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UPDATE IN INTENSIVE CARE MEDICINE: CRITICAL PATIENT SAFETY

Impact of patient safety on outcomes. From prevention to the treatment of post-intensive care syndrome

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KEYWORDS
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Abstract Survivors of critical illness may present physical, psychological, or cognitive symptoms after hospital discharge, encompassed within what is known as post-intensive care syndrome. These alterations result from both the critical illness itself and the medical interventions surrounding it. For its prevention, the implementation of the ABCDEF bundle (**A**ssess/treat pain, **B**reathing/awakening trials, **C**hoice of sedatives, **D**elirium reduction, **E**arly mobility and exercise, **F**amily) has been proposed, along with additional strategies grouped under the acronym GHIRN (**G**ood communication, **H**andout materials, **R**edefined ICU architectural design, **R**espirator, **N**utrition). In addition to these preventive measures during the ICU stay, high-risk patients should be identified for subsequent follow-up through multidisciplinary teams coordinated by Intensive Care Medicine Departments.
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PALABRAS CLAVE
Síndrome post-cuidados intensivos;
Analgesia;
Sedación;

Impacto de la seguridad del paciente en los resultados. Desde la prevención al tratamiento del síndrome post-cuidados intensivos

Resumen Los supervivientes de la enfermedad crítica pueden presentar síntomas físicos, psicológicos o cognitivos tras el alta hospitalaria, que se engloban en lo que se conoce como síndrome post-cuidados intensivos. Estas alteraciones son consecuencia tanto del propio proceso crítico como de las actuaciones sanitarias que ocurren en torno al mismo. Para

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Delirium;
Paquete medidas ABCDEF

su prevención se ha propuesto la aplicación del paquete de medidas ABCDEF (**A**sses/treat pain, **B**reathing/awakening trials, **C**hoice of sedatives, **D**elirium reduction, **E**arly mobility and exercise, **F**amily) al que recientemente se han sumado otras, agrupadas en las siglas GHIRN (**G**ood comunication, **H**andout materials, Redefined **I**CU architectural design, **R**espirator, **N**utrition). Además de estas medidas de prevención durante el ingreso en la UCI, los pacientes de riesgo deben ser identificados para un posterior seguimiento mediante equipos multidisciplinares coordinados por los Servicios de Medicina Intensiva.
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Introduction

Patients who survive critical illness can present physical, psychological or cognitive symptoms following discharge. If these symptoms persist for months, they may be regarded as sequelae or adverse events, many of which are avoidable, and which constitute what is known as post-intensive care syndrome (PICS).[1] These alterations are a consequence of both the critical disease itself and the medical interventions surrounding it. Preventive measures are therefore essential, are considered to be safe, and represent adherence to the good clinical practice guides based on scientific evidence. Failure to adopt such measures can lead to errors that may result in harm to the critically ill patient.

Since the term was introduced in 2010, the interest and number of studies on PICS have grown exponentially.[2,3] Patient quality of life and functional capacity are closely related to the above alterations – hence the importance of preventing the syndrome during admission to the Intensive Care Unit (ICU) and of monitoring those individuals at risk of suffering PICS.

Prevention

The prevention of PICS is based on the comprehensive and multidisciplinary management of the critically ill patient through implementation of the ABCDEF (**A**ssess/treat pain, **B**reathing/awakening trials, **C**hoice of sedatives, **D**elirium reduction, **E**arly mobility and exercise, **F**amily) bundle,[4] along with recently added strategies grouped under the acronym GHIRN (**G**ood communication, **H**andout materials, **R**edefined ICU architectural design, **R**espirator, **N**utrition) (Fig. 1),[5–7] which are described below:

Assess/treat pain: identification, prevention and management of pain

Pain in the critically ill patient can be caused by tissue damage inherent to the primary disease condition, invasive procedures, immobilization and mobilization. Pain activates the autonomic nervous system and can cause hemodynamic dysfunction, respiratory alterations, coagulopathy or immune system alterations. Sustained pain stimuli can produce hyperalgesia and an amplified response to minimally harmful stimuli, resulting in chronic pain. If not adequately identified, prevented and treated, this situation can have a psychological impact on the patient, in addition to the physiological effects commented above. Pain recall is an independent predictor of the development of posttraumatic stress disorder (PTSD).[8]

Excessive analgesic use can also lead to undesired side effects such as gastrointestinal hypomotility, gastric bleeding, renal dysfunction, and tolerance or withdrawal symptoms.[9]

Frequent (at least every 4 h) and protocolized pain assessments should be made using validated scales. In patients that are able to communicate, we can use the Verbal Numerical Rating Scale (vNRS) and the Visual Analogue Scale (VAS),[10] both scoring pain from 0 to 10 points, while behavioral scales are needed in case of patients unable to communicate, such as the Pain Indicating Behaviors Scale (*Escala de Conductas Indicadores de Dolor* [ESCID])[11] from 0 to 10 points, the Critical-Care Pain Observation Tool (CPOT)[12] scoring 0 to 8 points, or the Behavioral Pain Scale (BPS)[13] that scores from 3 to 12 points. In patients subjected to deep sedation and neuromuscular relaxation, where changes in behavior or gestures are not seen, we can useobjective instrumental methods that analyze components of the sympathetic and parasympathetic autonomic nervous system and which identify pain based on a numerical score.[14,15]

