# Is there a good protocol to avoid hypotension during regional anesthesia for C-section?

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**Volume preloading: pro and con**

Following spinal anesthesia even up to 2000ml of crystalloids may reduce but not eliminate hypotension. Administering the amount of crystalloids more rapidly did not decrease the risk of hypotension. Cooling of the fluid may increase MAP by ± 5mmHg but it may be questioned whether this increase is clinically important (1). Rout et al. demonstrated that the incidence of hypotension decreased from 71% to 55% for unpreloaded vs preloaded (crystalloids) subjects resp. (2) without effect on neonatal outcome.

Two other studies showed that the use of 1000ml of crystalloids alone does not appear to be better than no or little prehydration (3,4). The incidence of hypotension was still considerable despite the infusion of up to 50 mg ephedrine (as compared to less than 10mg in our department). Prehydration may induce pulmonary edema, a risk which may be reduced by the use of colloids. The properties of the available colloids may differ considerably. Hydroxyethylstarch (HES) 6% may offer less allergic potential than gelatins and dextrans while placental transfer may be ignored (5). In obstetrics the superiority of a crystalloid-HES combination has been shown and confirmed as compared to crystalloids alone (6-8). A recent study using invasive hemodynamic monitoring demonstrated that 1000ml HES 6% caused less hypotension than only 500ml HES or 1500ml crystalloids (8). Whereas 100% of the colloid remained intravascularly, only 28% of the crystalloid remained in the vascular space. The 6% concentration may be preferred because its volume retaining effect in excess of 100% lasts only 30 minutes.

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**Baricity: does it affect hypotension or the success of the block?**

The substance used for spinal anesthesia in most obstetric departments is hyperbaric bupivacaine. In a non-pregnant population, most studies have shown that with hyperbaric substances the cephalad spread is significantly greater than with plain substances. Consequently, enhanced rostral spread may also have hemodynamic percussions. The previous findings may not be identical for pregnant patients requiring less bupivacaine. Baricity-related differences in upper sensory level could not be evidenced in two studies using 12.5-15mg bupivacaine (11,12). In a study using small doses of bupivacaine (6.6mg) to which was added 3.3µg sufentanil (13), more hypotension was registered with the plain solution while the mean upper sensory level was identical for both groups. The hyperbaric substance however resulted in a more reliable block while the plain solution caused more incidental excessive rostral spread. As opposed to this Khaw et al. found more hypotension with hyperbaric ropivacaine than with the plain substance (14).



**Vasopressors: prophylaxis or treatment ? Which one?**

Gutsche et al. demonstrated that 25-50mg given intramuscularly within 30 min of instituting a subarachnoidal block, significantly decreased the incidence of hypotension (15). Placental transfer of such high ephedrine doses may result in higher neonatal catecholamine levels, fetal acidosis and rebound hypertension. The intravenous route for administering ephedrine either as an incremental dose or by infusion may be more effective and predictable than the IM route. Many studies have shown that ephedrine prophylaxis offers the same benefit as crystalloid preloading (16,17). We performed a study in prehydrated parturients, receiving low dose spinal anesthesia and found that patients receiving 5mg ephedrine immediately after the spinal injection showed less hypotension and nausea than the placebo group (18).

Subsequently studies have tried to define the optimal ephedrine dose when administered as a prophylactic bolus. While only a 30mg dose reduced the incidence of hypotension, reactive hypertension occurred with doses as from 20mg. Other studies demonstrated that ephedrine compared favorably with other vasopressors such as phenylephrine and angiotensin II (21,22). Phenylephrine treated parturients may often require atropine because of bradycardia (23). Studies with phenylephrine and angiotensin II have found less fetal acidosis as well (24) but it should be emphasized that many studies use too large doses of ephedrine (up to 50mg) while the clinical relevance needs to be demonstrated as well. A recent meta-analysis has confirmed the superiority of phenylephrine in the treatment of hypotension (25). Due to

the theoretical advantages of ephedrine with respect to uterine blood perfusion and the lack of bradycardia, we can ask ourselves what we are doing wrong and how we can use ephedrine in a more optimal way.

