COMBINATION OF CENTRAL VENO-ARTERIAL CARBON DIOXIDE GAP WITH ARTERIO-VENOUS OXYGEN CONTENT DIFFERENCE DURING RESUSCITATION AS A PREDICTOR OF MULTI-ORGAN DYSFUNCTION IN SEPTIC PATIENTS

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ABSTRACT:

Background: Venous-to-arterial carbon dioxide difference (Pv-aCO2) the Pcv-aCO2/arterial-to-venous oxygen content difference (Ca-cvO2) ratio may reflect the adequacy of blood flow during shock states. We sought to test whether the development of Pv-aCO2 Pcv-aCO2/arterial-to-venous oxygen content difference ratio during the very early phases of resuscitation is related to multi-organ dysfunction and outcomes in a population of septic patients resuscitated targeting the usual oxygen-derived and hemodynamic parameters.

Aim of the Work: To evaluate the changes in central venous-to-arterial carbon dioxide difference (Pcv-aCO2 gap) and in Pcv-aCO2/arterial-to-venous oxygen content difference (Ca-cvO2) ratio [Pcv-aCO2/Ca-cvO2 ratio] during the early resuscitation in sepsis and septic shock as a predictor for development of multi-organ dysfunction and mortality.

Patients and Methods: This prospective observational study was performed in a 24-bed mixed ICU in a university-affiliated hospital. We examined all septic patients with a new episode admitted to the emergency room or proceeding from clinical wards during a 24-month period. After approval by Ethical Medical Committee and obtaining informed consent, simultaneous blood samples were collected from the central venous line and the arterial catheter for obtaining venous and arterial gases respectively at T0, and 6 hours (T6), 12 hours (T12) and 24 hours (T24) later. Patients were classified twice; the first one into groups (A and B) according to PcvO2 gap and the second one into groups (C and D) according to Pcv-aCO2/Ca-cvO2 ratio. Group (A) Decreasing Pcv-aCO2 (high at T0, declining at T6), Group (B) Persistently high Pcv-aCO2 (high at T0 and T6), Group (C) Decreasing Pcv-aCO2/Ca-cvO2 ratio (high at T0, declining at T6), Group (D) Persistently high Pcv-aCO2/Ca-cvO2 ratio (high at T0 and T6).

Results: During the 24-month period, 58 septic patients older than 18 years with a new episode were screened. Patients with advanced cirrhosis (n = 4), patients with severe chronic obstructive pulmonary disease (n = 8) and pregnant women (n = 4) were not included for analysis; additionally, two patients refused the procedure. The final sample was therefore 40 patients. Our recent study found that patients with persistently high Pcv-aCO2 gradient at T6 [8.64 ± 1.66] developed more organ dysfunction and have had a higher mortality rate (61.1%). This study showed that the persistently elevated Pcv-aCO2/Pa-vO2 ratio at time 6 was associated with a
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mortality rate of 73.7% of the patients. While decreasing of Pcv-aCO2/ Pa-vO2 ratio within the first 6 hours of resuscitation was associated with a survival rate of 90.5%.

Conclusion: Data support the hypothesis that persistence of high PCO2 Gap and high Pcv-aCO2/ Pa-vO2 ratio during the early resuscitation of patients in sepsis is associated with significant higher multi-organ dysfunction and poor outcomes in critically-ill patients.

Recommendations: Future studies on a larger number of patients are needed and should test PCO2 Gap and Pcv-aCO2/ Pa-vO2 ratio as a perfusion goal during early phases of the resuscitation of patients in septic shock to confirm its reliability.

Key words: Dysoxia - Septic Shock - PCO2 gap - Pcv-aCO2/ Pa-vO2 ratio - Organ Dysfunction - Clinical Outcome

INTRODUCTION:

Inadequate tissue perfusion is a factor in the pathogenesis and clinical course of multi-organ failure in the critically ill. Current techniques for monitoring tissue perfusion have largely focused on systemic blood flow and the balance between oxygen demand and supply. An early hemodynamic optimization that targets central venous oxygen saturation (ScvO2) and systemic hemodynamic parameters improves outcomes in severe sepsis and septic shock reinforcing the idea that tissue perfusion abnormalities are flow dependent at least during the very early stages. However, normalizing systemic hemodynamic parameters does not guarantee adequate tissue perfusion, and in fact a substantial number of patients still progress to multi-organ dysfunction and death despite meeting ScvO2 targets(1).

Moreover, some studies demonstrate that oxygen-derived parameters such as central venous oxygen saturation (ScvO2) are commonly normalized at ICU admission and maneuvers such as emergent intubation can quickly improve ScvO2 despite regional and tissue perfusion derangements(2).