The monitoring of pain in patients who are able or unable to communicate is one of the quality indicators of the Spanish Society of Intensive and Critical Care Medicine and Coronary Units (*Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronarias* [SEMICYUC]) in critically ill patients.[16]

The treatment of pain initially should be based on non-pharmacological measures such as music therapy, relaxation techniques (e.g., mindfulness), massages and local cold application (cold packs). If these measures fail, drug treatment should be introduced adapted to the intensity of the pain and the clinical condition of the patient. In this context, multimodal strategies are indicated, combining opioids (fentanyl, remifentanil or morphic chloride) with non-opioid analgesics (paracetamol, non-

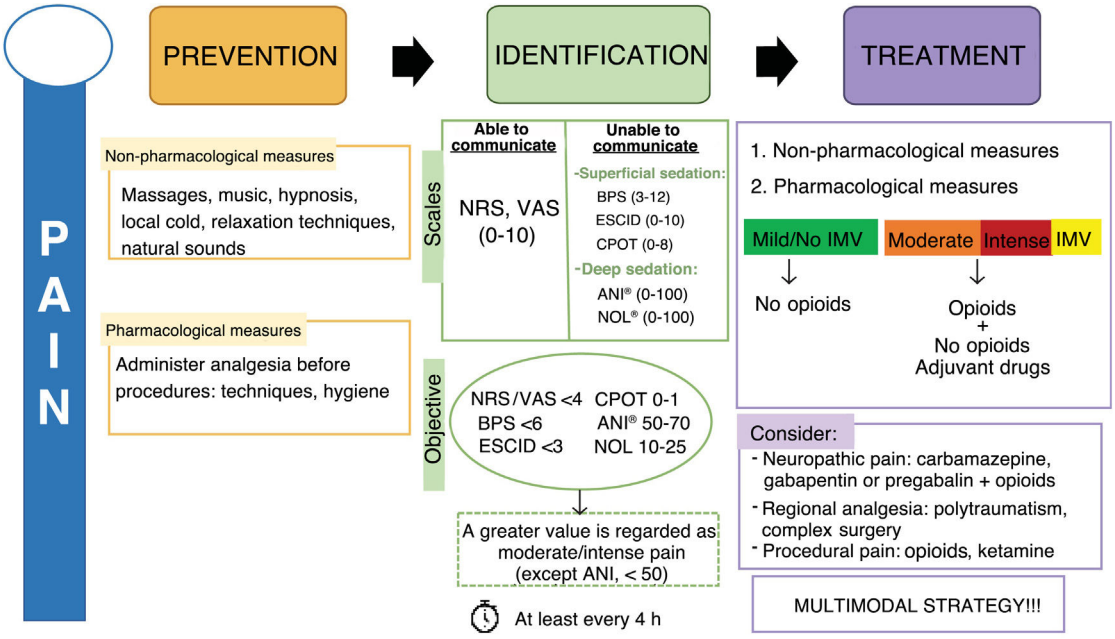

Figure 1 Prevention, identification and management of pain.
vNRS, numeric rating scale; VAS, visual analogue scale; ESCID, Pain Indicating Behaviors Scale (Escala de Conductas Indicadores de Dolor); BPS, Behavioral Pain Scale; CPOT, Critical-Care Pain Observation Tool; ANI, Analgesia Nociception Index; NOL, nociception level index; IMV, invasive mechanical ventilation; Cx, surgeries.
Reproduced from[7] (with permission).

steroidal anti-inflammatory drugs [NSAIDs]), coadjuvants (dexmedetomidine, corticosteroids or ketamine), neuropathic pain analgesics (gabapentin, carbamazepine or pregabalin) or regional analgesia (epidural, muscle blocks, etc), seeking to control the pain and reduce the opioid doses and side effects (Fig. 1).

Breathing/awakening trials: reduction of sedation and spontaneous breathing trial

For decades, sedatives have helped to reduce pain, stress and discomfort in critically ill mechanically ventilated patients . However, many studies have also demonstrated their potential short- and long-term negative effects, such as respiratory depression, hemodynamic instability and metabolic acidosis, in addition to a prolongation of mechanical ventilation (MV), ICU stay and an increased risk of delirium.[17,18] For this reason, mild sedation strategies are currently recommended (Richmond Agitation Sedation Scale [RASS] −2 to +1), except in the presence of absolute indications of deep sedation: severe acute respiratory distress syndrome (ARDS), intracranial hypertension (ICH), status epilepticus, hypothermia or the use of neuromuscular blockers (NMBs).[19] Thus, the new sedation strategies should seek the minimum necessary dose, favoring patient cooperation and communication, the withdrawal of respiratory support and early mobility.

Some studies have shown that daily sedative interruption strategies are safe and improve the outcomes in terms of days without MV as well as shortening ICU stay,[20] though mild sedation protocols are also effective and pose fewer risks.[19] In fact, daily assessment of the interruption of sedation, spontaneous breathing trials, the monitoring of sedation, adequate indication and the monitoring of neuromuscular block as well as of sedation during neuromuscular block, are regarded as quality indicators by the SEMICYUC.[16]

In order to achieve the aims of sedation, it is essential to make use of validated scales that measure the level of sedation, such as the RASS,[21] which yields a score of −5 to +4 points, or the Riker Sedation Agitation Scale (SAS),[22] with a score of 1–7 points. In patients undergoing deep sedation or neuromuscular relaxation, objective tools such as the bispectral index (BIS)[23] and the train-of-four (TOF),[24] should be used. Conscious or superficial sedation is considered when the patient presents RASS 0, −1 or −2, while deep sedation is defined as RASS −3, −4 or −5 and BIS between 40–60. Bispectral levels under 40 are associated with oversedation. Such levels have been observed in up to 35% of all critically ill patients[25] – a fact that must be considered given its deleterious impact and safety concerns for the patient (Fig. 2).

