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Oncological patients in the intensive care unit: prognosis, decision-making, therapies and end-of-life care

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Summary

The effectiveness of intensive care unit (ICU) care for cancer patients remains controversial. Advances in antitumour and supportive care led to major improvements in outcomes of oncological patients in the ICU. Improved cancer therapies and supportive management of organ dysfunctions have contributed to improved survival rates. As a consequence, the number of cancer patients requiring ICU admission is rising. Frequently, cancer patients have a poor performance status and are vulnerable. It is a heterogeneous population, where the nature and curability of the neoplasm and the severity of critical illness cause a plethora of issues about ICU admissions. Therefore, oncological patients are often considered inappropriate for ICU admission. So far, no specific severity-of-illness scoring system can reliably predict the outcome of critically ill oncological patients and scoring systems or survival predictors are lacking. The major determinants of mortality and prognosis are the number of organ failures, need of mechanical ventilation (especially for acute respiratory distress syndrome), vasopressor support (>4 hours) and therapies that have preceded ICU admission. The underlying neoplasm seems to have a little impact on the outcome. The most frequent reasons leading a cancer patient to ICU are postoperative recovery, respiratory failure, infection and sepsis. To date, scientific reports suggest that acute organ dysfunction should be managed at its onset, preferably within 2 hours after the admission, whereas further aggressive ICU management should be reappraised after a few days of full support. Prognosis should be reassessed at frequent intervals with particular attention to the development of multiple organ dysfunctions. Discussing the code status is a sensitive matter and should be balanced between the patient's wish and objective medical outcome assessment. The latter can only be achieved in a multidisciplinary team of intensivists, oncologists/haematologists and potentially palliative care experts, preferably by consensus. Transition from restorative to palliative care should be made when there is no benefit from further intensive treatment, there is no trend to recovery in the first days of intensive care and where symptom palliation would improve the quality of life. Patients' autonomy and dignity should remain paramount in any decision-making.

Current data do not support any absolute criteria for triaging. Establishment of clear goals and approach to admit and treatment for oncological patients in the ICU are however urgently needed. This requires further prospective studies for independent validation in different medical settings and identifying prognostic tools that can aid with decision-making and patient selection for ICU. Cancer should not be seen as an exclusion criterion and priority should be given to assure the quality of life of oncological patients.

Key words: *ICU, oncological patients, end of life, cancer patients, critical illness*

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Introduction

Over recent decades, intensive care unit (ICU) admission of cancer patients has been an extremely controversial and delicate issue, involving concerns about inappropriate use of limited resources and deprivation of critical medical care. Some efforts have been made to refine the selection criteria, but there is an urgent need of guidelines that can support clinicians and ICU teams in triaging and managing oncological patients [1, 2].

Indisputably, advances in tumour therapies, improvements in ICU interventions and progress in selecting patients likely to benefit from ICU admission have contributed to an improved survival of critically ill cancer patients. However, validated data are needed to demonstrate these changes in a scientific context and to aid intensivists in decision making [3–5]. Regrettably, most studies are outdated and therefore fail to reflect recent advances in prognosis of oncological patients in the ICU. Certain prognostic factors, such as aplasia, resuscitation or bone marrow trans-

plantation, have lost their significance for the outcome of critical illness in this population. ICU admission has been considered inadvisable for cancer patients, on the basis of studies published in the 1990s that reported a dismal prognosis for cancer patients. New data suggest that cancer patients benefit as much as noncancer patients from intensive care support. Mortality rates, as well as infectious and toxic adverse events, have decreased significantly. Additionally, another essential piece of evidence has influenced the clinical and scientific approach: the underlying malignancy rarely influences short-term survival after ICU admission.

In this evolving context, it can be assumed that critically ill cancer patients might have acceptable outcomes after an ICU stay. Admission policies, goals and strategies for oncological patients need to be appropriately adapted, and triage criteria should be easy to use and evidence based so that they help to avoid refusing life support to patients with cancer who might benefit from it [6–8].