**Low dose spinals and EVE**

Whereas previously bupivacaine dose for spinal anesthesia ranged between 12 and 15mg, some even more, the addition of adjuvant drugs has enabled to decrease this dose. Unfortunately too little number of colleagues have discovered that 5 to 6mg with an opioid is more than sufficient to perform a C-section. Such a low dose will reduce the incidence and severity of hypotension while the motor block induced may wear off by the end of surgery allowing faster discharge out of recovery. One study pointed out that bupivacaine 5mg + fentanyl 25µg decreased the incidence of hypotension, vasopressor requirement and nausea/vomiting (26). Van de Velde et al. found bupivacaine 9mg to cause more hypotension and longer-lasting motor block than a 6mg dose while the block quality was similar (27). Some colleagues believe that epidural volume extension (EVE) with saline after a low dose spinal is better for reducing cardiovascular effects but this is highly speculative and has never been demonstrated up to now (28).



**Remaining to be demonstrated...**

Few studies found **ropivacaine and levobupivacaine** to offer less hypotension although it remains difficult to provide final evidence for this in well designed studies as the potency issues are still ongoing.

**Other vasopressors** have been used as well such as aramine, angiotensin and ergotamine... but in fact these substances have been abandoned.

Most recently also **ondansetron** (29) has been found in non-obstetric practice to cause less hypotension and may offer new horizons in patients at risk for potent vasopressors such as any parturient.

No study up to date has evaluated whether the timing during the day of elective C-section may play a role in the incidence and severity of hypotension. In a retrospective review of 300 consecutive C-sections there was a trend towards less hypotension when surgical delivery is scheduled during the afternoon (30). This is quite opposite to the expectation that these patients would be more at risk to develop hypotension as they may be more dehydrated but are in accordance with studies not finding any benefit when giving crystalloids in volumes of 15mL/kg or more (3,4).

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# Perioperative fluid replacement therapy in pediatric patients

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**Introduction**

Fluid replacement therapy should be adapted to the physiologic differences between newborns, children and adults. Fluids and electrolytes balance are affected by growth and maturation of the kidney.

The main difference between infants and adults consists in the fact that 40% of body water in newborns is extracellular fluid (ECF), while in adults the ECF is 20%. Intracellular fluid (ICF) volume and plasma volume are similar at all ages. A newborn looses 10% of his body weight if he drinks nothing for a whole day. Hypotonic fluid losses from the body area are from sweat and diarrhea.

Fluid losses from the body from trauma, burns, upper GI tract (vomiting, ileus, peritonitis) are isotonic. For every 1°C fever, about 10% more fluid replacement is necessary.

Fetal kidney produces only amniotic fluid therefore renal vascular resistance (RVR) is high while renal blood flow (RBF) and glomerular filtration rate (GFR) are low in the first 24 h postpartum. Postpartum RVR decreases and RBF and GFR increase. In the first five postpartum days there is a marked improvement in renal function and the ability to conserve fluid and excrete an overload. At first month the kidney is approximately 60 % mature.

Fluid and sodium conservation is limited in newborns and infants and even worse in premature infants.

Tubular function is limited for excretion and reabsorption mechanisms. Premature babies have limited ability to reabsorb sodium and will therefore become hyponatremic without adequate replacement.

After 18 months, renal function is completely matured.

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**Fluid therapy in children**

Fluid therapy in children may be associated with iatrogenic hyponatremia. Some children might develop postoperative lethargy, headache, nausea, vomiting, respiratory deterioration, cardiac arrest and coma.

Fatal cerebral edema has been reported due to administration of large volumes of hypotonic fluid.

In UK and Northern Ireland 50 cases of serious morbidity or death associated with the administration of IV fluids acquired hyponatremia have been reported in the last ten years in previously healthy children.



A multi center survey concluded that 60,6% of the anesthetists in UK were using hypotonic fluids (Dextrose 4% with Saline 0.18%) in pediatric anesthesia.

A critical question and discussion topic in the pediatric medical literature is whether too much fluid or a wrong type of fluid is being given.

A fluid that is isotonic with plasma is the compound sodium lactate solution (Hartmann's). This solution is used for children of all ages, with or without added dextrose.

