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Safety Issues That Should Be Considered When Mobilizing Critically Ill Patients

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Mobilization is used by physiotherapists as a treatment technique for patients with a wide range of disorders, including those who are critically unwell in ICUs and out-patients undergoing rehabilitation programs. The aims of mobilization include:

1. Improving respiratory function by optimizing ventilation/perfusion matching, increasing lung volumes, and improving airway clearance
2. Reducing the adverse effects of immobility
3. Increasing levels of consciousness
4. Increasing functional independence
5. Improving cardiovascular fitness
6. Increasing psychological well being

Additionally, for critically ill patients, mobilization may reduce the incidence of pulmonary complications, hasten recovery, decrease the duration of mechanical ventilation, and decrease the length of ICU or hospital stay.

In many cases when mobilization is being used as a treatment technique, it is used with the specific intent of challenging the patient, to provoke, among other things, cardiovascular or respiratory responses. Therefore, in all situations where mobilization is to be used as a treatment technique, it is important that the issue of its safety is addressed before the treatment is instituted. This is particularly important for critically ill patients, as these patients, by virtue of their critical illness, are likely to have marked limitations to their cardiovascular or respiratory reserve, and thus their exercise tolerance. Hence, whenever a critically ill patient is mobilized, a thorough review of the safety of mobilization is mandatory to minimize the risk of detrimental effects.

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Despite mobilization frequently forming part of the management of critically ill patients, there are surprisingly little data regarding its effectiveness and safety in this setting. Based on a literature review and the authors' clinical experience, Stiller and Phillips [1] reviewed safety issues that they believed should be considered when mobilizing acutely ill patients. Following this, the same group of authors conducted a clinical study evaluating the effect of 69 mobilization treatments on the hemodynamic and respiratory parameters of 31 ICU patients [2]. Prior to mobilization, patients in this study were screened using the criteria described by Stiller and Phillips [1]. It was found that while mobilization resulted in significant increases in heart rate (HR) and blood pressure (BP), and a nonsignificant fall in percutaneous oxygen saturation (SpO_2), deterioration in clinical status requiring intervention only occurred on 4.3% of occasions. Thus, in this patient sample of acutely ill patients where the screening criteria outlined by Stiller and Phillips [1] were used to guide practice, mobilization was a safe intervention for most subjects. Chang and colleagues [3], investigating the effects of standing on a tilt table for 15 chronically critically ill patients, reported that no patients suffered adverse effects from the intervention.

The aim of this article is to provide ICU practitioners with comprehensive guidelines that can be used to assess the safety of mobilizing critically ill patients. It is important to stress that these guidelines are precisely that, guidelines, and as such are intended to guide clinical practice, not to mandate it. The main safety factors that should be addressed include those that are intrinsic to the patient, such as the patient's medical background and cardiovascular and respiratory reserve and factors extrinsic to the patient, such as any patient attachments, environment, and staffing. The information contained within this article has been covered partially in three previous publications by the author [1,2,4] and an article by Ciesla and Murdock [5] that outlined the common attachments found in ICU patients. Two figures (Figs. 1 and 2) from Stiller and Phillips [1] that summarize the safety factors that should be reviewed when mobilizing critically ill patients have been reproduced in this article.

Intrinsic factors

Medical background and current condition

Prior to mobilization, the patient's medical background should be reviewed in terms of his or her past medical history (see Fig. 1), as this can provide ICU practitioners with information that can help identify how well that patient is likely to tolerate mobilization [1]. In particular, it can indicate in what way the patient's reserve may be limited and therefore the signs and symptoms that particularly need to be monitored during the mobilization treatment. For example, if a critically ill patient has a history of significant cardiac or respiratory disease, it is likely that his or her cardiac