This article reviews recent scientific insights and consensus opinions from experts, in order to validate and educate about current developments of intensive care in oncological patients. It aims to provide suggestions for further studies and discusses the need for specific oncological ICU admission and treatment guidelines.

Dilemma

Treatment in the ICU is generally considered appropriate for patients who can profit from the intensive care, i.e., patients suffering from potentially reversible diseases. Oncology patients, especially patients with advanced cancer, are by definition irreversibly ill. However, one should bear in mind that a number of patients with an underlying "irreversible" diseases, such as chronic obstructive pulmonary disease or heart failure, are commonly treated in ICUs. It is also increasingly recognised that patients and their families suffer from long-term sequelae even after successful treatment in the ICU. Against that background, it is necessary to approach critically the issue of ICU admission of cancer patients and the extent of the intensive measures applied.

The facts

Improved prognosis of cancer patients

Over the last decade, oncological therapies have made tremendous progress, significantly changing the prognosis for cancer patients, even those in advanced stages. Patients profit from improvements in therapeutic schemes and protocols, as well as from novel, targeted therapies, which improve overall survival and quality of life. Progress in immunotherapy has exceeded expectations, leading to successful management with immunotherapeutic agents both alone and in combination. Side effects, which strongly influence quality of life, have been markedly reduced. New molecular insights are being gained rapidly and the scientific progress translated to the clinic is enormous. Cancer entities that were considered to have a very poor prognosis (such as ovarian, small cell or cerebral cancers) are now in a new era of great therapeutic results with a manageable safety profile [9–11]. Furthermore, symptom management of advanced cancer has also improved, allowing patients to reduce their hospital stays, physician visits and psychosomatic burden. Metastatic bone pain, cerebral symptoms due to brain metastasis, hypercalcaemia, anorexia, insomnia, neuropathy and many other conditions can now be successfully managed with a variety of methods, from medication to invasive approaches or radiotherapy [12–16].

Therapeutic and diagnostic advances for cancer patients in the ICU

Several recent studies have reported an improvement in outcome for critically ill patients with cancer. The populations studied should be seen from a scientific perspective: most were specific subgroups, such as patients with lung cancer, requiring mechanical ventilation, receiving chemotherapy in ICU, or with a prolonged ICU stay of >20 days.

Overall advances in ICU management, diagnostic and therapeutic approaches, as well as improvements in infection control, contributed to the amelioration of patients' prognosis. More aggressive and novel anti-infectious treatment benefits immunosuppressed individuals. Patients with bone marrow aplasia profit from the advent of hematopoietic growth factors.

With the increasing incidence of cancer, ICU teams are now better educated and gain more experience in the management of cancer patients, and a high case volume is associated with improved survival. This has been validated in a study of Lecuyer et al., which confirmed that patients in high-volume ICUs had a lower mortality, and that a case volume increase of as little as one admission per year led to a significant mortality reduction [17–19]. However, it is relevant that in most centres, intensivists can also regularly consult with oncologists and haematologists.

Few data are available on survival rates in vulnerable populations such as patients with malignancies. In the past, the mortality of mechanically ventilated patients was estimated to be 80%, and was 90–95% in patients in multiple organ failure. Recent reports, however, show significantly lower mortality (27–30%) in unselected cancer patients admitted to an ICU. This was best demonstrated in the largest study, which included a mixed population of critically ill patients with cancer and reported hospital, 3-month, and 1-year mortality rates of 39, 47 and 57%, respectively. The highest rates were in patients who were mechanically ventilated, on vasopressor support, or receiving renal replacement therapy (approximately 60% each) [20]. Subpopulation studies provided similar figures: for example, various studies have reported 39% and 43.1% ICU mortality compared with 55%, 47% and 59.2% hospital mortality of patients with haematological cancers in Scotland. Decreased mortality was also demonstrated in cancer patients who developed severe sepsis or septic shock. Even current chemotherapy or neutropenia are not associated with an increased mortality. This suggests that mortality of critically ill cancer patients is gradually approaching that of noncancer patients [21–23].