Isotonic fluids such as saline 0.9 %, Hartmann's or a colloid are the most common choice to be used as a bolus in the event of hypovolemia. 11.1% for all anesthetists in UK use standard maintenance with hypotonic Dextrose with Saline and also use this solution for boluses to correct intraoperative hypovolemia.

For the postoperative period, only 14.1% of the UK anesthetists were giving Hartmann's solution or Saline 0.9%.

Majority of the anesthetists calculate perioperative maintenance fluid requirement using the formula described by Holliday and Segar or the 4/2/1 formula.

First 10 kg x 4cc (+) Second 10 kg x 2cc (+) Rest kg x 1 cc

For newborn, where the whole nutrition is liquid the calculated maintenance formula for intraoperative fluid requirement is:

ml/h = +/- 100 ml x weight : 24

In healthy patients, water excretion by the kidneys is controlled by vasopressin (ADH). Vasopressin is released by a variety of stimuli such as decreased extracellular fluid volume, hypovolemia, pain, nausea, stress and drugs (i.e. morphine).

APA (the European Association of Pediatric Anesthetists) recommends

using glucose solution in neonates and infants, to avoid the possibility of intraoperative hypoglycemia (Dextrose 4% with Saline 0.18%; Dextrose 2.5% or 5% with Saline 0.45%, Dextrose 5% with Saline 0.33%).

Pediatric anesthetists recommend the restriction of fluids postoperatively after routine, minor surgery.

Postoperative fluid replacement is recommended for hemodynamic instability or in children unable to take fluids by mouth.

If hypotonic fluids are used, monitoring of fluid and electrolytes balance is recommended.

Hyponatremia in children is corrected with isotonic fluids and fluid restriction.

Our recommendation is use of isotonic fluid solutions (i.e.Hartmann's) for infants and older children. For newborns Dextrose 5% with Saline 0.33%/0.45% is preferred, along with blood electrolytes monitoring.



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# Ghiduri si protocoale pentru desprinderea de suportul ventilator



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Suportul ventilator este folosit adesea pentru scurte perioade de timp la pacientii intubati de electie pentru alte motive decat insuficienta respiratorie. Astfel se intampla la pacientii ventilati dupa o interventie chirurgicala majora ca parte a ingrijirilor postoperatorii sau la cei intubati pentru protectia cailor aeriene. Oprirea brusca a suportului ventilator si, cel mai adesea, extubarea rapida sunt in general posibile la astfel de pacienti, daca urmatoarele criterii sunt indeplinite:

- pacientul este treaz, alert si poate respira spontan eficient. Volumul curent trebuie sa fie normal, eventual masurat spirometric;
- indicatia clinica pentru suportul ventilator nu mai exista;
- caile aeriene sunt lipsite de secretii, ce se pot evacua prin aspirare sau tuse eficienta si pacientul este capabil sa-si protejeze caile aeriene impotriva aspiratiei;
- radiografia pulmonara este normala, fara semne de atelectazii sau condensari pulmonare;
- la pacientii ventilati mecanic dupa o interventie chirurgicala pe cord deschis sau dupa o interventie chirurgicala majora, gazele sanguine trebuie sa fie normale sau aproape normale, atat in timpul suportului ventilator cat si dupa intreruperea sa;
- pacientul este nevoie sa ramana internat in sectia de terapie intensiva pentru a continua prin umidifierea gazelor inspirate, aerosolizare, fizioterapia respiratorie si la nevoie reintubatie.

Atunci cand apar complicatii pulmonare postoperatorii care produc insuficienta respiratorie sau atunci cand apar alte complicatii ca infectia sau

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hemoragia, mentinand pacientul in stare critica, decizia de intrerupere a suportului ventilator este necesar sa fie amanata. Criteriile clinice impreuna cu parametri respiratori trebuie luate in considerare pentru a decide momentul in care se poate incepe desprinderea de ventilator la acesti pacienti (Tab. 1).

Pacientii care au nevoie de suport ventilator de durata, saptamani sau chiar luni sunt dificil de despris de ventilator. Decizia de a pune in aplicare un protocol de desprindere de suportul ventilator, la astfel de pacienti, trebuie sa se bazeze in primul rand pe criteriile clinice. Parametri paraclinici ajuta la luarea deciziei de desprindere de ventilator, dar trebuie sa sustina sau sa completeze criteriile clinice.