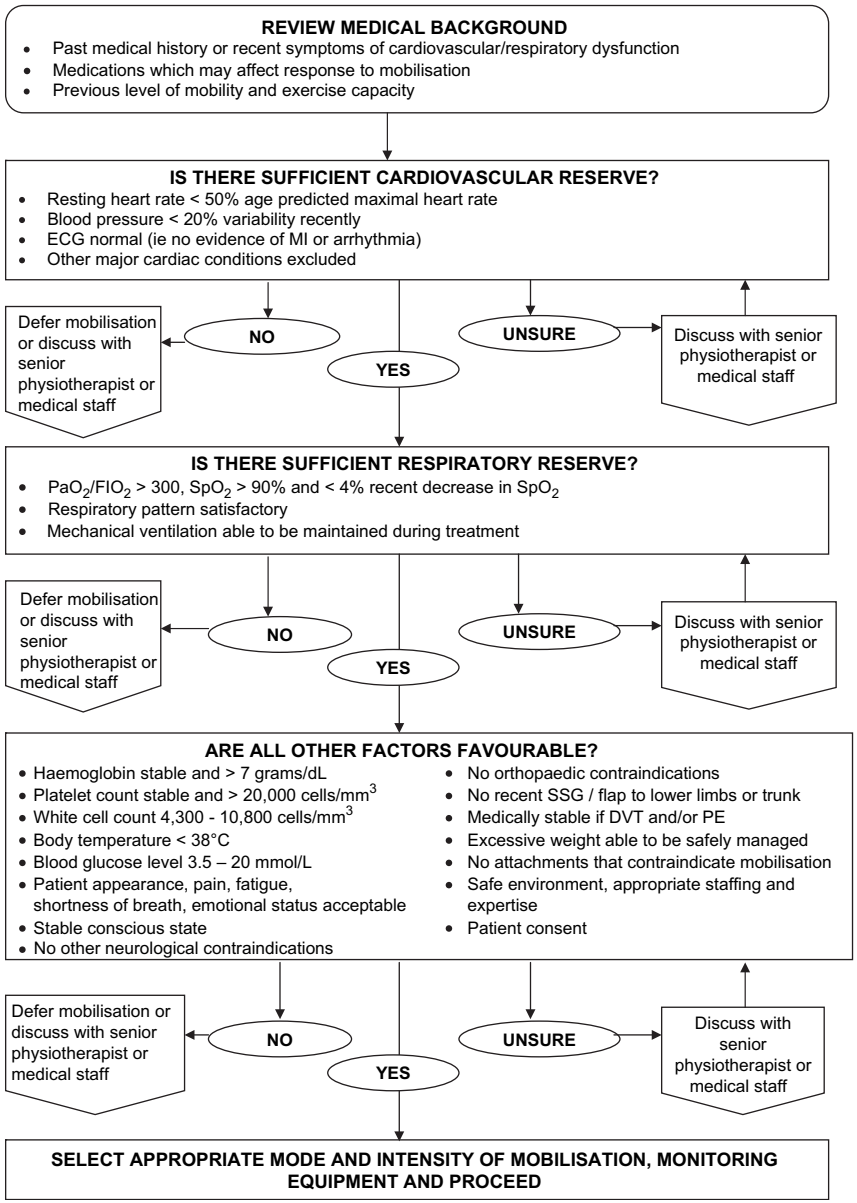

Fig. 1. Overview of safety issues before mobilizing critically ill patients. (*Reproduced from* Stiller K, Phillips A. Safety aspects of mobilising acutely ill inpatients. Physiother Theory Pract 2003; 19(4):239–57; with permission of Taylor & Francis Group, LLC., http://www.taylorandfrancis.com.)

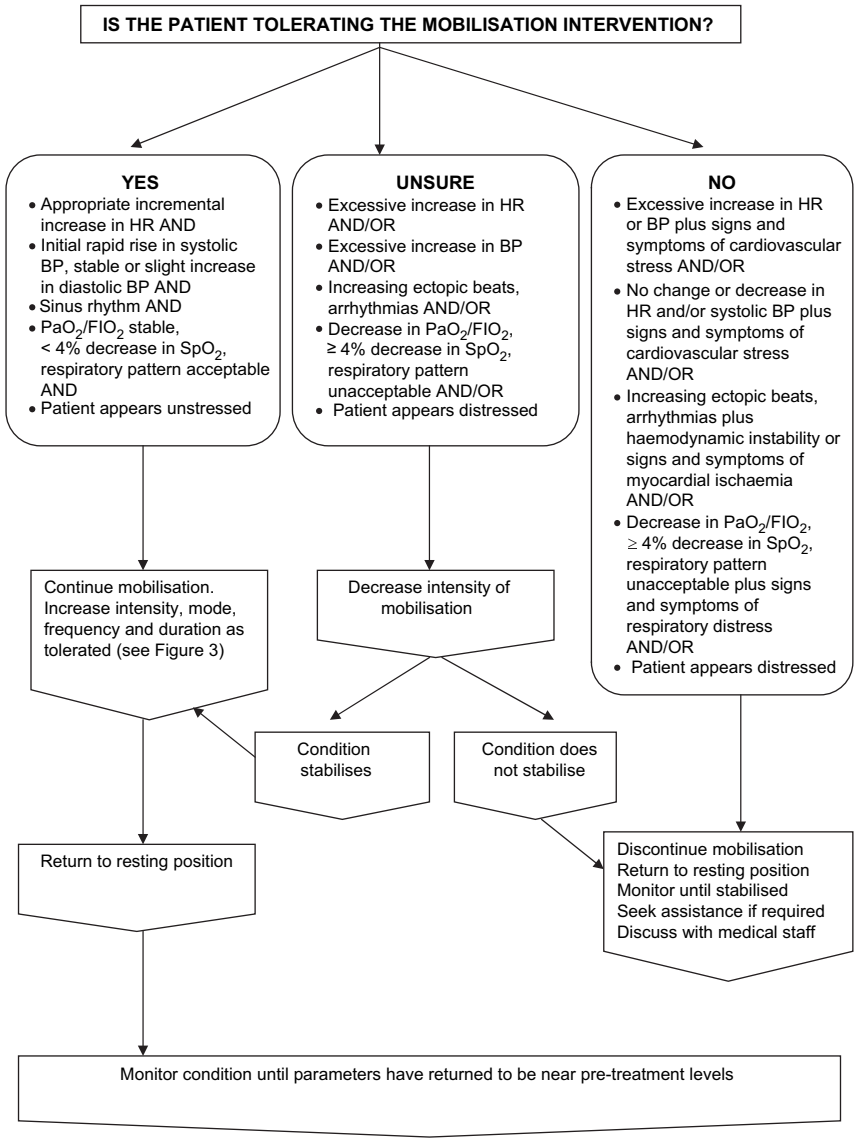

Fig. 2. Troubleshooting while mobilizing critically ill in-patients. (*Reproduced from* Stiller K, Phillips A. Safety aspects of mobilising acutely ill inpatients. Physiother Theory Pract 2003;19(4): 239–57; with permission of Taylor & Francis Group, LLC., http://www.taylorandfrancis.com.)