In the context of patient quality care and safety projects, the SEMICYUC and the working group in sedation, analgesia and delirium (GTSAD) propose the inclusion of the ''Zero Overdose'' project as a practical teaching tool to enhance global awareness of convenience, safety and management in order to maximize the clinical outcomes and minimize the harmful effects of excessive sedation.[26]

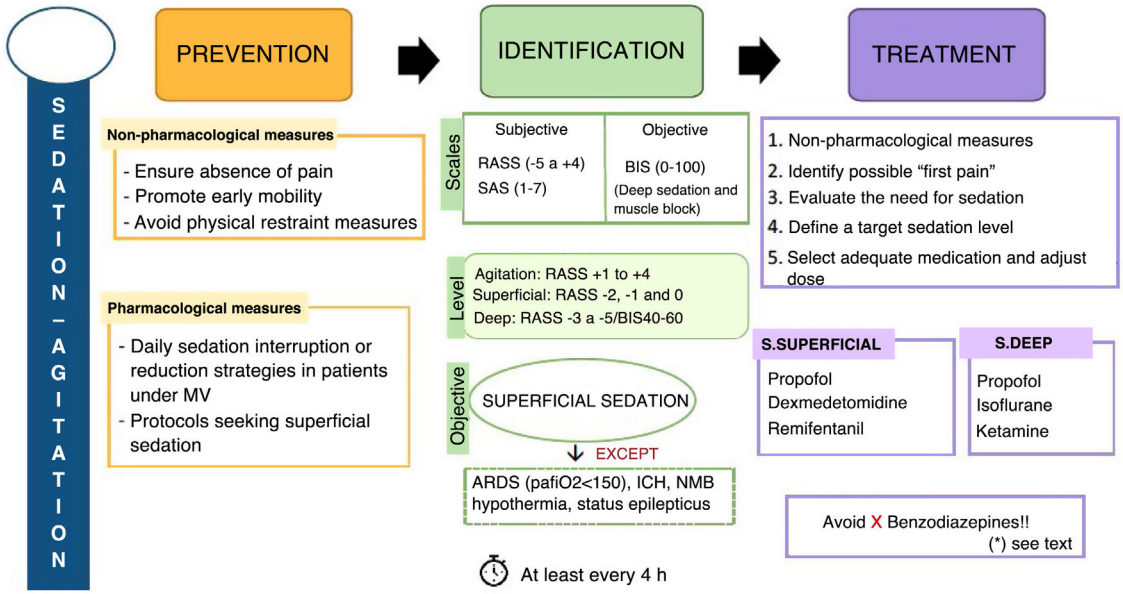

Figure 2 Sedation-Agitation.
MV, mechanical ventilation; RASS, Richmond Agitation Sedation Scale; SAS, Riker Sedation-Agitation Scale; BIS, bispectral index; ARDS, acute respiratory distress syndrome; ICH, intracranial hypertension; NMB, neuromuscular block.
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Choice of sedatives

In order to reduce stress and discomfort in mechanically ventilated patients, it is advisable to guarantee adequate analgesia, discard and treat delirium, and favor the previously mentioned non-pharmacological strategies, such as environmental enhancement, postural measures, relaxation and music therapy, among others. If this proves to be ineffective, pharmacological approach should be considered according to the objective of sedation, which should be established on an individualized basis and adapted dynamically to the clinical condition of the patient.

Preferably, and except in the presence of an absolute indication of deep sedation,[19] superficial and conscious sedation should be provided with drugs such as dexmedetomidine, propofol or remifentanil.

In those cases where deep sedation is justified, short half-life drugs such as propofol or ketamine should be chosen or inhaled sedatives such as isoflurane should be used,[27] avoiding benzodiazepines due to their association with delirium, increased ICU stay and estimated costs.[28] The latter drugs are only indicated in alcohol deprivation, refractory status epilepticus or in cases of difficult sedation as the second or third step where isoflurane is not available or contraindicated[7] (Fig. 3). Adequate sedation is a relevant quality indicator in the critically ill patient.[16]

Delirium reduction: evaluate, prevent and treat delirium

Delirium, defined as acute brain dysfunction characterized by attention, consciousness and cognition alterations with an acute and fluctuating course is a frequent condition in the ICU. It is associated with modifiable risk factors such as benzodiazepine use, deep sedation or blood transfusions, as well as with non-modifiable factors such as patient age, dementia, prior condition, urgent surgery or trauma, and high severity scores. Thus, the appearance of delirium is potentially modifiable.[19]

A relationship has been demonstrated between the appearance of delirium and poorer global cognitive and executive function , three and 12 months after discharge,[29] as well as an independent association between duration of delirium and long-term cognitive alterations.[30] Hence the prediction, detection and management of delirium constitute a guarantee of quality and safety. The identification of delirium and its non-pharmacological prevention are quality indicators in the critically ill patient, with the former being a relevant indicator.[16]

There are validated predictive models that can help in identifying those patients at an increased risk of suffering delirium during ICU stay, such as the Early Prediction Model for Delirium (E- PRE-DELIRIC) at the time of admission to the ICU, and the Prediction Model of Delirium (PRE-DELIRIC)[31] in the first 24 h of stay, facilitating the early application of preventive strategies.

