventricular dysfunction, heart failure and arrhythmias may occur in previously asymptomatic patients more than a year after anthracycline therapy. It is postulated that doxorubicin can cause subclinical myocardial injury during pre-adolescent years and this in later years retards appropriate growth of the myocardium during growth spurt.

Cardiovascular toxicity associated with othyer agents is summarized in Table 2.

Table 2: Other chemotherapeutic agents with cardiovascular toxicity

Agent	Cardiovascular effect
Cyclophosphamide	Fulminant CCF secondary to hemorrhagic myocarditis, acute pericarditis with effusion Risk increased with dose > 200 mg/m^2 and anthracycline combination
Bleomycin	Acute pericarditis
5-Fluorouracil	coronary insufficiency presenting as angina / myocardial infarct due to coronary spasm
Cytosine arabinoside	Acute pericarditis
Paclitaxel and docetaxel	Asymptomatic bradycardia severe brady and tachyarrhythmias including ventricular fibrillation and asystole, conduction disorders myocardial ischaemia, infarction, risk increased with con comitant cisplatinum therapy, peripheral edema due to fluid retention (docetaxel)

Pulmonary Complications of Chemotherapy

Administration of several chemotherapeutic agents, such as busulfan, cyclophosphamide, paclitaxel, etc., can lead to pulmonary complications. Bleomycin, an antitumour antibiotic, is the foremost of these in producing lung damage.[15-19] Several patterns of pulmonary toxicity produced by bleomycin have been described:

1. Dose dependant interstitial pneumonitis progressing to chronic fibrosis
2. An acute hypersensitivity pneumonitis with peripheral eosinophilia resembling eosinophilic pneumonia
3. An acute chest pain syndrome
4. A bronchitis obliterans with organizing pneumonia
5. Pulmonary veno-occlusive disease

The earliest detection of pulmonary fibrosis may be achieved through the serial evaluation of pulmonary function. Sequential measurement of carbon monoxide diffusion capacity (DLCO) may indicate the presence of occult pulmonary changes. Arterial hypoxemia is commonly found and spirometry reveals decreased lung volumes compatible with restrictive lung disease. Regression or amelioration of the toxic pulmonary pathology may occur with immediate cessation of therapy. Steroid therapy has been found to be effective in some cases.

Hyperoxia and bleomycin

Of utmost importance is the debate about the amount of oxygen to be administered to a patient given bleomycin. On the basis of available data, it seems prudent to reduce the concentration of inspired oxygen to the lowest level

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

to maintain SpO_2 > 90%. The judicious use of PEEP to enhance oxygenation and the postoperative use of rigorous physiotherapy to treat ventilation-perfusion abnormalities may be preferable to the use of enriched oxygen concentrations. Conservative fluid management is important; use of colloids is beneficial as compared to crystalloid. Other chemotherapeutic agents producing pulmonary toxicity are listed in Table 3.

Effects of Chemotherapeutic Agents on Renal, Hepatic and Central Nervous Systems

Cisplatinum, a commonly used platinum compound, was introduced in 1970s. The dose-limiting factor for single agent use, however, is nephrotoxicity.[20,21] 30% of patients receiving cisplatinum will develop nephrotoxicity, especially if the hydration is not ensured. Cisplatinum leads to wasting of magnesium and potassium. The renal toxicity may be accentuated if the patient receives aminoglycosides concomitantly. The newer analogues of cisplatinum, such as carboplatin and oxaloplatin are less nephrotoxic with equal efficacy in controlling the malignancy.

Hepatocellular dysfunction is manifest as raised serum enzymes, fatty infiltration of liver and cholestasis, due to direct toxic effect of the drug or its metabolite. L-asparginase and cytarabine are most commonly implicated agents in hepatocellular dysfunction. A decreased synthetic function with low proteins and coagulation abnormalities may be seen. Blockage of the venous outflow in the small hepatic veins results in veno-occlusive disease. It can present abruptly and may have a fulminant course resulting in death. Ascites, painful hepatomegaly and encephalopathy may result after administration of cytarabine, cyclophosphamide, mitomycin, etc.

Table 3: Other drugs causing pulmonary toxicity

Agents	Incidence	Description
Busulfan	4-10%	Pulmonary fibrosis, pulmonary alveolar lipoproteinosis
Cyclophosphamide	< 2%	Pneumonitis with or without fibrosis
Mitomycin	< 10%	Similar to bleomycin
Cytosine arabinoside	5-32%	Non-cardiogenic pulmonary edema with or without pleural effusion
Methotrexate	7%	Hypersensitivity pneumonitis like picture or noncardiogenic pulmonary edema or Pulmonary fibrosis or Pleurisy with acute chest pain

The Post-Surgical Cancer Patient

Spectrum of postoperative care in cancer patients may range from patients following major surgery requiring intensive monitoring, nursing care and short term ventilatory support, to critically-ill patients with sepsis and multi-organ failure.