or respiratory reserve will be limited and hence affect his or her ability to tolerate mobilization. Hence, care should be taken to monitor the cardiovascular and/or respiratory systems during mobilization. Other examples where the patient's medical background can influence mobilization include those

patients with musculoskeletal conditions such as osteoporosis or bony metastases, where particular care with manual handling would need to be taken during mobilization to minimize the risk of bony fracture. Similarly, an underlying neurological condition such as hemiplegia, ataxia, multiple sclerosis, or vertigo/dizziness can influence a patient's ability to mobilize and affect what mode of mobilization intervention is selected.

In addition to reviewing each patient's past medical history, it is important to consider the patient's usual level of mobility and fitness (see Fig. 1) and thus try and ascertain if his or her current condition is pre-existing, caused by the current problem, or a combination of both [1].

In a similar fashion to past medical history, the history of the patient's presenting condition and current symptoms also should be reviewed, as it will help the ICU practitioner gain an indication of what systems are likely to limit mobilization and therefore what signs and symptoms to particularly monitor during any mobilization intervention [1]. This review includes checking the patient's current medications, as some medications will affect the patient's ability to mobilize or the response to mobilization (see Fig. 1). For example, in an ICU setting, while sedatives may not prevent mobilization, they may reduce the ability of the patient to cooperate with the treatment, making it appropriate to select more passive modes of mobilization. Some medications, most notably beta-blockers, will suppress the patient's normal HR response to exercise and mobilization; therefore, in this setting HR cannot be used to gauge exercise intensity.

Although formal exercise testing before interventions such as mobilization can establish each patient's maximal HR and tolerance of exercise, such testing is inappropriate in the ICU setting. Instead, ICU practitioners should review how well the patient has tolerated other recent interventions (eg, standard nursing care or medical interventions) and ascertain which systems, if any, limited these interventions. Thus, the patient's response to these interventions provides an indirect exercise test. For example, if a critically ill patient recently has exhibited profound and prolonged oxygen desaturation with even a minor intervention such as being passively turned in bed, this indicates severely limited respiratory reserve, making it very unwise to attempt any mobilization activity that would increase oxygen demand further.

Cardiovascular reserve

Heart rate

The usual HR response to exercise in normal subjects is an incremental increase in HR, dependent on the person's underlying fitness and the intensity of the exercise [6,7]. The HR response to exercise for critically ill patients is not known, although preliminary data by Stiller and colleagues [2], involving 31 patients in an ICU, found that mobilization resulted in a significant increase in HR over baseline levels, with the magnitude of the increase approximately 10%. Similar increases in HR were reported by

Weissman and colleagues [8] during active and passive limb movements for 23 critically ill patients.

There is little published clinical research concerning resting HRs when determining the safety of mobilizing critically ill patients before the intervention [1]. In clinical practice in the Royal Adelaide Hospital ICU, the author has found it extremely useful to express each patient's resting HR as a percentage of his or her age-predicted maximal HR, to provide an estimation of the patient's cardiac reserve. Stiller and Phillips [1] suggested that a critically ill patient with a high resting HR (ie, one that is already more than 50% to 60% of age-predicted maximal HR), may have limited cardiac reserve to tolerate activities that are likely to further increase HR (see Fig. 1). They also noted, however, that such resting HR data should not be used in isolation to determine the safety of mobilization, but instead considered collectively with other safety concerns to provide a more comprehensive picture of the patient. Indeed, Stiller and colleagues [2] found that mobilization was tolerated safely by most of their sample of 31 ICU patients, despite the sample's mean resting HR being more than 50% of the age-predicted maximum on 80% of occasions.

In terms of target HRs during the mobilization of critically ill patients, there appears to be no published research. Thus, in the setting of critical illness, where improving cardiorespiratory fitness is unlikely to be a primary aim, Stiller and Phillips [1] recommended aiming for an exercise HR either below or at the very low end of the range used for increasing the fitness of stable outpatients (ie, approximately 50% to 60% of maximal HR). It is essential that the HR of critically ill patients be monitored carefully during mobilization and exercise to ensure that the HR response is within expected levels. Signs that mobilization and exercise are not being tolerated include an abnormally high increase in HR, particularly if it does not stabilize, or, conversely, a marked fall in HR (see Fig. 2) [1]. Observation and questioning of the patient for signs and symptoms of cardiovascular stress (eg, shortness of breath, clamminess, faintness, or chest pain) during the intervention also can indicate if cardiac reserve is being stressed unduly (see Fig. 2) [1].

Finally, it is important to re-emphasize that it is only in rare circumstances that HR should be used on its own to mandate whether to go ahead with the mobilization of a critically ill patient. Instead it should be used in combination with the other safety issues raised in this article to support clinical decision making.