Following the good practice recommendations of the working groups of the SEMICYUC,[32] regular assessment of the appearance of delirium should be carried out during admission, using validated tools in all patients, particularly in those with a high risk of developing the disorder. In this way, early identification proves possible, with the adoption of the measures required to shorten its duration and avoid the development of alterations in the long term. The available validated tools include the Confusion Assessment Method for

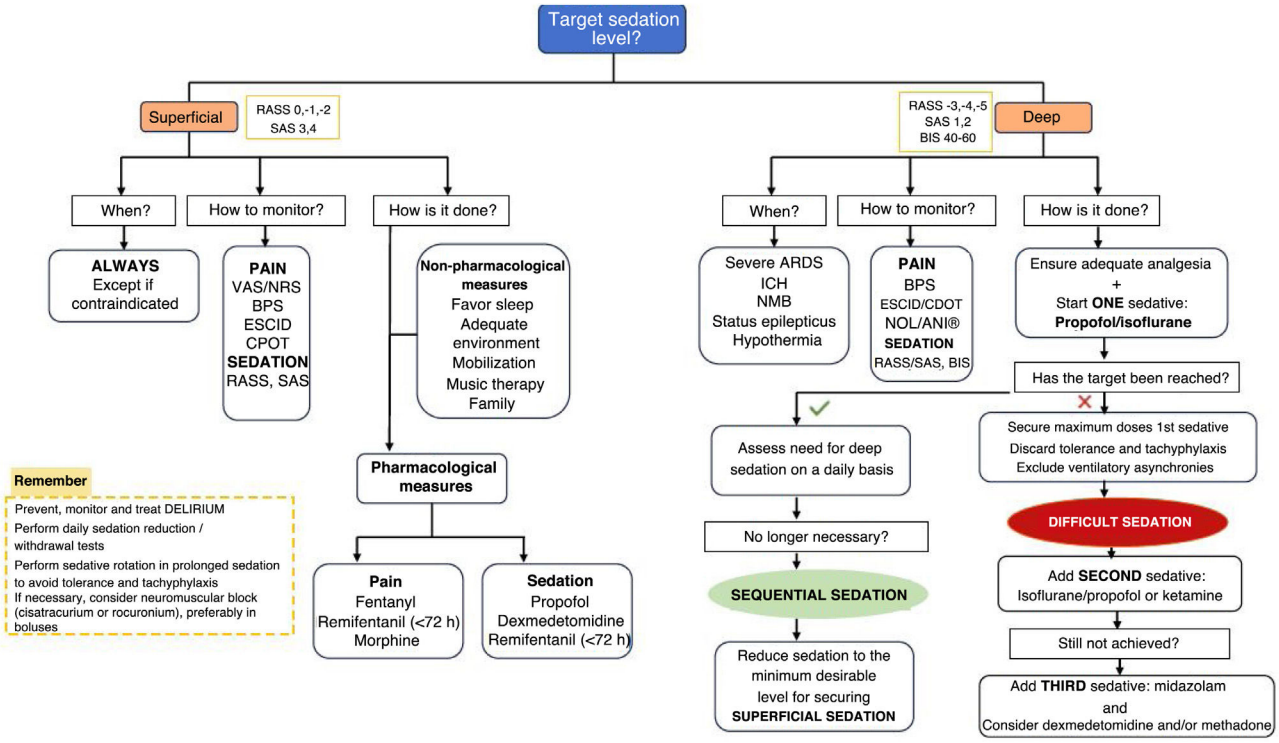

Figure 3 Analgosedation algorithm in the critically ill patient.
NRS, numeric rating scale; VAS, visual analogue scale; ESCID, Pain Indicating Behaviors Scale (Escala de Conductas Indicadores de Dolor); BPS, Behavioral Pain Scale; COPT, Critical-Care Pain Observation Tool; ANI, Analgesia Nociception Index; NOL, nociception level index; RASS, Richmond Agitation Sedation Scale; SAS, Riker Sedation-Agitation Scale; BIS, bispectral index; ARDS, acute respiratory distress syndrome; ICH, intracranial hypertension; NMB, neuromuscular block; BZD, benzodiazepines; CAM-ICU, Confusion Assessment Method for the ICU; ICDSC, Intensive Care Delirium Screening Checklist.
Reproduced from[7] (with permission).

the ICU (CAM-ICU)[33] and the Intensive Care Delirium Screening Checklist (ICDSC).[34]

The strategies for the prevention and treatment of delirium may include non-pharmacological interventions[35] based on preservation of the sleep-wake cycle, early mobility, prolonged family visits, technological tools to help in communication and neurocognitive development, orientation measures such as natural light or the use of clocks and televisions, the avoidance of mechanical restraints, etc. Moreover, if these measures prove insufficient, preventive drug treatments can be prescribed, such as nocturnal low-dose dexmedetomidine or melatonin to favor the sleep-wake cycle, with the avoidance of benzodiazepines – particularly at high doses and in continuous infusion. In relation to pharmacological treatment, the drugs of choice are α-2-agonists (dexmedetomidine or clonidine), with typical (haloperidol) or atypical antipsychotics (quetiapine, risperidone, olanzapine) being held in reserve in case of refractory agitation or psychotic symptoms, administered at the lowest dose possible and adjusted to the duration of the agitation symptoms of the patient. Valproic acid may be used in cases of delirium that fail to respond to these agents[7,36] (Fig. 4).