Obviously, some specific neoplasms, such as acute leukaemia or pancreatic cancer, as well as metastatic and advanced disease, are associated with increased mortality. Higher mortality in patients with haematological malignancies admitted to the ICU is also associated with haemodynamic instability [24].

As in the general population, early intervention before ICU admission is independently associated with decreased in-

hospital mortality in critically ill cancer patients, whereas delays in transfer to an ICU are associated with a poorer survival and prolonged hospital stay.

Diagnosis on ICU admission rarely/never related to the underlying malignancy

Against intuitive assumptions, the main reasons for cancer patients to be admitted to the ICU are hypotension (shock) and acute respiratory failure, noninfectious in nature. These are followed by sepsis, acute kidney injury, bleeding, oncological emergencies, and postoperative care after complex or large tumour resection. Bronchial cancer is the most common solid tumour type in adults encountered in the ICU; leukaemia and lymphoma are the most common haematological cancers [1]. In haematological cancer patients, indications for ICU admission include mucositis, acute graft-versus-host disease, diffuse alveolar haemorrhage, cardiac dysfunction, hypertension and veno-occlusive disease of the liver.

Even for patients receiving palliative care, admission may be appropriate for the treatment of acute, reversible conditions. Typical indications are cardiac tamponade, severe dehydration or respiratory insufficiency that can be managed with noninvasive ventilation.

The diagnoses most often seen at ICU admission of oncological patients are summarised in table 1.

Improved short-term outcome of cancer patients at the ICU

When cancer patients become critically ill, ICU care is often considered futile. However, it is crucial to understand whether the outcome of cancer patients differs from that of noncancer patients.

Studies on long-term prognosis of oncology patients after admission are sparse and open to bias due to their observational nature. However, perceptible improvements in the prognosis of acutely ill oncological patients, including paediatric patients, have been achieved in recent years [25–27]. In fact, since 2002 some reports have mentioned ICU admission as an independent favourable prognostic factor for short-term outcome [17, 28–30]. Admission to the ICU worsens the prognosis of a cancer patient substantially; however, the stage of the malignancy has little or no impact on short-term survival [5, 11]. As for noncancer patients, the ICU outcome depends on the need for organ support, severity of the acute illness and the number of failed organ systems. These facts had already been reported over 30 years ago [3, 6]. Adult oncology patients who require mechanical ventilation for acute respiratory failure experience an ICU mortality of >40% that increases to >60% when respiratory failure is due to acute respiratory distress syndrome. Not requiring mechanical ventilation lowers the in-hospital mortality rate to 25%; intubation immediately increases the percentage, regardless the indication for mechanical ventilation. Multiple organ dysfunction syndrome has the worst prognosis. The outcome of septic shock has also improved for cancer patients, which is related to implementation of new adjuvant therapies [31]. Advances in sepsis diagnosis and management led to a significant reduction in mortality rates due to sepsis in critically-ill adult patients with cancer, to as low as 28%. The Sepsis Occurrence of Acutely Ill Patients study (SOAP) reported similar mortality in patients with and without cancer (27 vs 23%) [32, 33]. Studies consistently report that the worst outcomes are to be expected in patients who were mechanically ventilated, on vasopressor support, or receiving renal replacement therapy. Poor performance status has also been shown to be a predictor of poor outcome [3, 19, 22].

Even though studies vary in their predetermined inclusion criteria, sample number and follow-up period, they predominantly show that earlier ICU admission and management of critically ill cancer patients is associated with higher survival. A rather deflating study of Thiéry et al. showed that the 30-day survival was 26% for cancer patients who were considered “too sick” and 78.7% for patients considered “too well” for ICU admission.

Strikingly, as many as 60% of critically ill patients with advanced cancer admitted to the ICU are never discharged home; those who are have a median survival of only 33 days [22, 34]. Furthermore, 55 to 75% of ICU cancer survivors report severe symptoms such as pain, discomfort, anxiety and sleep disorders [22, 35]. Although aggressive treatment is not recommended for this group, ICU admission may be appropriate for the treatment of reversible conditions such as cardiac tamponade, severe dehydration,

Table 1: Diagnosis at ICU admission in cancer patients.