Blood pressure

The usual BP response to exercise in normal subjects is an initial rise in systolic BP, with a further linear increase as exercise intensity increases [7,9]. In contrast, diastolic BP tends to remain stable or only slightly increase at higher levels of exercise intensity [6,9]. In their sample of 31 critically ill patients, Stiller and colleagues [2] found that systolic and diastolic BP

significantly increased from resting levels during mobilization. Weissman and colleagues [8] and Norrenberg and colleagues [10] also documented an increase in BP of approximately 10% during active and/or passive limb movements in critically ill patients.

As with HR, there are no published clinical data concerning safe levels of resting BP when deciding whether to mobilize critically ill patients. Stiller and Phillips [1] suggested that a stable BP may be more important than an absolute BP value (see Fig. 1). They considered that an acute increase or decrease in BP of 20% or more represented hemodynamic instability and would be likely to delay mobilization. If a critically ill patient requires inotropic medication (eg, adrenaline, nor-adrenaline, dopamine) to maintain an adequate BP, this is indicative of hemodynamic instability. Although it may be safe to mobilize patients who have stable BP on low levels of inotropes, in many instances where inotropes are required to maintain BP, mobilization will have to be deferred [1].

In a similar fashion to HR, the BP response during mobilization and exercise can provide information regarding how well a particular patient is tolerating the intervention—with an excessive increase in BP or a fall in BP indicating intolerance (see Fig. 2) [1].

Cardiac status

The American College of Sports Science and Medicine [6] lists numerous cardiac conditions that preclude the performance of exercise tests in normal subjects. It would seem appropriate that these conditions also be used as absolute or relative contraindications to mobilization in critically ill patients (see Fig. 1) [1]. These are as follows:

Recent significant change in the resting ECG, suggesting significant ischemia, recent myocardial infarction (within 2 days), or other acute cardiac event (see Fig. 1)
Unstable angina
Uncontrolled cardiac arrhythmia causing symptoms or hemodynamic compromise
Severe symptomatic aortic stenosis
Uncontrolled symptomatic heart failure
Acute pulmonary embolus (PE) or pulmonary infarction
Acute myocarditis or pericarditis
Suspected or known dissecting aneurysm
Acute infections

In terms of the safety of mobilizing patients who have ECG abnormalities at rest, Stiller and colleagues [2] found that cardiac arrhythmias were present on 12% of occasions before mobilization. In all cases, these arrhythmias were relatively minor and stable, and no change in the severity or frequency of arrhythmias was noted during the mobilization intervention. Thus, if arrhythmias are infrequent and not affecting hemodynamic stability

(eg, the occasional premature atrial or ventricular contraction), they should not interfere with the ability to mobilize.

During the actual mobilization intervention, ECG monitoring is mandatory in critically ill patients as it provides an instantaneous measurement of HR and allows the detection of arrhythmias (see Fig. 2). More details regarding ECG monitoring during mobilization can be found in the article by Stiller and Phillips [1]. Additionally, all patients should be observed carefully for signs and symptoms of cardiac stress (eg, clamminess, chest/arm/neck pain, shortness of breath). There are certain patient groups that have an increased risk of myocardial irritability (eg, patients who have an elevated serum potassium caused by acute renal failure). Particular care should be taken to monitor the ECG of these patients during mobilization and also to observe them for signs and symptoms of cardiac stress [1]. Clearly, if signs or symptoms suggestive of myocardial ischemia develop, mobilization should be ceased at that time and the patient reviewed by appropriate medical staff.

Respiratory reserve

Oxygenation

Along with the assessment of cardiovascular reserve, it is of major importance that ICU practitioners review the respiratory reserve of critically ill patients when assessing the safety of mobilization. When assessing respiratory reserve before mobilization, Stiller and Phillips [1] recommended calculating the patient's partial pressure of oxygen in the arterial blood/inspired fraction of oxygen (PaO_2/FIO_2) ratio, rather than relying on the PaO_2 alone. The reason for using the PaO_2/FIO_2 ratio rather than PaO_2 alone, is that it takes into account the amount of oxygen that the patient is requiring to give that PaO_2. Patients with a PaO_2/FIO_2 ratio of more than 300 are likely to have sufficient respiratory reserve to tolerate mobilization, whereas those with a value of between 200 and 300 have marginal respiratory reserve, and patients with a value of less than 200 have little or no respiratory reserve (see Fig. 1) [1]. Although the lower PaO_2/FIO_2 values do not contraindicate mobilization, they do indicate the need for extreme care when undertaking activities that are likely to increase oxygen demand. In the setting of a low PaO_2/FIO_2 ratio, oxygenation should be monitored carefully during the treatment (eg, using percutaneous oxygen saturation [SpO_2]) and the initial intensity of the mobilization intervention modified to minimize patient effort.