*Tabel 1. Cauze ce duc la dependenta de suportul ventilator*

| Cauze | Descriere |
|---|---|
| Afectiuni neurologice | Cauze centrale, afectiuni de nervi periferici |
| Afectiuni respiratorii | Tulburari ale mecanicii respiratorii |
| | Afectarea musculaturii respiratorii: |
| | - forta musculara diminuata |
| | - tulburari metabolice |
| | - denutritie |
| | - tulburari in aportul si extragerea O2 |
| | Tulburari ale schimburilor gazoase |
| | - cauze vasculare |
| | - alterarea raportului ventilatie/perfuzie |
| Afectiuni cardio-vasculare | Toleranta cardiaca diminuata a efortului musculaturii respiratorii |
| | Necesar mare de O2 la tesuturi |
| Cauze psihologice | |

**Criterii de desprindere de suportul ventilator de durata**

Ca un principiu general, suportul ventilator mecanic este posibil a fi intrerupt atunci cand indicatia pentru care a fost instituit nu mai este de actualitate. Aceasta inseamna ca afectiunea care a dus la indicatia de suport ventilator, fie ca este pulmonara sau nu, s-a vindecat sau s-a ameliorat substantial (Tab. 2).

Este de asemenea important ca un pacient cu suport ventilator sa-si mentina gazele sanguine in limite normale la valori ale $FiO_2$ de 0,4 – 0,5 pentru a putea pune in discutie desprinderea de ventilator. Exceptie fac pacientii cu bronhopneumopatie cronica obstructiva (BPOC) care au fost ventilati pentru o insuficienta respiratorie acuta sau cronica. Acesti pacienti sunt obisnuiti in

conditii „normale" cu valori ale $PaO_2$ de aproximativ 60 mmHg si valori peste normal ale $PaCO_2$.

Este important ca plamanii, pe cat posibil, sa fie fara infectie, atelectazie sau edem. Obstructia cailor aeriene, fie prin dopuri de mucus sau bronhospasm, trebuie indepartata pentru ca astfel creste in mod dramatic efortul respirator.

Tulburarile echilibrului acido-bazic se corecteaza inainte de inceperea procesului de desprindere de suportul ventilator. Acidoza metabolica poate creste semnificativ lucrul mecanic respirator, iar alcaloza metabolica poate duce la tulburari ale statusului mental si inhibarea respiratiei.



Se apreciaza clinic daca pacientul va putea sa respire eficient odata cu retragerea suportului ventilator. In evaluarea clinica se pune accent pe statusul nutritional si neuromuscular. O nutritie deficitara, tulburarile electrolitice, hipomagneziemia si hipofosfatemia duc la dificultati in desprinderea de suportul ventilator. Starile catabolice severe duc la pierdere in greutate si de masa musculara, in pofida unei nutritii care asigura aport caloric si proteic mare. O alimentatie bogata in hidrati de carbon duce la cresterea productiei de $CO_2$, cu cresterea efortului respirator, mai ales la pacientii critici sau la cei care prezinta o afectiune respiratorie preexistenta. La astfel de pacienti nutritia se compune in principal din lipide pentru aportul caloric, cu cantitati mai mici de hidrati de carbon.

*Tab. 2. Criterii pentru desprinderea pacientului de suportul ventilator*

| |
|---|
| Afectiunea pulmonara sau extrapulmonara pt care s-a institui suportul ventilator s-a vindecat sau s-a ameliorat substantial, tuse eficienta |
| Valorile gazelor sanguine sa se mentina normale la $FiO_2$ 0,4 (exceptie pacientii cu BPOC) |
| Lipsa infectiei pulmonare, edemului pulmonar, atelectaziei sau obstructiei de cai aeriene |
| Tulburarrile acido-bazice si electrolitice sa fie corectate |
| Pacient constient, cooperant si pregatit psihic, fara sedare, GCS ≥ 13 |
| Pacient stabil hemodinamic, preferabil fara suport inotrop |
| Status nutritional si neuro-muscular adevcat |
| **Nu** se tenteaza desprinderea de ventilator in prezenta urmatoarelor: febra mare, convulsii, HDS, dilatatie gastrica, ileus, insuficienta renala sau hepatica |
| In respiratie spontana (tub „T") nu trebuie sa existe modificari semnificative ale frecventei cardiace, tensiunii arteriale, fara tahicardie sau dispnee, pacientul sa fie capabil sa-si mentina gazele sanguine si un volum curent de 5-7 ml/kg |
| Afebril sau T< 38°C |
| Hb ≥ 8-10 g% |