The general postoperative management after major surgery follows the routine course of care including the recovery from the residual action of anesthetic drugs, management of postoperative bleeding if any, fluid balance, postoperative nutrition, pain relief and other surgery related issues. Several groups of cancer surgeries need special mention.

Head, neck, face and craniofacial cancer surgery

Close to 40% of cancers in India originate in the head/neck and face regions. Anticipated problems include a difficult airway due to trismus, major maxillofacial excision and replacement of excised tissue by flaps, which make visualization of the airway impossible. These patients will often need to have the tracheal tube *in situ* overnight to maintain the airway and to protect the airway from blood, saliva and secretions, which the patient may not be able to swallow. It is not uncommon to have intraoral hemorrhage in first 12h after operation. The patient can choke on his own blood if the airway is not protected. Usually, a tracheostomy is electively performed in patients who undergo total glossectomy or undergo extensive excision with mandibulectomy crossing the midline.

Prolonged intubation may lead to problems such as blocked tubes, usually due to encrustation with blood clots and inadequate humidification, and unplanned extubation. Removal of such an airway may lead to problems and reintubation may be difficult for the reasons mentioned earlier.

Aspiration is a common reason for respiratory failure and readmission of patients to the ICU after Head and Neck surgery.

Esophageal surgery

Esophagectomy represents the highest risk among elective surgical procedures on any region.

A great deal of Indian population with cancer esophagus report late in the hospital and are already cachexic, dehydrated and chronically vasoconstricted due to

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

prolonged hypovolemia. They require large amounts of fluids to compensate for the huge amount lost to third space. Mediastinal lymphadenectomy as a part of radical clearance interrupts many lymphatic channels; this leads to impaired removal of interstitial water. It is, therefore, mandatory to manage fluid administration very carefully. A fine balance must be achieved so that interstitial edema is prevented but not at the cost of vital organ perfusion. In the absence of monitoring of DO2, CI and VO2, adequacy of tissue perfusion is determined by monitoring base line CVS and RS parameters by correlation with CVP. The end point of the values of these parameters is determined by correlating with adequacy of urine output, absence of metabolic acidosis, normal bicarbonates, base deficit less than 3 meq. and low serum lactate. Respiratory complications after esophagectomy are the result of interaction of several factors viz., increase in the lung water (interstitial edema), hypoventilation due to thoracotomy pain, peripheral alveolar collapse, occasional sympathetic pleural effusion, dilated stomach tube acting as a space occupying lesion in the mediastinum, occult tracheo-esophageal fistula silently soiling the mediastinum and aspiration. Early enteral feeding via jejunostomy placed at surgery is the norm. Mediastinitis is a serious consequence of the leak at anastomotic site or along the stomach tube. It is clinically suspected when the patient begins to have tachycardia or supraventricular arrhythmia, bronchospasm, tachypnoea, respiratory failure and pleural effusion. The diagnosis of leak may be confirmed by radiological technique after injection of radio-opaque dye, CT scan or by visualization of ischemic or dehisced areas on esophagogastroscopy. The analysis of the drain fluid for amylase shows almost two to four times higher values than normal. Disconnection of the anastomosis with esophagostomy and gastrostomy or drainage and thorough irrigation of the thoracic cavity are the surgical options. Complications include sepsis, SIRS and progression to multiorgan dysfunction.

The Non-Surgical Cancer Patient in ICU

A cancer patient may require intensive care for several reasons:

1. Overwhelming infection and sepsis[22]

These can occur in the setting of immunosupression seen following myeloablative therapy for bone marrow transplant or after intense chemotherapy producing agranulocytosis. The type of infection and organism producing infection will depend on the part of the immune system that is affected. For example after radical chemotherapy mucosal and skin barriers are breached and bacteria and candida will be the most likely pathogens. In the initial period of neutropenia following two to four weeks of transplant, herpes simplex virus, candida, aspergillus and bacterial infections predominate. The full chemotactic function of the neutrophil does not recover for 100 days post-transplant. From three months to one year after transplant T cells and B cells are dysfunctional and varicella-zoster, hepatitis C, pneumocystis carinii pneumonia and pnuemococcal pneumonia are the most common infections till T cell function recovers. The antibiotic prescription must take into account these issues, and the local pathogenic flora. Management of immunocompromised patient is beyond the scope of this review.