Although there is only limited published clinical research, mobilization was found to be a safe intervention for critically ill patients when the respiratory considerations noted by Stiller and Phillips [1] were implemented [2]. In this study [2], the mean PaO_2/FIO_2 ratio of the 31 ICU patients was 263 before mobilization, with 29% of patients having a PaO_2/FIO_2 ratio of less than 200. Despite these low values, there were only three occasions (4.3%) when patients showed significant clinical deterioration during

mobilization. In all three cases, this was significant oxygen desaturation. On one of these three occasions, the patient had a PaO_2/FIO_2 ratio of 145 before mobilization, with the other two patients having ratios of 232 and 291. Six other patients, however, had a ratio of less than 145 before mobilization yet tolerated the intervention with no desaturation. Chang and colleagues [3], in a study investigating the respiratory effects of standing chronically critically ill patients on a tilt table, had, as one of their inclusion criteria, that subjects needed to have a PaO_2 of more than 70 mm Hg with an FIO_2 less than or equal to 0.4, which equates to a PaO_2/FIO_2 ratio of 175 or more. They found that while standing on a tilt table significantly increased minute ventilation, tidal volume, and respiratory rate, no significant change was seen in arterial blood gases. These preliminary data from Stiller and colleagues [2] and Chang and colleagues [3] suggest that the PaO_2/FIO_2 ratio provides information that is helpful, rather than directive, in terms of determining the safety of mobilization. Certainly, in clinical practice in the Royal Adelaide Hospital ICU, the author has found that calculating the PaO_2/FIO_2 ratio provides valuable objective data that can contribute to decision making regarding the safety of mobilizing critically ill patients.

Although it is not as sensitive and reliable as the PaO_2/FIO_2 ratio, the patient's SpO_2 can be used to provide an indication of oxygenation both before and during mobilization. A SpO_2 of 90% or more, accompanied by a recent fluctuation of less than 4%, is likely to indicate sufficient respiratory reserve to tolerate mobilization (see Fig. 1) [1]. Providing some support for this recommendation, Stiller and colleagues [2] found that there were only 2 of 69 occasions of mobilization when resting SpO_2 was less than 90%, and on one of these occasions the patient went on to deteriorate clinically during mobilization. Thus, although firm conclusions cannot be drawn because of the limited sample size, a resting SpO_2 of less than 90% may be helpful in predicting those patients who are likely to deteriorate during mobilization. A cut off point for SpO_2 of at least 90% was also used by Chang and colleagues [3] when deciding when to commence using a tilt table for their sample of chronically critically ill patients.

For the critically ill patient, it is recommended that a pulse oximeter be used to continuously monitor SpO_2 during any mobilization intervention, with the advantage that it can provide HR and SpO_2 data instantaneously (see Fig. 2) [1].

Hypercapnia

The presence of an acutely elevated partial pressure of carbon dioxide in arterial blood ($PaCO_2$) indicates acute respiratory failure, and although the high $PaCO_2$ in itself does not affect the ability to mobilize, any associated problem with oxygenation should be considered [1]. A chronically raised $PaCO_2$ is unlikely to affect the ability to mobilize, unless it is associated with a marked deterioration in conscious state [1].

Respiratory pattern

As well as reviewing oxygenation, observing a patient's respiratory pattern can provide additional information regarding respiratory reserve (see Fig. 1) [1]. This observation includes respiratory rate, the presence of asynchronous or paradoxical movement of the chest wall and abdomen, overactivity of the accessory respiratory muscles, and unduly prolonged expiration or wheezing. In clinical practice, there are times when a patient is maintaining adequate oxygenation (based on the PaO_2/FIO_2 ratio and SpO_2), but only able to do this at the expense of an increased work of breathing, reflected by a high respiratory rate and labored breathing. In such a setting, the numbers may say 'go', but subjective observation suggests deferment, or at least caution, if attempting any mobilization. Respiratory pattern should also be monitored during the actual mobilization procedure to ensure the patient is not becoming distressed (see Fig. 2).

Mechanical ventilation

The need for a critically ill patient to be ventilated mechanically is not in itself a reason to prevent or even modify mobilization (see Fig. 1). Clearly, however, the necessity for high levels of mechanical ventilatory support to maintain adequate gas exchange indicates an underlying major limitation of respiratory reserve, and any additional challenge to respiratory reserve by virtue of mobilization should be undertaken with extreme care [1].

It has been the author's clinical experience that ICU staff occasionally suggest temporarily taking a patient off mechanical ventilation to facilitate the ease of mobilization (as it decreases the number of patient attachments). Although this may seem an attractive option, the author's experience and recommendations are that patients should remain on the most supportive level of ventilation during mobilization to maximize their respiratory reserve, at least initially [1]. Indeed, if respiratory reserve is particularly limited, increasing the level of ventilatory support during mobilization could be advocated so that the intervention is tolerated better. Additionally, for those patients receiving mechanical ventilation, it is recommended that less demanding modes of mobilization should be attempted initially, with the treatment progressed as tolerated [1]. If a patient tolerates a mobilization intervention on a particular level of ventilatory support, at subsequent treatments either the same mobilization intervention can be used and the level of ventilatory support reduced, or a higher-intensity mobilization intervention can be attempted with the same level of ventilatory support.

Hematological and metabolic considerations

Prior to mobilization, the critically ill patient should be reviewed regarding hematological and metabolic considerations, including hemoglobin, platelet count, white cell count, body temperature, and blood glucose level [1].

Hemoglobin

When assessing the safety of mobilization and exercise, the hemoglobin level is relevant as the oxygen-carrying capacity of the blood is proportional to the hemoglobin level. Although normal values for hemoglobin range from 12 to 18 g/dL, chronically low hemoglobin values (eg, less than 7 g/dL) are associated with conditions such as chronic renal failure [11,12]. Thus, rather than relying on an absolute low value for hemoglobin to indicate that mobilization should be deferred, an acute fall in hemoglobin may be more clinically appropriate as an indication of active or recent bleeding, especially if it is associated with hemodynamic instability (see Fig. 1) [1].