La pacientii cu insuficienta hepatica, cu insuficienta renala cronica, alcoolism cronic si cei care sunt intr-o stare critica de lunga durata desprinderea de suportul ventilator se realizeaza cu dificultate, in primul rand datorita

starii de nutritie precare si a faptului ca nu sunt capabili sa depuna un efort respirator eficient.

Inainte de inceperea procesului de desprindere de suportul ventilator este necesara stabilizarea pacientului din punctul de vedere a hemodinamicii. Pe cat posibil, este bine sa se astepte stabilirea unei hemodinamici fara suport inotrop sau vasoactiv, inainte de inceperea procesului de desprindere de suportul ventilator la pacientii in stare critica.

Suportul ventilator trebuie continuat si procesul de desprindere de suportul ventilator trebuie amanat in cazul in care pacientul prezinta febra mare, convulsii sau atunci cand sunt prezente complicatii ca: dilatatie gastrica cu staza importanta, ileus, hemoragie digestiva superioara, insuficienta renala acuta.



Este necesar ca pacientul sa fie treaz, orientat, cooperant si sa fie pregatit psihic si motivat pentru a se putea desprinde de suportul ventilator.

**Criteriile obiective pentru desprinderea de ventilator**

Criteriile obiective utilizate pentru a sustine decizia bazata pe criteriile clinice pentru desprinderea de ventilator sunt reprezentate de: frecventa respiratorie sub 30 respiratii/minut, volum minutul sub 10L/minut, volum curent de cel putin 5-7ml/kg, capacitatea vitala de cel putin 800-1000 ml, iar forta inspiratorie maxima sa fie mai mare de -20 cmH2O. pH-ul sangelui areterial trebuie sa se situeze intre 7,35 si 7,45, $PaO_2$ intre 70 si 100 mmHg la $FiO_2$ de 0,4, iar $PaCO_2$ trebuie sa fie normala., exceptie facand pacientii cu BPOC la care se accepta valori mai mari ale $PaCO_2$ cu care acestia sunt obisnuiti. De asemenea este necesar a avea un raport $V_D/V_T$ mai mic de 0,6, iar gradientul presional alveolo-arterial al oxigenului la FiO2 1 sa fie mai mic de 250 mmHg (Tab. 3).

*Tabel 3. Parametri respiratori pentru desprinderea de ventilator*

| **1. Parametri ventilatori** |
|---|
| - frecventa respiratorie < 30/min |
| - V minutul < 8L/min si nu > 10L/min |
| - V curent minim 5-7 ml/kg |
| - CV minim 800-1000 ml |
| - Forta inspiratorie maxima > -20 $cmH_2O$ |
| - VD/VT < 0,6 |
| - Gradientul presional al $O_2$ alveolar-arterial la $FiO_2$ 1 < 250 mmHg |
| **2. Gazele sanguine** |
| - pH 7,35-7,45 |
| - $PaO_2$ 70-100 mmHg la $FiO_2$ de 0,4 |
| - $PaCO_2$ 35-45 |

Desprinderea de ventilator nu este posibila atunci cand presiunile de varf sau de platou sunt mari. Complianta statica este de preferat sa fie mai mare de 30 ml/cm $H_2O$, iar rezistenta la nivelul cailor aeriene sa nu fie crescuta. PEEP-ul trebuie redus si eliminat inainte de a incepe procesul de desprindere de suportul ventilator.

Unul dintre testele simple care se pot efectua la patul bolnavului pentru a determina daca este posibila desprinderea de ventilator este numararea respiratiilor dupa deconectarea de ventilator. O frecventa respiratorie peste 30/min si un volum curent < 300 ml este o indicatie clara pentru continuarea suportului ventilator.