In the past, authors described the coexistence of venous acidemia and increased venous carbon dioxide (CO2) during cardiac arrest in both animals and critically ill humans. Thereafter, increases in the venous-to-arterial carbon dioxide difference (Pcv-aCO2) were reported during hypovolemic, cardiogenic, obstructive, and septic shock. Interestingly, an inverse curvilinear relationship between Pcv-aCO2 and cardiac output was described, highlighting the importance of blood flow on venous CO2 accumulation. Pcv-aCO2 thus aroused clinical interest as a marker of global perfusion during shock states(3).

Other data suggest that high Pcv-aCO2 could identify septic patients who remain inadequately resuscitated despite achieving oxygen metabolism targets, reinforcing the notion of Pcv-aCO2 as a marker of global perfusion due to its ability to track blood flow alterations or even detect anaerobic CO2 generation(4).

Furthermore, patterns of recovery or derangement of Pcv-aCO2 during very early stages of resuscitation of septic shock have not been widely described and recent studies trying to demonstrate the reliability of Pcv-aCO2 as a tool in resuscitation of septic patients could have been influenced by selection bias because not all potential patients were elected to catheter insertion and goal-directed therapy(5).

In addition, some authors have suggested that correcting the Pcv-aCO2 gap by an approximation of the oxygen consumption, the Pcv-aCO2/arterial-to-venous
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oxygen content difference (Ca-cvO\textsubscript{2}) ratio, might be superior to the Pcv-aCO\textsubscript{2} gap to detect anaerobic metabolism, and therefore should be a more reliable parameter to guide the resuscitation process\textsuperscript{(6)}.

**PATIENTS AND METHODS:**

This prospective observational study was performed in a 24-bed mixed ICU in a university-affiliated hospital. We examined all septic patients with a new episode admitted to the emergency room or proceeding from clinical wards during a 24-month period. Patients were excluded if they were younger than 18 years old, pregnant, had severe chronic obstructive pulmonary disease, advanced liver cirrhosis (Child–Pugh C), chronic renal failure on regular dialysis, Patients with Pcv-aCO\textsubscript{2} gap less than 6 mmHg, Patients with Pcv-aCO\textsubscript{2}/Ca-cvO\textsubscript{2} ratio less than 1.4 and Patients already enrolled in another study.

**General management:**

All patients were evaluated by the Intensive Care Unit rapid response team according to our local procedures. Each patient was equipped with an arterial cannula and a central venous catheter. Our early goal-directed therapy included a bundle of interventions that sought to obtain: mean arterial pressure $\geq$ 65 mmHg; urine output $\geq$ 0.5 ml/kg/minute; normalization of serum lactate; and ScvO\textsubscript{2} $\geq$ 70\%. The use of vasopressors was standardized to maintain a mean arterial pressure $\geq$ 65 mmHg, and repeated fluid challenges with crystalloids or colloids were used to optimize the stroke volume as well as to allow the lowest dose of vasopressors. Dobutamine was added for persistent ScvO\textsubscript{2} $\leq$ 70\% after fluid resuscitation if hematocrit was less than 30\%. A low dose of 50 mg of hydro-cortisone was given within 6 hours of resuscitation when use of vasopressors persisted after an adequate fluid restitution. Mechanical ventilation was provided when needed under light sedation (midazolam) and analgesia (fentanyl); the tidal volume was limited to 6 to 8 ml/kg. Finally, stress ulcer and venous thrombosis prophylaxis were provided according to international recommendations.

**Study protocol:**

This study was done after approval by Ethical Medical Committee and obtaining informed consent. A written informed consent was waived because no new therapeutic interventions were performed and all measurements and procedures routinely followed the local protocols for the management of septic patients. Simultaneous blood samples were collected from the central venous line and the arterial catheter for obtaining venous and arterial gases respectively and also lactate measurements at T0, and 6 hours (T6), 12 hours (T12) and 24 hours (T24) later. Measured variables included arterial oxygen tension (PaO\textsubscript{2}), arterial carbon dioxide tension (PaCO\textsubscript{2}), central venous oxygen tension (PcvO\textsubscript{2}), central venous carbon dioxide tension (PcvCO\textsubscript{2}), arterial oxygen saturation (SaO\textsubscript{2}) and central venous oxygen saturation (ScvO\textsubscript{2}). Furthermore, SOFA Score was measured daily.