Platelet count

Platelet count is relevant when considering the safety of mobilization and exercise, as patients with a very low platelet count are at higher risk of microvascular trauma and bleeding, which in turn have the potential to result from any activity (such as mobilization) that significantly increases BP. There are no clear clinical guidelines regarding a minimum limit for platelet count that would ensure that mobilization can be undertaken safely. A count of 20,000 cells/mm^3, however, may be considered a comparatively safe lower limit (see Fig. 1) [1].

White cell count

An abnormally high ($>10{,}800$ cells/mm^3) or low ($<4{,}300$ cells/mm^3) white cell count can indicate the presence of acute infection [12]. In itself, acute infection does not preclude mobilization, but as infection can increase the patient's oxygen utilization, caution is required if undertaking activities, such as mobilization, that further increase oxygen demand (see Fig. 1) [1].

Blood glucose level

Blood glucose level normally ranges from 3.8 to 5.8 mmol/L [11]. Mobilization and exercise have the potential to increase any hypo- or hyperglycemia, particularly in those patients with type 1 diabetes. Hence, additional care should be taken to check blood glucose levels of these patients and monitor for signs and symptoms of hypo- or hyperglycemia before and during mobilization (see Fig. 1) [1].

Other considerations

In addition to the factors already discussed, there are numerous other intrinsic patient-related factors that should be reviewed before mobilizing critically ill patients (or indeed any patient) to ensure the safety of the intervention, including the appearance of the patient, neurological status, the presence of certain orthopedic conditions, and nutritional status (see Fig. 1) [1].

Patient appearance, level of pain, fatigue, and perceived exertion

Reviewing the appearance of a patient, while more subjective in nature, can provide a wealth of information to the discerning clinician regarding how well a patient will tolerate, or is tolerating, mobilization (see Figs. 1 and 2) [1]. The appearance of the patient includes factors such as his or her respiratory pattern (already described), facial expression, conscious state, emotional status, level of pain and anxiety, presence of central or peripheral cyanosis, pallor, flush, sweatiness or clamminess, nutritional status (over- or underweight), and muscle bulk.

Every effort should be made to minimize the patient's pain, fatigue, and level of exertion before attempting mobilization to maximize the effectiveness of the intervention (see Fig. 1). For the conscious, cooperative patient, simple verbal or visual analog scales can be used to measure the patient's level of pain, fatigue, or rate of perceived exertion at rest and during mobilization.

Neurological status

The neurological status of the critically ill patient should be assessed, albeit quickly, before mobilization (see Fig. 1) [1]. An acute fall in a conscious state may reflect a new neurological event that requires specific investigation. A decreased level of consciousness does not preclude mobilization necessarily, but may necessitate using more passive modes of mobilization (eg, sitting upright in bed, sliding, or mechanical transfer to a chair). A heightened level of consciousness, such as agitation, restlessness, or confusion, also can influence and at times preclude mobilization. The review of neurological status should, at least periodically, include muscle strength, as this will influence the mode of mobilization selected. Clearly, patients with profound muscle weakness resulting from conditions such as critical illness weakness will require more passive and supported modes of mobilization than those with normal muscle power. The presence of high intracranial pressure or low cerebral perfusion pressure preclude mobilization.

Orthopedic conditions

Various orthopedic conditions can affect whether mobilization can occur and if so, what mode of mobilization needs to be used (see Fig. 1) [1]. For example, patients with pelvic/or spinal fractures may not be able to mobilize at all initially but instead require rest in bed. Patients with limb fractures may need to have the fracture protected in terms of its weight-bearing status, hence affecting the mode of mobilization to be used. Clarification of mobilization and weight-bearing status should be sought from the appropriate medical staff. For complex patients (eg, a patient with multiple injuries after trauma), it is essential to check the impact that each injury will have on mobilization before commencing any activity. Depending on the mode of mobilization that is going to be used, range of motion also should be

reviewed to ensure that the patient has sufficient joint range to undertake the activity.

Split skin grafts and flaps

The presence of recent split skin grafts (SSG) or myocutaneous flaps to the trunk or lower extremity may prevent mobilization, as these procedures often are followed by a period of bed rest (see Fig. 1) [1]. When mobilization is allowed, compression bandaging of some sort is often used if the affected body part is going to be placed in a dependent position. Management of SSG/flaps varies considerably from one hospital to another; hence it is recommended that ICU clinicians discuss management with appropriate medical staff.

Deep vein thrombosis and/or pulmonary embolus

To date, there do not appear to be any clinical guidelines or research specifically evaluating the safety of mobilizing patients with a deep vein thrombosis (DVT) or PE. In theory, mobilization has the potential to dislodge a thrombus, and hence mobilization is often deferred until therapeutic anticoagulation is achieved [1]. Moreover, as anticoagulation will not dissolve the actual thrombus itself, some clinicians advocate deferring mobilization until the likelihood of the thrombus embolizing has diminished. As residual thrombus, however, may still be detected months after therapeutic anticoagulation, at some point mobilization must occur, particularly as further immobilization will predispose the patient to DVT formation. The author's experience has been that clinical practice with respect to mobilizing patients with a DVT can vary considerably within a hospital, let alone from one hospital to another. Until definitive evidence becomes available, clearance to mobilize patients with a DVT or PE should be obtained from medical staff and the patient reviewed for cardiovascular and respiratory stability (see Fig. 1) [1].