**Tehnici de desprindere de ventilator**

Procesul de desprindere de ventilator este unul de durata si presupune rabdare, perseverenta si se poate realiza prin mai multe metode. Una dintre metode este in **respiratie sponatana si tub in T** sau ventilatie CPAP si ventilatie spontana sau IMV cu reducerea progresiva a respiratiilor impuse si suport presional. Desprinderea de ventilator se realizeaza gradual la pacientii care au fost cu suport ventilator indelungat, la cei care au fost in stare critica de lunga durata, la cei care au forta musculara diminuata sau au o stare de nutritie precara. Se incepe cu deconectarea de pe ventilator doar de 15-30 minute si o singura data pe zi. Apoi aceste perioade se prelungesc progresiv, cu o supraveghere atenta si constanta, pana cand pacientul este deconectat pentru o perioada mai lunga de cat perioada de conectare. Urmatorul pas este reprezentat de deconectarea de ventilator pe toata durata zilei si apoi reconectarea in cursul noptii. In final pacientul este deconectat de suportul ventilator si in cursul noptii.

Parametrii care se monitorizeaza in cursul procesului de desprindere de ventilator sunt reprezentati de frecventa pulsului, tensiunea arteriala, frecventa respiratorie si alte semne care denota ventilatie ineficienta. Aparitia tahipneei peste 30 respiratii pe minut in cursul procesului de desprindere, arata oboseala musculaturii respiratorii si desprinderea de suportul ventilator trebuie intrerupta, amanata sau incetinita. De asemenea gazele arteriale trebuie sa se mentina la valori satisfacatoare in perioadele de ventilatie spontana. Scaderea $SpO_2$ sub 90% sau cresterea $PaCO_2$ peste 45 mmHg cand pacientul este in respiratie spontana sunt indicatori clari ca procesul de desprindere de ventilator trebuie incetinit (Tab. 4).

*Tab. 4. Criterii pentru toleranta la procesul de desprindere de suportul ventilator*

| Criteriul | Descrierea |
|---|---|
| Parametri obiectivi care indica succesul/toleranta | Gaze sanguine acceptabile ($SpO_2 \geq$ 85-90%; $PaO_2 \geq$ 50-60 mmHg; pH $\geq$ 7,32; crestere a $PaCO_2 \leq$ 10 mmHg)<br>Stabilitate hemodinamica (puls < 120-140/min; P nu se modifica > 20%; TAS < 180-200 mmHg; TAD > 90 mmHg, TA nu se modifica > 20%, fara vasopresoare)<br>Stabilitate respiratorie (FR $\alpha$ 30-35 resp/min) |
| Parametri clinici subiectivi care indica intoleranta | Schimbari ale statusului mental (somnolenta, coma, agitatie, anxietate)<br>Aparitia unui disconfort evident<br>Disforie<br>Semne de crestere a efortului respirator (intrarea in actiune a musculaturii accesorii, respiratie paradoxala) |



O alta metoda de desprindere de ventilator cu ajutorul tubului in T si sub stricta supraveghere, este reprezentata de **trialuri zilnice** pana cand pacientul respira eficient 60 de minute pe tubul in T (frecventa respiratorie, puls, TA si volum curent adecvate), apoi se poate extuba. Daca pacientul, dupa extubare, nu respira eficient se reintubeaza si se institue suport ventilator asistat/controlat pentru urmatoarele 24 de ore. Ziua urmatoare se repeta incercarea de desprindere de suportul ventilator. Aceasta metoda s-a aratat eficienta la pacientii care au fost pe suport ventilator in cursul a unei perioade de aproximativ o saptamana. Este totusi indoielnic ca aceasta metoda sa fie eficienta la pacientii ventilati mecanic pe perioade lungi de timp, de saptamani sau luni.

Primul criteriu care trebuie indeplinit in cazul procesului de desprindere de ventilator prin tehnica de respiratie spontana este siguranta pacientului. O prelungire exagerata a incercarilor de respiratie spontana, atunci cand nu sunt intrunite criteriile de toleranta duce la precipitarea oboselii musculaturii respiratorii, instabilitate hemodinamica, disconfort si alterarea schimburilor gazoase. De aceea se impune o monitorizare atenta in primele minute a trialului de respiratie spontana si de abia apoi se poate lua o decizie de continuare. Pacientul continua procesul de desprindere de suportul ventilator pentru 30 de minute, dar nu mai mult de 120 de minute. Nu s-au constatat diferente, in ceea ce priveste evolutia pacientilor, intre diferitele metode de

desprindere prin respiratie spontana, adica CPAP (5 $cmH_2O$), niveluri scazute ale suportului presional (5-7 $cmH_2O$) sau tubul in T (Tab. 5).