Pcv-aCO\textsubscript{2} was defined as the difference between the central venous CO\textsubscript{2} partial pressure and the arterial CO\textsubscript{2} partial pressure. The arterial oxygen content (CaO\textsubscript{2}), central venous oxygen content (CcvO\textsubscript{2}), arterial-venous oxygen content difference (Ca-cvO\textsubscript{2}), and Pcv-aCO\textsubscript{2}/Ca-cvO\textsubscript{2} ratio were calculated according to the following formulas:\textsuperscript{(7)}

\[
\begin{align*}
\text{CaO}_2 &= (1.34 \times \text{SaO}_2 \times \text{Hb}) + (0.003 \times \text{PaO}_2) \\
\text{CcvO}_2 &= (1.34 \times \text{ScvO}_2 \times \text{Hb}) + (0.003 \times \text{PcvO}_2) \\
\text{Ca-cvO}_2 &= \text{CaO}_2 - \text{CcvO}_2 \\
\text{Pcv-aCO}_2 \text{ gap} &= \text{PcvCO}_2 - \text{PaCO}_2 \\
\text{Pcv-aCO}_2/\text{Ca-cvO}_2 \text{ ratio} &= \frac{\text{Pcv-aCO}_2}{\text{Ca-cvO}_2}
\end{align*}
\]
Patients were classified twice; the first one into groups (A and B) according to Pcvo2 gap and the second one into groups (C and D) according to Pcv-aCO2/Ca-cvO2 ratio. Group (A) Decreasing Pcv-aCO2 (high at T0, declining at T6), Group (B) Persistently high Pcv-aCO2 (high at T0 and T6), Group (C) Decreasing Pcv-aCO2/Ca-cvO2 ratio (high at T0, declining at T6), Group (D) Persistently high Pcv-aCO2/Ca-cvO2 ratio (high at T0 and T6)

**Data analysis:**

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when parametric and median with inter-quartile range (IQR) when non-parametric and percentiles were used to assess the distribution of some parameters. Also, qualitative variables were presented as number and percentages.

The comparison between groups regarding qualitative data was done by using **Chi-square test** and/or **Fisher exact test** when the expected count in any cell found less than 5. The comparison between two independent groups with quantitative data and parametric distribution was done by using **Independent t-test** while with non-parametric distribution was done by using **Mann-Whitney test**. Also, receiver operating characteristic curve (ROC) was used to assess predictors of mortality at 28 day with its sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and area under curve (AUC). The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: P-value > 0.05: Non significant (NS), P-value < 0.05: Significant (S), P-value < 0.01: Highly significant (HS)

**RESULTS:**

During the 24-month period, 58 septic patients older than 18 years with a new episode were screened. Patients with advanced cirrhosis (n = 4), patients with severe chronic obstructive pulmonary disease (n = 8) and pregnant women (n = 4) were not included for analysis; additionally, two patients refused the procedure. The final sample was therefore 40 patients.

Patients’ characteristics of group A and B showed no statistically significant difference between the two groups regarding gender and age (Table 1).

| Table (1): Patient’s characteristics of groups A and B: |
|---------------------------------|-----------------|-----------------|------|------|---|
|                                | Group A         | Group B         | P-value | Sig. |
|                                |                 |                 |        |      |
| No. = 22                       | No. = 18        |                 |        |      |
| Gender                        | Females (Number and %) |                  |        |      |
|                               | 13 (59.1%)      | 13 (72.2%)      | 0.386* | NS   |
|                               | Males (Number and %) |            |        |      |
|                               | 9 (40.9%)       | 5 (27.8%)       |        |      |
| Age (years)                   | Mean ± SD       |                 |        |      |
|                               | 66.27 ± 12.38   | 67.28 ± 11.34   | 0.792* | NS   |

The need of inotropes was 16 (72.7%) Vs. 16 (88.9%) in groups A and B respectively and mechanical ventilation was 8 (36.4%) Vs. 12 (66.7%) in groups A and B respectively. There no statistically significant difference between groups (A & B) regarding need of inotropes and mechanical ventilation (Diagram 1).
Combination of central veno-arterial carbon dioxide gap with arterio-venous oxygen content ...

Diagram (1): Need of Inotropes and Mechanical ventilation in groups A and B.

The number of organs dysfunction was significantly lower in group A (2.20±1.57) compared to group B (3.93±1.77) (Table 2). The total length of stay was comparable between the two groups (7.55±4.52) in group A and (8.33±5.03) in group B (Table 2). However, mortality was significantly higher in group B 11(61.1%) compared to group A 6(22.7%) (Table 2). Number of organs dysfunction was compared between groups A and B Diagram 2) with more patients in group A suffering from one organ dysfunction 8 (36.4%) while more patients in group B suffered 5 organ dysfunctions 5 (27.8%).