Nutritional status

The patient's nutritional status can have a marked impact on the safety of mobilization [1]. Calculating a patient's body mass index (BMI) is an easy and useful way of categorizing body weight, with a BMI of 20 to 25 considered normal, 25 to 30 overweight, more than 30 to 40 obese, more than 40 morbidly obese, and less than 20 underweight. Underweight patients may have malnutrition and thus have decreased peripheral and respiratory muscle power, both of which can affect their ability to mobilize. Additionally, with underweight patients, careful handling to ensure that bony prominences and skin are not damaged during transfers is essential. The presence of excessive body weight is an important consideration when contemplating mobilization (see Fig. 1), with marked obesity increasingly encountered in Western societies. If the overweight patient also has reduced muscle power, excessive body weight can be the major safety

consideration before attempting mobilization. In this scenario, the safety of the patient and the attending staff should be considered. Various mobility aids specifically designed for heavy patients can be used to facilitate the safety of mobilization [1].

External factors

In addition to the intrinsic patient-related factors already discussed, there are numerous factors extrinsic to the patient that should be reviewed before mobilizing critically ill patients, including patient attachments, work environment, staffing considerations, and patient consent (see Fig. 1) [1].

Patient attachments

Although all critically ill patients will have various attachments, many of these do not interfere with the ability to mobilize, apart from the need for care to be taken to ensure they are not dislodged (see Fig. 1). These include ECG leads, arterial lines, venous lines, central venous catheters, pulmonary artery catheters, urinary catheters, pulse oximetry, and underwater sealed drains [1,5]. Although detaching and thus minimizing the number of patient attachments undoubtedly facilitates the ease of mobilization, it is an important safety consideration, particularly when mobilization is first being attempted, that those attachments that provide vital physiological data (eg, ECG leads and pulse oximeters) remain connected.

Tracheostomy and endotracheal tubing

The presence of a tracheostomy tube can facilitate mobilization of the mechanically ventilated patient, as long as care is taken to ensure the tracheostomy tube is not dislodged or pulled on during the intervention [1,5]. Mobilization of patients with endotracheal tubes is possible, but as the longer length of tubing makes it more vulnerable to dislodgement or movement, which in turn may cause vocal cord trauma, extreme care should be taken to support the tubing and any ventilator attachments [1]. The safety issues for patients who are being ventilated mechanically by noninvasive means are similar to those of the intubated patient, in that while it is possible for them to mobilize, care should be taken to ensure that the mask seal and adequate ventilation are maintained during the intervention.

Epidural

An epidural does not prevent mobilization (and in many cases, effective analgesia can facilitate it), but care should be taken to ensure that the patient does not have a motor block (by checking for normal lower limb strength) or a sympathetic block (by checking for normal BP) before

attempting any weight-bearing activities [1]. In some hospitals, including the Royal Adelaide Hospital, it is protocol that patients who have epidurals are mobilized by at least two staff members.

Dialysis

Although there is no specific reason why the presence of dialysis tubing will prevent or limit the mobilization of critically ill patients, the author's clinical experience has been that in many cases practical concerns will limit mobilization. For example, the dialysis tubing may be too short to allow mobilization, and any movement of the tubing during attempts at mobilization can interfere with the blood flow.

Intra-aortic balloon pump

An intra-aortic balloon pump, used to augment critically low cardiac output and BP, indicates the presence of hemodynamic instability, thus, in the author's experience, contraindicating mobilization [1,5].

Temporary pacemaker

A temporary pacemaker precludes the ability to mobilize, as movement has the potential to dislodge the pacing wire and thus prevent capture of the signal [1].

Sengstaken-Blakemore/Minnesota tubes

Sengstaken-Blakemore/Minnesota tubes may be used for managing patients with bleeding esophageal varices. Mobilization in this setting is contraindicated, as dislodgement of these tubes, which have esophageal and/or gastric balloons, could result in rupture of the esophagus or stomach [1].

Intracranial pressure monitoring/cerebrospinal fluid drain

An intracranial pressure (ICP) monitor is used most often for patients who have a major brain injury, and thus the underlying neurological condition usually will preclude mobilization. Hospital protocols should be consulted, or appropriate medical staff questioned, regarding the ability of mobilizing critically ill patients with a cerebrospinal fluid (CSF) drain.

Environment

Prior to mobilizing any patient, including those who are critically ill, another factor extrinsic to the patient that should be reviewed is the environment, to ensure that it is as safe and as uncluttered as possible (see Fig. 1) [1]. For example, this assessment should include checking that any patient attachments are sufficiently long and positioned appropriately for the activity that is going to be undertaken, that the bed height is optimal, and that weight limits of any equipment being used are adhered to.

Staffing

When mobilizing critically ill patients, it is essential that there are sufficient staff available, and that these staff are trained properly and fit to perform the required task (see Fig. 1) [1]. Additionally, appropriate staff should be available to review the patient in the event that the patient deteriorates during mobilization. To facilitate communication, it is preferable that one ICU practitioner be responsible for coordinating the mobilization intervention at a particular time. It has been the author's experience that a close rapport between clinician and patient can facilitate mobilization, and for this reason, it is better, particularly initially, that one ICU practitioner who is familiar with the patient and his or her situation, and sensitive to his or her needs, should be involved in all mobilization activities.