Early mobility and exercise

The survivors of critical illness suffer long-term physical sequelae, including ICU acquired weakness (ICUAW) which can be seen in 25%–50% of all patients and limits their physical function and quality of life.[37] The main risk factor in this regard is confinement to bed and prolonged immobilization.

The beneficial effects of mobilization strategies include the prevention of polyneuropathy and myopathy in the critically ill patient, improvement of quality of life, a shortening of ICU and hospital stay and a decrease of in-hospital mortality. The main techniques used for early mobility include kinesitherapy, transference and locomotion training, neuromuscular electrical stimulation and cycle ergometry.[38]

In order to implement these measures, it is essential to incorporate a physiotherapist within the ICU team to gradually introduce exercises (classified as in-bed and out-bed) according to the clinical condition of the patient. In-bed exercises include passive mobilization (when the patient is unable to collaborate), postural changes (active and passive), sitting in bed andactive mobilization (the patient collaborates with resistance and/or active exercises). Out-

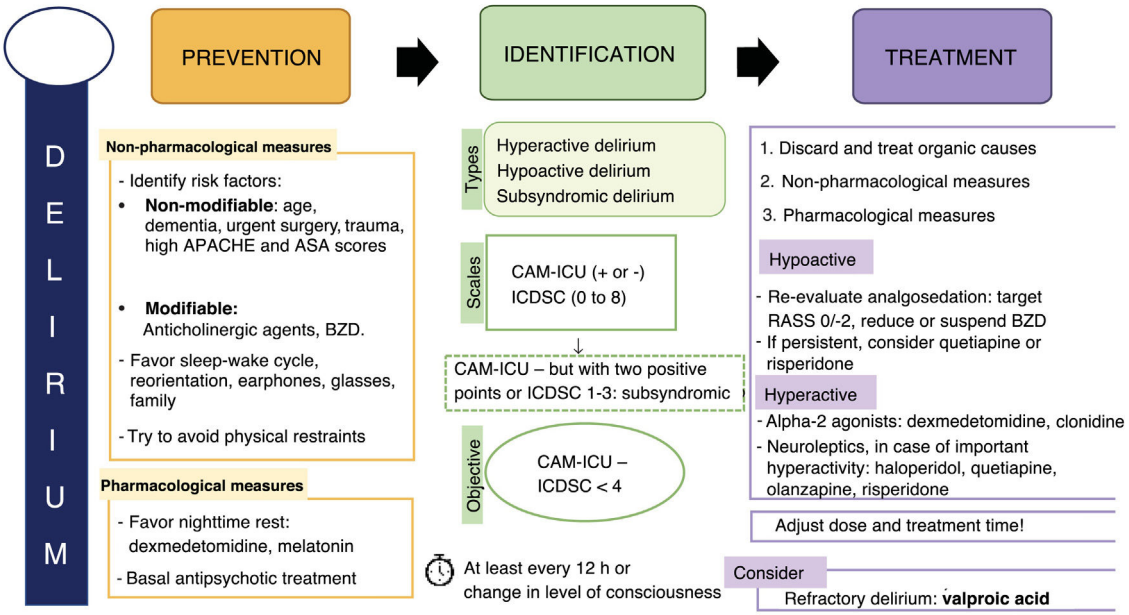

Figure 4 Prevention, identification and management of delirium.
BZD, benzodiazepines; CAM-ICU, Confusion Assessment Method for the ICU; ICDSC, Intensive Care Delirium Screening Checklist. Reproduced from[7] (with permission).

bed exercises, on the other hand, are based on control of the trunk (sitting at the edge of the bed), standing, transfers to the chair (active or passively) and walking (with different levels of aid).

In recent years, projects have been introduced that go beyond rehabilitation and exercise in the ICU, moving patients safely to outdoor spaces such as hospital gardens, which offers both, physical and psychological benefits.[39]

Family: family inclusion and empowerment

The families of critically ill patients become the interlocutors of their wishes and needs. In addition, the presence of relatives can help reduce anxiety, thereby lessening the risk of delirium, minimizing the use of restraints and self-removal of medical devices (thereby reducing self-inflicted injury),avoiding, therefore, delays in clinical recovery and long-term sequelae. Accordingly, protocols have been adopted for some time seeking to integrate families with unrestricted visits and encouraging their participation and preparation in the critically ill patient care plan.