	Common indications	Rare indications
Malignancy related	Pulmonary embolism Hypercalcaemia Tumour lysis syndrome Superior vena cava syndrome Disseminated intravascular coagulation Adrenal insufficiency/crisis	Spinal cord compression Hyperuricaemia with resulting oliguria Lambert-Eaton syndrome Hyponatraemia Seizures Posterior reversible encephalopathy syndrome Upper airway obstruction Malignant pericardial tamponade Hyperviscosity syndrome Hyperleucocytic syndrome Thrombocytopenia/ haemorrhage
Cancer therapy related	Neutropenic fever Anaphylaxis Cytokine release syndrome Arrhythmias Pulmonary thromboembolism Tumour lysis syndrome Congestive heart failure	Drug-induced organ failure All-trans retinoic acid syndrome Thrombocytopenia/haemorrhage Thrombotic microangiopathy
Noninfectious	Transfusion-associated lung injury Pneumonitis Transfusion-associated circulatory overload	Alveolar haemorrhage Polymyositis Engraftment syndrome
Infectious	Neutropenic fever Pneumonia Sepsis	

or respiratory insufficiency that can be managed with non-invasive ventilation [36]. Azevedo suggested that cancer patients with good prognosis and nonprogressive disease requiring ventilatory support should receive full intensive care, because one-half of these patients survive. Among patients admitted to ICU because of complications of their therapy, respiratory failure is the most common indication for admission, with a reported ICU mortality of approximately 50% [6, 8]. In general, prognosis associated with the aetiology of the acute illness in the context of life expectancy from the underlying malignancy should be discussed before or soon after admission to the ICU [37, 38]. Last but not least, improved outcome in critically ill cancer patients is also a consequence of a better selection of patients admitted to the ICU.

Available scoring systems and predictive factors

As for any other disease entity, scores are reliable for cohorts, but not for individuals. In the case of cancer patients, this problem is even more complicated, as it merges diffusely with ethical and open questions, combined with gaps in our knowledge due to trial limitations and insufficient understanding of many cancer mechanisms. One could even provocatively ask whether scores account for cancer. And with a given score, does additional cancer matter?

Current evidence suggests that cancer-specific features have a minimal effect on short-term prognosis during an acute critical illness [39–41]. Traditional physiological scores such as Acute Physiology and Chronic Health Evaluation (APACHE), Simplified Acute Physiology Score (SAPS) and Mortality Probability Models (MPM) are of limited assistance for ICU triage [42–44]. In cancer patients, assessment of the critical illness and risk stratification is even more challenging, especially in the light of the difficulty in accurately predicting the outcome. However, several studies have addressed this problem and reported that the number of failed organ systems is the main prognostic factor. Higher APACHE II and Sequential Organ Failure Assessment (SOFA) scores were also associated with an increased ICU mortality [34, 35, 45, 46]. Nevertheless, there are some data indicating that three general models – APACHE II, SAPS II and SOFA – were fairly accurate predictors of mortality in critically ill cancer patients [47]. They can predict clinically meaningful outcome for adult ICU patients and can be used for investigational purposes.

Knaus et al. conducted a number of large prospective studies and reported that sepsis, aplasia, previous bone marrow transplantation, metastatic disease or previous admission to ICU were not associated with a poorer prognosis or increased mortality risk [48]. However, mortality was higher when time to antibiotic treatment was >2 hours or when initial antibiotics were not adapted. Larche et al. studied the Logistic Organ Dysfunction (LOD) score of ICU cancer patients. LOD calculated at day 3 seems to be a useful predictive tool and to be superior to the SAPS II. Groeger and colleagues proposed a system of seven variables to estimate the mortality. It includes intubation after 24 hours, leukaemia, progression or recurrence of cancer, allogeneic bone marrow transplantation, cardiac arrhythmias, disseminated intravascular coagulation and need for vasopressor therapy. Prior surgery with curative intent was a protective factor.