*Tab. 5. Protocol de desprindere de ventilator in respiratie spontana*

| |
|---|
| Se pozitioneaza pacientul ridicat in sezut |
| Se evita sedarea, in afara cazurilor in care pacientul este extrem de anxios |
| Se ataseaza tubul in T cu flux mare de oxigen umidifiat sau se mentine pacientul conectat la ventilator cu CPAP 5 cmH2O |
| Se continua daca nu apar semne de epuizare a musculaturii respiratorii |
| Daca nu se poate continua se revine la ventilatia mecanica initiala |
| Pacientii cu suport ventilator de scurta durata (sub 21 zile) se pot extuba dupa 30-120 de minute de respiratie spontana eficienta |
| In caz de nereusita nu se incearca decat o data /zi |
| La pacientii care au beneficiat de suport ventilator prelungit (peste 21zile), la cei care au dificultati cu eliminarea secretiilor, sau la cei care au avut nevoie de reintubatie, se extubeaza dupa 24 de ore de ventilatie spontana eficienta |



In unele centre se prefera ca procesul de desprindere de suportul ventilator sa foloseasca o tehnica care utilizeaza **modul de ventilatie IMV**. Astfel respiratiile impuse se reduc treptat pana cand pacientul respira spontan. Suportul presional este utilizat de asemenea pentru desprinderea de suportul ventilator, in special la pacientii cu BPOC. Se incepe cu un suport presional de 20 $cmH_2O$, apoi acesta se reduce treptat urmarindu-se volumul curent si frecventa respiratorie. Daca pacientul respira eficient cu un suport presional de 5 cm $H_2O$, el poate respira eficient si pe tubul in T.

Efectuarea unei traheostomii asigura un dispozitiv mai sigur de ventilatie mecanica si permite o mai mare flexibilitate in procesul de desprindere de suportul ventilator prin CPAP sau respiratie spontana. Prezenta tubului endotraheal la nivelul nasului sau cavitatii bucale poate cauza disconfort si anxietate, frustrare prin imposibilitatea de a comunica eficient si poate prelungi procesul de desprindere de suportul ventilator. Prezenta traheostomiei de obicei imbunatateste comunicarea pacientului scazand disconfortul si anxietatea. Dezumflarea partiala a balonasului sondei de traheostomie permite si vorbirea, chiar daca pacientul este inca pe suport ventilatilator cu presiune pozitiva. Un alt avantaj al traheostomiei rezida in faptul ca imbunatateste efortul respirator prin scaderea spatiului mort.

**Recomandari pentru desprinderea de suportul ventilator**

1. La pacientii care necesita ventilatie mecanica mai mult de 24 de ore, se impune investigarea si diagnosticarea tuturor cauzelor posibile care

determina dependenta de ventilator. Aceasta este cu atat mai important la pacientilor care incercarea de desprindere de suportul ventilator nu a avut succesul scontat (Grad B).