The clinical practice guides based on scientific evidence offer strong recommendations on the need for patient and family education in the interventions that are going to be carried out, their indications, scope, advantages, limitations and risks.[40]

Good communication

The inability of critically ill patients to communicate, especially in those subjected to mechanical ventilation, can cause distress, feelings of isolation and fears of not having their needs met. This in turn can result in anxiety, depression or PTSD.[41]

Methods should be adopted to guarantee correct communication, allowing patients at all times to express their physical, emotional and spiritual needs. This can be done through simple techniques such as gestures, writing or letters, words, phrases or image cards. Other more sophisticated tools include augmented and alternative communication systems.[6]

Handout materials and holistic and personalized care

Patient isolation, with disconnection from usual life and separation from the home and familiar environment, can give rise to psychological disorders. In order to prevent such problems, it is important to incorporate non-pharmacological interventions such as music therapy adapted to the preferences of the patient, allowing the use of personal electronic devices, access to news in the ICU, the strategic placement of photographs and the creation of an environment as close to that of home as possible.[6]

Redefined ICU architectural design

In recent years, several studies have proposed redesigning the areas within the ICU, seeking to prevent delirium and reduce anxiety and stress in patients. The proposals include large spaces with natural light and separation from noise and technical devices, with spaces for families, television screens or means allowing direct communication with relatives and orientation elements (clocks, calendars, etc.). In addition, augmented sensory devices are

proposed, such as virtual reality headsets, loudspeakers, sound-lowering earphones, etc., along with early mobilization protocols.[6]

Respirator: adaptation to the respirator

MV poses the main challenge in the prevention of sequelae, since the technique is often stressful and painful. This makes it necessary to use analgosedation and – in some cases – neuromuscular blockers. On the other hand, the prolongation of MV implies longer bed confinement, ICUAW, and problems in establishing effective communication with the patient. Lastly, patient-respirator asynchrony can prolong MV, with an increased risk of lung and muscle injuries that lead to physical sequelae such as dyspnea or limited lung capacity. It is important to correct such asynchrony, adapting the respiratory to the patient and not the other way around, to avoid oversedation.[42]

Several studies have analyzed the sequelae in survivors of ARDS, documenting persistent alteration of diffusion capacity of carbon monoxide(DLCO test) and functional limitations referred to exercise as evidenced by the SF-36 or SF-12 tools and the 6-minute walking test (6MWT).[43–46] Over the short term, the pulmonary sequelae appear to be related to lung injury and the duration of MV, though, over the long term, the extrapulmonary causes (loss of muscle mass, ICUAW, etc.) determine the functional prognosis.

In order to avoid these sequelae, and in addition to an adequate ventilatory strategy, other measures should be adopted to avoid prolonged MV, identify and correct asynchronies, ensure adequate management of analgosedation, and guarantee adequate nutrition and early rehabilitation.[47]

Nutrition

Malnutrition in critically ill patients is closely related to ICUAW. Thus, a key strategy for avoiding physical sequelae is to guarantee adequate patient nutrition based on the catabolic/anabolic processes.[48] The latest clinical guides on nutrition in the ICU[49] consider all critically ill patients admitted for over 48 h to be at risk of malnutrition. Apart from the body mass index (BMI) and basal metabolic rate (BMR), it may be useful to use the GLIM (Global Leadership Initiative on Malnutrition) criteria.[50] The GLIM is a useful and validated tool for application in the hospital setting at the time of patient admission, and can be used to establish an early nutritional diagnosis with subsequent intervention.

It is advisable to start with oral feeding rather than using the enteral or parenteral route, in the first 48 h of admission, on a continuous basis and ensuring tolerance with the use of prokinetic agents, if needed. In the early phase it is advisable to administer a hypocaloric diet, affording a gradual increase in calorie supply after the third day, with protein 1.3 g/kg/day, without exceeding 5 mg/kg/min of glucose or carbohydrates, or 1.5 g/kg/day of lipids.[49] It should be remembered that physical activity may improve the effects of nutritional therapy.

Therapeutic approach to PICS

The conceptual changes in Intensive Care Medicine have done away with the old model of the intensivist enclosed within the ICU walls. The new model of critical illness focuses not only on the period in which the patient is admitted to the ICU but also on the previous period (early detection of serious illness in the ward) and the period after discharge from hospital[51] (Fig. 5), seeking not only to ensure survival but also survival with quality of life (patient return to work, social, family and other activities as before admission). Accordingly, despite the preventive measures adopted during admission to the ICU, we need to identify patients at risk for posterior assessment in the intensive care outpatient clinic to detect and treat the sequelae.

The risk factors warranting patient enrollment in follow-up programs differ among the existing protocols and consensuses.[1,52,53] The points below may be seen as a summary of what has been published to date. The risk factors include concrete conditions (e.g., sepsis, ARDS, cardiac arrest, etc.) that have been described in some documents[53]:

1 Patients receiving ventilatory support for more than 48 h (invasive or noninvasive, or high-flow mechanical ventilation).
2 Patients with an ICU stay of over 5 days.
3 Patients who have suffered multiorgan dysfunction (two or more organs).
4 Patients who have suffered delirium during ICU admission.
5 Patients who in the opinion of the supervising physician should be evaluated in the intensive care outpatient clinic.

Such follow-up is focused on patients with recovery potential, excluding those with unrecoverable sequelae or with severe cognitive or psychiatric disorders or severe neurological or neuromuscular diseases or disabilites prior to admission. While such differentiation is complex, it is crucial for adequate patient selection.