2. Metabolic complications of cancer or cancer chemotherapy[23]

A wide variety of abnormalities occur such as hypercalcemia or hyperphospatemia or Cushing's syndrome seen with small cell carcinoma of lung. A brief discussion of common disorders follows.

a) Tumor lysis syndrome

Case reports of metabolic and electrolyte abnormalities in patient receiving chemotherapy for rapidly proliferating tumours such as Burkitt's lymphoma and leukemias, were first published in 1950s and later Bertino and colleagues proposed the mechanism linking these observations. The syndrome has also been described in chronic myeloid leukemia in an acute blast crisis, non-Hodgkin's lymphoma and occasionally in small cell cancer of the lung and metastatic breast cancer. The syndrome is caused by rapid lysis of malignant cells resulting in hyperuricaemia, hyperkalaemia, hyperphosphataemia, hypocalcaemia and an increase in blood urea nitrogen. These abnormalities can occur as early as six hours following chemotherapy and in the last five to seven days after treatment. The hyperuricemia is caused by the massive release of intracellular nucleic acids and their metabolism by xanthine oxidase into uric acid. Urate crystals can form in the renal collecting ducts and

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

result into acute renal failure. Similarly, potassium and phosphate are released from the tumour cells and their excretion is hampered by the hyperuricemia. The best approach to management is to prevent its occurrence by proper hydration. Patient with diagnosis of rapidly growing lymphoma, uric acid levels of more than 10 mg/dl and high blast count in leukemia, high lactate dehydrogenase before treatment are at greatest risk of developing tumour lysis syndrome.

Management of tumour lysis syndrome

1. Allopurinol 500 mg/m^2/day for three days; this is reduced to 200 mg/m^2/day after three days of chemotherapy.
2. Hydration 3000 ml/m^2/day
3. Urinary alkalinization (pH > 7) with $NaHCO_3$ 100 ml/L then adjust as needed
4. Replace calcium IV slowly
5. Monitor serum chemistry 12-24 hrs. In case of rise of uric acid postpone chemotherapy till levels are controlled
6. Treat hyperkalemia with exchange resins
7. Aluminium hydroxide 30-60 ml six hourly is orally to bind phosphates
8. Hemodialysis if Sr K > 6 meq/L, Sr Uric acid > 10 mg/dL, Sr phosphorus rapidly rising or > 10 mg/dL.

b) Hypercalcemia

Hypercalcemia is the commonest metabolic complication of malignancies. Approximately 10-2 0% cancer patients will have hypercalcemia some time in course of their malignancy. It is most frequently associated with multiple myeloma, lung cancer, breast cancer, cancer involving the head and neck, T-cell lymphomas, renal carcinoma, as well as other solid tumors. The clinical symptoms are nonspecific and include lethargy, confusion, nausea and anorexia. In lymphomas and leukemias there is overproduction of activated vitamin D leading to hypercalcemia. Vigorous hydration with intravenous normal saline combined with the use of furosemide, is the standard therapy. Corticosteroids, diphosphonates, mithramycin and calcitonin can all reduce serum calcium levels by reducing bone resorption of calcium.

d) Adrenal failure

Cancers of lung, breast, kidney, stomach and pancreas often metastasize to the adrenals. A more than 90% destruction of adrenals makes the patient symptomatic causing weakness, postural hypotension, electrolyte disturbances etc. Diagnosis is made with cosyntropin stimulation test. If the response is suboptimal physiologic doses of glucocorticoids need to be administered.

Many other metabolic and endocrine complications such oncogenic osteomalacia, tumor induced hypoglycaemia, etc., may occur. The complete description is beyond the scope of this discussion.

3. Mechanical complications and complications due to direct invasion of contiguous tissues

a) Cardiac complications

Cardiac dysfunction in cancer patients can result from mechanical effect of the tumors on the heart, pericardium and great vessels. Cardiac tamponade can occur due to metastases from breast cancer, lung cancer, melanoma or leukemias. Encasement of the heart or malignant pericardial effusion leads to tamponade causing shortness of breath, decreased exercise tolerance and cough. Urgent pericardiocentesis may be needed in the presence of hemodynamic compromise. Repeated filling of effusion may necessitate repeated drainage or a pericardial window to be made surgically.