2. Pacientii care sunt pe suport ventilator mecanic pentru insuficienta respiratorie pot trece la un protocol de desprindere de ventilator daca indeplinesc urmatoarele criterii (Grad B):
   a. Cauza care a determinat insuficinta respiratorie s-a ameliorat sau a disparut
   b. Oxigenare adecvata ($PaO_2/FiO_2$ > 150-200, PEEP ≤ 5-8 cmH2O, FiO2 ≤ 0,4 - 0,5, pH ≥ 7,25)
   c. Stabilitate hemodinamica, fara semne de ischemie miocardica, absenta unei hipotensiuni semnificative (fara terapie vasopresoare sau cu doze mai mici de 5 µg/kg/min dopamina sau dobutamina)
   d. Pot initia un efort respirator eficient
3. Tentativa de desprindere de suportul ventilator initiat pentru insuficienta respiratorie trebuie sa se desfasoare in respiratie spontana si nu la pacientii care au nevoie de un suport ventilator mecanic substantial. Se utilizeaza o perioada scurta de respiratie spontana pt a determina capacitatea pacientului de a trece la o tehnica de desprindere in respiratie spontana. Criteriile care stau la baza aprecierii faptului daca pacientul tolereaza procesul de desprindere de suportul ventilator in respiratie spontana sunt reprezentate de paternul respirator, eficienta schimburilor gazoase, stabilitatea hemodinamica si confortul pacientului. Daca pacientul indeplineste criteriile, respira spontan, eficient 30-120 minute se poate lua in cosiderare desprinderea definitiva de ventilator (Grad A).
4. Decizia de extragere a protezarii cailor aeriene la un pacient care a fost cu succes desprins de suportul ventilator trebuie sa se bazeze pe aprecierea integritatii cailor aeriene si a capacitatii pacientului de a-si proteja calea aeriana (Grad C).
5. Pacientii care sunt pe suport ventilator mecanic pentru insuficienta respiratorie si care nu sunt capabili sa suporte cu succes un trial de desprindere de ventilator in respiratie spontana trebuie sa aiba o cauza pentru aceasta nereusita. Deindata ce cauza care a determinat insuficienta respiratorie s-a corectat si daca pacientul continua sa indeplineasca criteriile pentru desprinderea de suportul ventilator, incercari de desprindere in respiratie spontana trebuie efectuate zilnic, la fiecare 24 de ore (Grad A).
6. Pacientii care sunt pe suport ventilator mecanic pentru insuficienta respiratorie si care nu sunt capabili sa suporte cu succes un trial de

desprindere de ventilator in respiratie spontana trebuie sa primeasca un suport ventilator adecvat si stabil, neobositor si confortabil (Grad B).

7. La pacientii post-chirurgicali metodele de analgezie si sedare si metodele de ventilatie trebuie sa aiba ca si scop respiratia spontana si extubarea precoce (Grad A).
8. Este necesara realizarea unor protocoale pentru desprinderea de suportul ventilator destinate cadrelor medii din terapie intensiva. De asemenea este nevoie de realizarea si implementarea unor protocoale pentru sedare si analgezie in terapie intensiva (Grad A).
9. Realizarea unei traheostomii are indicatie dupa o perioada initiala de stabilizare pe suport ventilator, atunci cand devine evident ca pacientul va avea nevoie de suport ventilator prelungit. Traheostomia trebuie realizata atunci cand pacientul poate avea beneficii evidente dupa efectuarea sa. Pacientii care pot avea un beneficiu major din realizarea unei traheostomii precoce sunt: acei pacienti care necesita niveluri ridicate de sedare pentru a tolera tubul endotraheal; acei pacienti care au o mecanica respiratorie la limita si traheostomia le poate scadea efortul muscular respirator prin scaderea rezistentei cailor aeriene; aceia care au un beneficiu psihologic datorat faptului ca se pot alimenta pe cale orala, pot comunica prin limbaj articulat si se pot mobiliza eficient; la aceia la care imbunatatirea mobilizarii duce la ameliorarea eforturilor de fizioterapie (Grad B).
10. In afara situatiilor in care este clar ca insuficienta respiratorie este datorata unor afectiuni ireversibile (leziune superioara de maduva spinarii, scleroza laterala amiotrofica), un pacient care necesita suport ventilator mecanic de lunga durata pentru insuficienta respiratorie nu trebuie considerat dependent permanent de suport ventilator pana cand nu s-au efectuat incercari de desprindere de ventilator timp de 3 luni (Grad B).
11. Atunci cand exista un pacient stabil, la care nu s-a reusit desprinderea de suportul ventilator in terapie intensiva, acesta trebuie transferat intr-o sectie capabila sa preia pacientul dependent de suportul ventilator si sa continue ventilatia mecanica si incercarile de desprindere de suportul ventilator (Grad C).
12. Strategiile de desprindere de suportul ventilator la pacientii care au fost ventilati perioade lungi de timp trebuie efectuate cu rabdare, printr-un proces lent cu cresterea treptata a perioadelor de respiratie spontana (Grad C).

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