Attention should be given to ensure that the patient is kept informed about what is going to occur and when. A high standard of verbal communication skills, whereby clear, concise, calm, confident, and unhurried instructions are given, is essential. Similarly, effective nonverbal communication, through the use of eye contact and touch, is also vital [13].

Patient consent

As with any medical intervention, patient consent should be sought before mobilization (see Fig. 1). Thus, the potential benefits and risks of the intervention should be explained to the patient in clear language and the patient allowed the opportunity to ask questions, voice fears, and take an active role in decision making [13]. Although it may be difficult for the ICU patient to talk because of the presence of an endotracheal or tracheostomy tube, every effort should be made to allow the patient to communicate by nonverbal means. At present, at least in the Royal Adelaide Hospital, the consent to mobilize is verbal, without the need for formal written consent.

Selecting the mobilization intervention

A major consideration when considering the safety of mobilizing critically ill patients is the selection of the mobilization intervention, in terms of the mode of mobilization and its intensity, duration, and frequency (see Fig. 1) [1]. A general safety tip when mobilizing critically ill patients is that it is far safer to increase the intensity of mobilization slowly and progressively as each treatment is tolerated, rather than losing ground if too much is tried too soon.

There is no published clinical research regarding the most effective mode, intensity, duration, and frequency of mobilization for critically ill patients [1]. General physiological principles and clinical acumen, however, can be used to guide clinical practice. For example, although there are no supporting data, it is clear that the intensity of mobilization will vary considerably

according to its mode, ranging from lower-intensity tasks such as passive transfer to a chair or moving around in bed, to higher-intensity tasks such as standing transfers and walking. The mode of mobilization selected should be based on the assessment of the patient's underlying cardiovascular and respiratory reserve, the other safety considerations outlined in this article, and the patient's response to previous mobilization treatments. The most appropriate duration of mobilization can be extremely variable for critically ill patients. For example, some patients may only tolerate sitting on the edge of the bed for a few minutes, whereas others may be able to sit out of bed for a few hours or walk increasing distances. Similarly, the frequency of mobilization can range from the need for short frequent treatments to a more prolonged intervention once per day. The selection of the duration and frequency of mobilization treatments will depend on each patient's underlying condition and his/her individual response to the intervention.

Adhering to the general principles of rehabilitation, it is preferable that mobilization treatments be as functional as possible, thus increasing the patient's ability to perform activities of daily living. As with any exercise program, mobilization of the critically ill patient should, when possible, include a short warm-up period. This can be as simple as, for example, getting the patient to move his or her arms and legs for a few minutes before the mobilization task.

As already discussed, it is essential that safety issues are considered not only before mobilization, but also during and after the intervention. Fig. 2 shows, in simple flow chart format, the main factors that indicate whether a patient is tolerating the mobilization intervention. As can be seen, these rely on interpretation of monitored physiological signs and careful observation and questioning of the patient for adverse symptoms and signs. Following any mobilization intervention, it is essential that the patient be monitored and observed until vital signs have returned to baseline, or near baseline, levels, and any new symptoms have resolved.

Discussion

This article has provided guidelines for ICU practitioners to assist in clinical decision making when deciding whether to mobilize critically ill patients and when assessing how well the mobilization intervention is being tolerated. As noted earlier, because of a lack of data, these guidelines are not based primarily on evidence from clinical research. Instead, they rely on general exercise and physiological principles, and the author's clinical experience. In view of this fact, it is stressed that the safety factors raised in these guidelines should be used to guide clinical practice, not to mandate it. Although some experienced ICU clinicians may find these guidelines cumbersome and impractical to use, the safety factors discussed in this article nevertheless serve as a basic guide for less experienced staff and students to assist with clinical decision making.

In clinical practice there will be occasions when the decision is made to proceed with mobilization, despite the patient having marginal cardiovascular or respiratory reserve, because the potential benefits of the intervention outweigh its perceived risks. It is important to note that there is always a chance that despite all precautions, a patient, particularly one who is critically ill, may have an adverse response to mobilization. If care is taken before and during the intervention, however, any adverse reaction should be able to be identified at a relatively early stage, enabling appropriate intervention to stabilize the patient's condition and thus avoid long-lasting detrimental effects.

Clearly, further research is required into the effects of mobilizing critically ill patients. This should document both its beneficial effects and its associated risks, and thus enable the formation of evidence-based guidelines regarding which critically ill patients should be mobilized, when they should be mobilized, and how they should be mobilized.

Summary

This article provides comprehensive guidelines for ICU practitioners that can be used when assessing the safety of mobilizing critically ill patients. Given a lack of clinical data, these guidelines are based primarily on physiological principles and the author's clinical experience. The main safety factors that are covered include intrinsic factors related to the patient (eg, medical background, cardiovascular and respiratory reserve, and hematological considerations) and factors extrinsic to the patient (eg, patient attachments, environment, and staffing). These guidelines may be particularly useful for less experienced ICU practitioners, and it is recommended that they should be used to guide clinical practice, rather than mandate it.

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