Superior vena cava syndrome occurs due to obstruction to the blood flow caused by mediastinal tumors, fibrosis, thrombosis and direct invasion of great vessels with tumor. Facial and upper extremity edema, facial plethora and tachypnoea are most common clinical presentations. Death can occur from respiratory compromise due to obstruction. The treatment depends on the underlying malignancy and hence a definitive tissue diagnosis is essential. Lymphoma or small cell carcinoma may respond to chemotherapy and will reduce obstruction. In chemotherapy resistant tumors, radiotherapy may provide relief in significant number of patients.

b) Pulmonary complications

Mediastinal tumors, tumors causing SVC syndrome can cause mechanically induced respiratory compromise needing ventilatory assistance. Sometimes thymic tumors can act doubly by producing myasthenia as well as direct tracheal compression. Excision of tumor in such patients

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

if possible can alleviate the respiratory compromise by both removal of obstruction and curing myasthenia in up to 40% patients. Direct lymphangitic spread of the tumor subsequently leads to pulmonary hypertension and cor pulmonale. The prognosis of this condition is very poor.

c) Complications affecting the central nervous system

Spinal cord compression can be caused by epidural or bony metastases. The clinical manifestation will depend on the level of metastasis. High dose steroids can provide some relief till definite surgical therapy is undertaken. Brain metastasis with peritumour edema can lead to significant intracranial hypertension and also uncontrolled seizures. Unless urgent therapy is instituted, transtentorial herniation and subsequently death may occur. High-dose steroids, mannitol, intubation and ventilation to normocarbia may help to acutely reduce raised intracranial pressure. Definitive management may include surgery or radiotherapy. In patients with pancytopenia, fatal intracranial hemorrhage can occur which means curtains for most patients.

d) Gastrointestinal and genitourinary systems

Bowel obstruction due to external compression, GI involvement by lymphoma, biliary obstruction may all occur. Treatment depends on the histopathology of the tumor and respectability. It may not always be possible to provide surgical relief. Bleeding from the GI tract can be managed depending on the site of hemorrhage. Hydronephrosis due to ureteric obstruction is probably a commonest cause for renal dysfunction.

Conclusion

A blanket refusal to provide intensive care to cancer patient is inadvisable. The decision to provide or deny care should be based not only on prognosis of the acute illness but also the comorbidities, the availability of life prolonging treatment options and estimated chance of the patient having a reasonable survival with good quality of life. Some patients may be admitted to provide palliative care to alleviate suffering. The cancer patients may be admitted for a variety of reasons. Some postsurgical cancer patients present with unique problems related to presence of cancer and the intensivist needs to familiarise himself with these. The outcome for these patients is generally equivalent to the other non-cancer post-surgical patients. The cancer patients may also present to the intensive care for treatment necessitated by other forms of cancer therapy such as chemotherapy and radiotherapy. An acquaintance with the possible hazards of these therapies can help the intensivist manage these patients successfully. Intensive care of the cancer patient can often be rewarding and good results may be obtained by a systematic approach to the therapy.

References

1. Groeger JS, Auroroa R. Intensive Care, mechanical ventilation, dialysis and cardiopulmoinary resuscitation: Implications for the patient with cancer. Crit Care Clin 2001;17:791-803.
2. Nainan S, Sindhakar S, Divatia JV, Kulkarni AP, Dogra N. Outcome of medical oncology patients in the intensive care unit. Indian J Crit Care Med 2001;5:228-33.
3. Lloyd-Thomas AR, Dhaliwal HS, Lister TA, Hinds CJ. Intensive therapy for life-threatening medical complications of haematological malignancy. Int Care Med 1986;12:317-24
4. Yau E, Rohatiner AZ, Lister TA, Hinds CJ. Long term prognosis and quality of life following intensive care for life-threatening complications of haematological malignancy. Br J Cancer 1991;64:938-42.
5. Azoulay E, Recher C, Alberti C, Soufir L, Leleu G, Le Gall JR, *et al*. Changing use of intensive care for hematological patients: The example of multiple myeloma. Intensive Care Med 1999;25:1395-401.
6. Azoulay E, Moreau D, Alberti C, Leleu G, Adrie C, Barboteu M, *et al*. Predictors of short-term mortality in critically ill patients with solid malignancies. Intensive Care Med 2000;26:1817-23.
7. Blot F, Guiguet M, Nitenberg G, Leclercq B, Gachot B, Escudier B. Prognostic factors for neutropenic patients in an intensive care unit: Respective roles of underlying malignancies and acute organ failures. Eur J Cancer 1997;33:1031-7.
8. Kress JP, Christenson J, Pohlman AS, Linkin DR, Hall JB. Outcomes of critically ill cancer patients in a university hospital setting. Am J Respir Crit Care Med 1999;160:1957-61.
9. Staudinger T, Stoiser B, Mullner M, Locker GJ, Laczika K, Knapp S, *et al*. Outcome and prognostic factors in critically ill cancer patients admitted to the intensive care unit. Crit Care Med 2000;28:1322-8.
10. Benoit DD, Vandewoude KH, Decruyenaere JM, Hoste EA, Colardyn FA. Outcome and early prognostic indicators in patients with a hematologic malignancy admitted to the intensive care unit for a life-threatening complication. Crit Care Med 2003;31:104-12.
11. Larche J, Azoulay E, Fieux F, Mesnard L, Moreau D, Thiery G, *et al*. Improved survival of critically ill cancer patients with septic