The need for vasopressors and APACHE II score were reported to be independent prognostic factors for in-ICU mortality, whereas the length of stay in the ICU, Charlson comorbidity index score greater than 2 and the need for vasopressors were independent predictors of death after ICU discharge [49].

Basic bedside evaluation by physicians has been deemed a poor tool for predicting outcome in ICU cancer patients [42, 50]. Sepsis increases the mortality risk from 28 to 60%, but the prognosis is strongly influenced by the time of admission and initiation of antibiotics. Multiple organ failure (>3 organs) has a higher mortality in oncological patients than in those without cancer (75 vs 50%). The SOFA score includes this factor in the calculation. Sepsis due to pulmonary infection was associated with a 56 to 62% mortality rate and described in a retrospective study as an independent predictor of death at 28 days [41, 51]. Analogously, an independent predictor of death was fungal sepsis, especially invasive aspergillosis, with particularly high rates of mortality (up to 80%) [4, 52].

Poor response to chemotherapy, cancer relapse after an initial response, progressive or recurrent disease, malignant infiltration of vital organs or the airway, poor marrow recovery post haematopoietic cell transplantation, active graft-versus-host disease, delayed ICU admission, and need for advanced cardiac life support protocol have been identified as disease-related predictive factors for mortality, whereas diagnostic and therapeutic procedures (e.g., bronchoscopy with biopsy and surgical lung biopsy) are procedure-related predictive factors [24, 53, 54]. A summary of prognostic and predictive factors is given in table 2.

Malignancy, resuscitation status and course of critical illness

Data on whether the underlying cancer disease interferes with the ICU treatment of the critical illness are only deductive and based on the outcomes. It can be assumed that nonmetastatic solid tumours do not interfere as significantly with the intensive treatment as do haematological malignancies.

One of the most sensitive decisions for the patients and for the team in the ICU concerns the resuscitation status. Palliative care services are probably underutilised in the ICU and yet often prompt advance directives. Compromise of a patient's quality of life, permanent invalidity, and non-beneficial utilisation of limited medical resources are reasons to disfavour intensive therapy for oncological patients. The literature does not provide sufficient data on oncological

Table 2: Prognostic factors for mortality of cancer patients in the ICU.

Prognostic/predictive factors	Not prognostic factors
Age (older) (-)	Type of tumour (solid vs haematological)
Number of organ system failures (>2) (-)	
Respiratory failure (-)	
only requiring treatment with vasopressors (+)	
Isolate lung injury (+)	

(+): positive prognostic factor, (-): negative prognostic factor.

patients' outcomes after cardiac arrest [55, 56]. Antecedent studies reported low survival rates after cardiopulmonary resuscitation, especially of patients with haematological malignancies (40% of allogeneic haematopoietic cell transplant recipients develop one or more complications where transfer to an ICU is indicated) or metastatic solid tumours. However, as with improving general outcome trends, the triage decision about ICU admission after return of spontaneous circulation in cancer patients is presumably just as appropriate as for noncancer individuals.

Lecuyer and colleagues conducted a trial in an effort to identify patients who benefit from ICU admission. Under a broad admission policy, cancer patients were admitted to the ICU for 5 days for full-code treatment. The resulting recommendation was that physicians should consider transition to comfort or end-of-life care only after 5 to 6 days of full-code ICU management [17]. It seems undeniable that frequent reappraisals by and a close collaboration with oncologists are a crucial part of the management plan. Discussion of the prognosis of cancer patients in the setting of a critical illness is a key factor for making clinical decisions in the ICU.

Problems and considerations for setting clear recommendations

Several considerations might limit the setting of clear recommendations and guidelines for cancer patients in the ICU. Firstly, the severity of the critical illness might compromise the oncological treatment ("too sick for therapy"), which consequently reduces life span and quality. Long-term stays in the ICU, which require subsequent rehabilitation, are a common fear for responsible physicians, patients and families. It is obvious that a life span that is *per se* limited by the underlying cancer should preferably not be "eaten up" by ICU therapies and rehabilitation, as this would not be beneficial for the patient. Another crucial aspect is death due to critical illness. Understandably, this area closely touches an ethical debate. However, rationally, there are two sides of the coin: death in the ICU may prevent prolonged suffering caused by the cancer disease; successful ICU treatment (especially if recovery occurs) may give the patients the full life expectancy that they would have had without the ICU stay. Here, we address these problems and elaborate on the available data and experts' opinions known to date.