The patient history prior to admission to the ICU must be considered and documented. Based on the recommendation that ''the prediction of post-ICU problems and anticipatory guidance is a task ICU clinicians should try to take on'',[53] an evaluation is needed of the patient functional capacities prior to admission to the ICU and which in turn should be documented in the case history and physical examination, to serve as a reference in the post-ICU assessment, reporting it during the transfer of competences once the patient leaves the ICU.

Timing of first evaluation

The first Spanish working protocol[52] on patient follow-up in the intensive care outpatient clinic established a timing of three months from hospital discharge. Recent recommendations from other societies suggest earlier evaluation (4 weeks after hospital discharge). Likewise, rather than

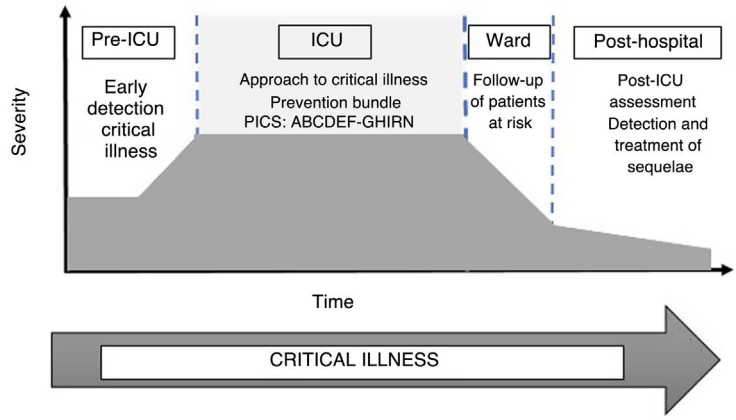

Figure 5 Critical illness model.
PICS, post-intensive care syndrome; ABCDEF, bundle: **A**ssess/treat pain, **B**reathing/awakening trials, **C**hoice of sedatives, **D**elirium reduction, **E**arly mobility and exercise, **F**amily; GHIRN, bundle of measures: **G**ood communication, **H**andout materials, Redefined **I**CU architectural design, **R**espirator, **N**utrition.
Reproduced from.[51]

establishing a prior timing of evaluations, they advocate continued assessments over the course of recovery, adapted to each individual patient and the needs of the affected spheres.[53] In other words, serial evaluations are recommended, based on sub-spheres, using the recommended tools, and which will be presented in the course of the document, establishing an order of priorities proportional to the level of severity, with a view to the care that will be provided by the post-ICU team.

PICS follow-up team

The team in charge of follow-up is to be coordinated by the specialist in Intensive Care Medicine, and although the characteristics of each team may vary depending on the possibilities of each center, a number of services are essential for guaranteeing the quality of patient care after hospital discharge (these moreover also being essential for the application of preventive measures during admission). Integration of the services of mental health (psychiatry and clinical psychology) and rehabilitation is crucial, and it is advisable to incorporate specialists in endocrinology and nutrition, due to the nutritional problems which some patients may continue to have after hospital discharge.

Assessment in the clinic

The activities to be carried out in the clinic can be summarized as: anamnesis (from hospital discharge), physical exploration, and evaluation of the domains that conform PICS (Table 1).

Psychological sphere assessment

Since the psychological disorders associated with PICS are anxiety, depression and PTSD, validated screening tools should be used to identify them, with referral to the corresponding specialist on the team, where applicable. The most widely used scales are described below.

1 Anxiety and depression. Hospital Anxiety and Depression Scale (HADS).[54] The HADS combines two subscales of 7 items that evaluate the symptoms of depression (HADS-D subscale) and anxiety (HADS-A subscale).
2 PTSD. Any of the following scales can be used to assess the symptoms of PTSD:
   - Impact of Event Scale (IES)-Revised.[55] This is a 22-item detection instrument based on the DSM-IV criteria. It has been adapted and validated in Spanish. In turn, the short IES-6[56] has slightly lower sensitivity and specificity than the original IES-R.
   - Posttraumatic Stress Disorder Symptom Severity Scale - Revised (*Escala de Gravedad de Síntomas Revisada [EGS-R] del Trastorno de Estrés Postraumático*).[57] This is a 21-item tool in correspondence with the diagnostic criteria of the DSM-V. The scale has been validated in the Spanish population and constitutes a modified and updated version of the EGS of 1997, which showed good psychometric properties.

Cognitive sphere assessment

The evaluation of cognitive function is a complex task that requires the participation of specialists trained in this area. However, screening for cognitive problems using simple tools proves useful for prompt and adequate patient referral to these specialized teams. The Montreal Cognitive Assessment (MoCA) test[58] is a simple questionnaire and is recommended for use by non-specialized personnel.

Physical sphere assessment

Physical function is one of the most affected spheres following discharge from the ICU. Its classical assessment comprises muscle strength and respiratory function. The former can be evaluated using a number of tests (6-minute walking test[59,60] or the get up and go test[61]) and objective measurement devices such as the dynamometer. In this regard, the measurements obtained must be compared against those obtained in the healthy population (in our setting we have the assessments published by Luna et al.[62]).

Table 1 Tools for assessing post-intensive care syndrome.