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

shock. Intensive Care Med 2003;29:1688-95.
12. Haines IE, Zalcberg J, Buchanan JD. Not-for-resuscitation orders in cancer patients-principles of decision-making. Med J Aust 1990;153:225-9.
13. Praga C, Beretta G, Vigo PL, Pollini C, Bonadonna G, Canetta R, *et al*. Adriamycin cardiotoxicity: A survey of 1273 patients. Cancer Treat Rep 1979;63:827-34.
14. Shan K, Lincoff AM, Young JB. Anthracycline-induced cardiotoxicity. Ann Intern Med 1996;125:47-58.
15. Waid-Jones M, Coursin DB. Perioperative considerations for patients treated with bleomycin. Chest 1991;99:993-9.
16. Goldiner PL, Schweizer O. The hazards of anesthesia and surgery in Bleomycin-Treated patients. Semin Oncol 1979;6:121-4.
17. Goldiner PL, Carlon GC, Cvitkovic E, Schweizer O, Howland W. Factors influencing postoperative morbidity and mortality in patients treated with bleomycin. Br Med J 1978;1:1664-8.
18. LaMantia KR, Glick JH, Marshall BE. Supplemental oxygen does not cause respiratory failure in Bleomycin-treated surgical patients. Anesthesiology 1984;60:65-7.
19. Donat SM, Levy DA. Bleomycin associated pulmonary toxicity: Is perioperative oxygen restriction necessary? J Urol 1998;160:1347-52.
20. Madias NE, Harrinton JT. Platinum nephrotoxicity. Am J Med 1978;65:307-14.
21. Fjeldberg P, Sorensen J, Helkjaer PE. The long term effects of cisplatin on renal function. Cancer 1986;58:2214-7.
22. Safdar A, Armstrong D. Infectious morbidity in critically ill patients with cancer. Crit Care Clin 2001;17:531-70.
23. Kapoor M, Chan GZ. Fluid and Electrolyte abnormalities. Crit Care Clin 2001;17:503-30.

Source of Support: Nil, **Conflict of Interest:** None declared.

This PDF is available for free download from a site hosted by Medknow Publications (www.medknow.com).

FORM IV

Statement about ownership and other particulars about newspaper (***Indian Journal of Critical Care Medicine***) *to be published in the first issue every year after the last day of February*

1.	Place of publication	:	Mumbai
2.	Periodicity of its publication	:	Quarterly (March, June, September and December).
3.	Printer's Name	:	Medknow Publications Pvt. Ltd.
	Nationality	:	Indian
	Address	:	A-108/109, Kanara Business Center, Off Link Rd, Ghatkopar (E), Mumbai - 400075, India Phone: 91-22-6649 1818/1816, Fax: 91-22-6649 1817
4.	Publisher's Name	:	Medknow Publications Pvt. Ltd.
	Nationality	:	Indian
	Address	:	A-108/109, Kanara Business Center, Off Link Rd, Ghatkopar (E), Mumbai - 400075, India Phone: 91-22-6649 1818/1816, Fax: 91-22-6649 1817
5.	Editor's Name	:	Dr. Sandhya Talekar
	Nationality	:	Indian
	Address	:	Shree Medical Foundation, Prayag Hospital, 1247, Deccan Gymkhana, Pune 411004, India. Tel: 91 20 553 2812 /553 2490, Fax: 91 20 553 4448 E-mail: editor@ijccm.org
6.	Names and addresses of individuals who own the newspaper and partners or shareholders holding More than one percent of the total capital.	:	Indian Society of Critical Care Medicine

I, **Sandhya Talekar**, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sandhya Talekar
Chief Editor

Date: 05/04/2007