Prolonged length of stay of oncological patients in the ICU

Long stays in the ICU are not only cost intensive, but also associated with an increased number of potentially life-threatening complications that might adversely affect patients' prognosis [57, 58]. The impact of ICU length of stay on the survival of critically ill cancer patients is not well established. A retrospective view of over 1000 oncological patients with an ICU stay ≥21 days showed that their short- and long-term survival rates were similar to patients with an ICU stay <21 days and the prognosis was better than expected *a priori* [5]. Nevertheless, 90% of the patients acquired nosocomial infections, almost all required mechanical ventilation and 80% underwent a tracheotomy. Another study from Brazil concluded that mortality rates of cancer patients with prolonged ICU admissions were comparable to those previously reported for critically ill noncancer patients. Moreover, the hospital and 6-month mortality rates were similar, regardless of the ICU length of stay. Advanced age, malnutrition, number of organ failures and poor status were reconfirmed as mortality predictors. Last but not least, it should be remembered, as elaborated in the earlier section "Available scoring systems and predictive factors", that three general models, APACHE II, SAPS II and SOFA, were fairly accurate predictors of mortality in critically ill cancer patients [47].

Palliative care of cancer patients at the ICU

Very often, patients with malignant disease are offered palliative care on the ward rather than being referred to the ICU. In the ICU, they tend to be switched to comfort therapy and symptom control. A cancer patient may be ill-served by prolonged, nonpalliative life support at ICU. However, in some cases, the high risk of fatal outcome and a poor quality of life outrage, and legitimise the tendency to palliation [59–62].

Ageing and booming populations are predicted to make palliative care a growing worldwide issue. The ICU is an independent, specific and often semi-closed environment, with a main focus on patient rescue and monitoring. Undeniably, psychological support has gained importance and has been developed to a level at which it is a consistent part of almost all departments caring for critical and/or cancer patients [17, 63, 64]. Especially under critical conditions, a functioning support system is necessary for vulnerable patients and their families. Mental burden, often combined with the fear of death of the loved ones, who frequently continue to stay in hospital without visible amelioration, can lead to tensions and misunderstandings if clear communication is not ensured [61, 64, 65].

In the context of deterioration of the disease, tense situations can stimulate disputes with the medical staff and affect the patient's situation [66]. Improvement in quality of care through education and raised awareness of the need to help families understand the ICU and the extent of the ICU options is the key to limiting conflicts and misperceptions [67].

Admission to an ICU is a traumatic event for cancer patients and their relatives. The ICU team uses their professional and technical skills to treat patients, but it is also essential to alleviate the mental suffering of patients and their families. Better cooperation allows a smoother treatment process and integrates families as recognised caregivers, since they play an important part in the overall care [68, 69].

In several countries, such as China, with a rapidly aging population and where cancer has officially been reported as epidemic, ICU teams are challenged with further barriers to adopting ICU palliative care [70, 71]. The preconception that only dying patients need palliative care affects both patients and their families, causing desperation and emotional refusal of palliation. Secondly, a number of national health insurance providers do not support pure in-hospital palliative care. This compromises the care quality and leads to a shortage of professional palliative-care staff. For China, this issue has been considered very seriously and efforts are being made to implement improvement measures, including education, policy making and increasing funds.

Although palliative care has not been shown to affect the mortality of critically ill adult patients in the ICU, it improves survival and quality of life in adult patients with cancer [59, 72, 73].