Questionnaires/tools	Domain	Comments/Cut-off points
Spirometry (in addition DLCO test)	Physical/Pulmonary	Alterations of the spirometric pattern according to ATS/ERS.[63–66]
Dynamometry	Physical/Neuromuscular	<85% of the healthy population.[62]
Walking test	Physical	Comprehensive assessment of the respiratory, cardiovascular, metabolic, musculoskeletal and neurosensory system response of the individual during the exercise. There are some contraindications to the walking test, such as recent or uncontrolled cardiac or coronary disorders, or incapacity to understand the test. The result should be interpreted with respect to the healthy population reference values.[59]
Get up and go test	Physical	Functional assessment is used to measure the patient's mobility and capacity to stand up from a chair, walk a short distance, and sit down again. The standard test procedure is as follows: The patient is seated in a standard chair with armrests. The patient is instructed to stand up from the chair without help and walk a short distance (about 3 m or 10 feet). The patient walks to the indicated point at a normal or safe maximum pace, without running. On reaching the indicated point, the patient turns around and returns to the chair. The patient sits down in the chair again. The test evaluates ***mobility, stability, coordination and balance***, as well as the risk of falls.[61]
HADS-A	Psychiatric	A score of $\geq$ 8 points identifies symptoms of ***anxiety*** [54].
HADS-D	Psychiatric	A score of $\geq$8 points identifies symptoms of ***depression***.[54]
PTSD Symptomseverity scale-Revised	Psychiatric	Global cut-off point of 20, and partial cut-off points above 3, 3, 5 and 5 corresponding to the re-experimentation, avoidance, cognitive alterations/negative mood state, and activation increase subscales, respectively.[57]
IES-R	Psychiatric	The patients are required to identify the traumatic event and respond to the 22 items exploring its perception. Each item is scored from 0 (nothing) to 4 (extreme), yielding a total score of 0 (minimum) to 88 (maximum). In addition, there are subscales for the items that evaluate intrusion, avoidance and hyper-alertness. A score of $\geq$ 33 has been used as a cut-off point for indicating the significant presence of ***post-traumatic stress symptoms***.[55]
MoCA test	Cognitive	Evaluation of ***global cognitive function***, including executive function, working memory/attention, episodic memory and language.[58] Score: 18—25: mild cognitive impairment Score 10—17: moderate cognitive impairment Score < 10: severe cognitive impairment.[53]
SF-12	Quality of life	Domains related to ***physical health***: general health, physical activities, common role activities and body pain. Domains related to ***mental health***: vitality, social activities, emotion influenced by limitations in role activities, and general mental health. Two ''summary'' scores are calculated – physical health and mental health – based on the weighted means of the 8 domains. A score of <50 indicates poor health-related quality of life compared with the reference population, while a score of >50 indicates good health-related quality of life.[68]

Table 1 (*Continued*)

Questionnaires/tools	Domain	Comments/Cut-off points
EuroQoL-5D-5L	Quality of life	Composed of two parts: the first part includes evaluations of ***mobility, self-care, common activities, pain and anxiety/depression***. The responses generate a 5-digit number expressing the selected level in each domain (e.g., ''11111'' or ''21123''), where each digit represents the selected level in each dimension (1, 2, 3, 4 or 5, corresponding to ''no problem'', ''slight problem'', ''moderate problem'', ''severe problem'' and ''extreme problem'', respectively). The health status corresponding to those 5 digits (the index) can be consulted and compared with the general population. The second part includes a visual analogue scale consisting of a vertical line on which the patients trace a horizontal line at the level which they feel represents their current health status.[69]

DLCO: Carbon monoxide lung diffusion test. ATS: American Thoracic Society. ERS: European Respiratory Society. HADS: Hospital anxiety (HADS-A) and depression scale (HADS-D). PTSD: Posttraumatic Stress Disorder; IES-R: Impact of Event Scale-Revised. MoCA: Montreal Cognitive Assessment test. SF-12: 12-item Short Form health survey.

Respiratory function in turn should be evaluated by spirometry and also the DLCO test. The protocol and interpretation of spirometry and DLCO are to be based on the standardization and guidelines of the American Thoracic Society (ATS) and the European Respiratory Society (ERS).[63–66] On the other hand, in recent years nutritional assessment has also been incorporated, since nutritional-metabolic optimization may have a positive impact upon functional recovery of the patient. There are no validated scales for the type of patients we are dealing with, however. The introduction of the GLIM criteria[67] for malnutrition, which are based on three phenotypical parameters (weight loss, low body mass index and reduced muscle mass) and two etiological factors (reduced food intake and inflammation), with the help of ultrasound, could be of use - though the screening and diagnosis of malnutrition in these cases remains to be clarified.

Quality of life

Health-related quality of life (HRQoL) questionnaires are used to measure patient physical, social and mental status. Different questionnaires are available, though perhaps the most widely used are the 12-item Short Form healthy survey (SF-12),[68] a short version of the SF-36 that explores physical and mental health through different items in 8 domains, and the EuroQol-5D-5L,[69] which is a generic and simple multiple-choice response instrument.

Conclusions

The sequelae frequently seen among survivors of critical illness are currently encompassed within what is known as post-intensive care syndrome (PICS), which comprises a series of symptoms in the physical, cognitive and psychological spheres. The first measure in the approach to PICS is prevention, and in this regard, bundles have been proposed for comprehensive and multidisciplinary symptoms management during the critical illness process. In addition to the prevention measures, it is important to identify patients at risk in order to ensure their post-hospital discharge assessment by the post-ICU follow-up team, which will detect, evaluate and treat the possible sequelae.

Conflict of interest

None.

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