Palliation and end-of life decisions are a common occurrence in the ICU for patients with malignancy and recipients of haematopoietic cell transplant. Prognosis should be reassessed at frequent intervals with particular attention to the development of multiple organ dysfunction. For those in whom the prognosis is predicted to be poor during their ICU admission (e.g., haematopoietic cell recipients with multiple organ failure), early discussion of the likely outcome with caregivers and family is essential, often prompting withdrawal of care. In addition, studies in this population consistently describe a continued decline in life expectancy once patients are discharged from the ICU. When appropriate, patients or family members should be advised that an incurable malignancy might progress throughout the duration of a critical illness such that at the point of discharge from the ICU death from their underlying cancer might be expected. For those in whom survival is predicted to be poor following discharge, early palliative and end-of-life discussions may elicit the desire to avoid readmission and or redirect care to palliation in the event that another acute life-threatening illness arises.

Balancing the harms and benefits in caring for elderly and oldest old oncological ICU patients

Balancing the benefits and harms when counselling and treating older cancer patients is a challenge, because with increasing age several changes in functional status, comorbidity and cognition may influence patients' comprehension of their cancer diagnosis, life expectancy, risks, prognosis and consequently the therapy decision.

The aging society is an issue that dominates the academic and public debates surrounding healthcare. Cancer is one of the leading diseases of older patients. However, age remains a barrier for accrual onto trials, which hinders development of therapeutic approaches for elderly patients. On the other hand, age remains a controversial prognostic factor for cancer patients in a critical illness. As with other factors, age was investigated in last decade studies before the era of advanced, modern ICU care. They reported no influence of age on the mortality of ICU cancer patients.

Despite concerns over the appropriateness and quality of care provided, the number of elderly patients in the ICU is increasing. More recent studies have evaluated age as an independent prognostic factor and indicated a higher mortality rate in patients older than 60 years with severe comorbidities, poor functional status and multiple iorgan failure [4, 74, 75]. In particular, comorbidity is an important, independent prognostic factor in the oldest cancer patients. It is suggested that in -older cancer patients, comorbidity is a more suitable surrogate than the "chronological age". However, it needs to be emphasised that, in unselected ICU patients, increased age had already been shown to be associated with increased mortality in last decade studies e.g., SAPS II and APACHE II. Thus, alternatives for ICU admission should be considered in geriatric patients with severe critical illnesses [76].

Conclusion

Hospitals vary in their threshold for admitting oncological patients to the ICU. There are no binding guidelines on how to select patients to be admitted and the final decision is mostly courtesy of the ICU attendant in charge. In general, our experience with an interdisciplinary approach (with no available data so far) shows that oncologists appear to be overly optimistic and intensivists tend to be too pessimistic.

There is insufficient data on ICU outcomes in cancer patients, and hence a lack of specific guidelines on ICU admissions of this special population. Therefore, so far, the decisions are mostly individual and based on:

- life-expectancy and quality of life without the acute illness;
- estimated length of stay in ICU and the duration of rehab after ICU;
- effect of the critical illness on the oncological therapy and the consequences thereof;
- specific interactions of conditions caused by the cancer and the cancer therapy combined with the ICU management;
- wishes of the patient (considering the abovementioned issues).

The ultimate goal is to assure an appropriate quality of life for an appropriate life span with appropriate ICU resources.

Recommendations

In face of the advances reviewed above, the triage decision to admit cancer patients to ICU should not be arbitrary or solely based on the underlying malignancy. The severity of the acute illness should be the pivotal factor in the decision to provide invasive therapy. The threshold of admitting cancer patients to the ICU and initiating ICU therapy should be low in order to prevent unjustified undertreatment. However, there should be a rigorous repeated reevaluation in place to prevent unjustified overtreatment. The decision to readmit a cancer patient should follow the same principals. Based on previous work, we suggest considering cancer patients for an ICU trial consisting of unlimited care, including invasive haemodynamic support, monitoring and mechanical ventilation, with use of the standard indication/contraindication schemes. A follow-up, preferably in an interdisciplinary setting (ICU team, oncologists/haematologists, palliative care specialists if appropriate), should occur after 7 days. A consensus decision should be based on a general specialists' opinion, as well as according to the dynamics of the SOFA score. If the SOFA score does not indicate a clinical improvement, a de-escalation of therapy should take place. Certainly, the quality of life, patient's wish and family opinion should also be taken into consideration.

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