Table (2): Number of Organ dysfunction, length of total stay and mortality in groups A and B:

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>P-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. = 22</td>
<td>No. = 18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of organs dysfunction</td>
<td>Mean ± SD</td>
<td>2.20 ± 1.57</td>
<td>3.93 ± 1.77</td>
<td>0.010*</td>
</tr>
<tr>
<td>Length of total stay (days) (Intensive care unit and hospital stay)</td>
<td>Mean ± SD</td>
<td>7.55 ± 4.52</td>
<td>8.33 ± 5.03</td>
<td>0.605*</td>
</tr>
<tr>
<td>Mortality at 28 day (Number and %)</td>
<td>5 (22.7%)</td>
<td>11 (61.1%)</td>
<td>0.014*</td>
<td>S</td>
</tr>
</tbody>
</table>

Diagram (2): Number of Organ dysfunction in groups A and B.
SOFA Score in groups A and B showed statistically significance difference on the 3rd day being significantly lower in group A {4.5(3-7)} than in group B {8(3-12)} (Diagram 3).

Diagram (3): SOFA Score distribution in groups A and B.

Also, for the two groups C and D, there was no statistically significant difference between the two groups regarding gender and age (Table 3). Group C and D showed comparable results in the need of inotropes. it was 15(71.4%) Vs. 17 (89.5%) in groups C and D respectively. However, the need of mechanical ventilation was significantly higher in group D 14(73.3%) compared to group C 6(28.6%) (Diagram4).

Table (3): Patients characteristics in group C and D:

<table>
<thead>
<tr>
<th></th>
<th>Group C</th>
<th>Group D</th>
<th>P-value</th>
<th>Sig.</th>
</tr>
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<tbody>
<tr>
<td>No. = 21</td>
<td>No. = 19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females (Number and %)</td>
<td>13 (61.9%)</td>
<td>13 (68.4%)</td>
<td>0.666</td>
<td>NS</td>
</tr>
<tr>
<td>Males (Number and %)</td>
<td>8 (38.1%)</td>
<td>6 (31.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>Mean ± SD</td>
<td></td>
<td>0.126</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>64.00 ± 11.27</td>
<td>69.74 ± 11.89</td>
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</tr>
</tbody>
</table>

Diagram (4): Need of inotropes and need of mechanical ventilation in group C and D.

The number of organs dysfunction was significantly lower in group C (1.62±1.19) compared to group D (4.19±1.47), also the mortality was significantly lower 2(9.5%) in group C versus 14(73.3%) in group D (Table 3). More patients in group C suffered from one organ dysfunction 9(42.9%) while more patients in group D suffered from 5 organ dysfunction 6(31.6%) (Diagram 5).
Combination of central veno-arterial carbon dioxide gap with arterio-venous oxygen content …

Table (4): Number of Organs dysfunction, length of total stay and mortality in group C and D:

<table>
<thead>
<tr>
<th></th>
<th>Group C</th>
<th>Group D</th>
<th>P-value</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Organ dysfunction</td>
<td>No. = 21</td>
<td>No. = 19</td>
<td>0.000•</td>
<td>HS</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td>Mean ± SD</td>
<td>1.62 ± 1.19</td>
<td>4.19 ± 1.47</td>
<td></td>
</tr>
<tr>
<td>(Intensive care unit and hospital stay)</td>
<td></td>
<td>8.19 ± 4.55</td>
<td>7.58 ± 4.99</td>
<td>0.687•</td>
</tr>
<tr>
<td>Mortality at 28 day (Number and %)</td>
<td>2 (9.5%)</td>
<td>14 (73.7%)</td>
<td>0.000/</td>
<td>HS</td>
</tr>
</tbody>
</table>

Diagram (5): Distribution of organ dysfunction in group C and D.

SOFA Score in group C and D showed statistically significance difference on the 3rd day being significantly lower in group C {4(3-7)} than in group D {10(3-12)} (Diagram 6).

Diagram (6): SOFA Score in group C and D.

Pcv-aCO₂ Gap had diagnostic performance in prediction of death, with sensitivity 100%, 87.5%, 76.9% at T6 , T12, T24 respectively and specificity 50% , 75%, 82.4% at T6 , T12, T24 respectively (Table 5 and Diagram 7).
Table (5): Receiver operating characteristic curve (ROC) for Pcv-a CO\textsubscript{2} Gap at T6 and T12 as predictors for mortality

<table>
<thead>
<tr>
<th></th>
<th>Cut off point</th>
<th>AUC</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6</td>
<td>&gt;6</td>
<td>0.773</td>
<td>100</td>
<td>50</td>
<td>57.1</td>
<td>100</td>
</tr>
<tr>
<td>T12</td>
<td>&gt;6.4</td>
<td>0.852</td>
<td>87.5</td>
<td>75</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>T24</td>
<td>&gt;5.9</td>
<td>0.821</td>
<td>76.9</td>
<td>82.4</td>
<td>76.9</td>
<td>82.4</td>
</tr>
</tbody>
</table>

Pcv-aCO\textsubscript{2}/Ca-cvO\textsubscript{2} ratio had perfect diagnostic performance in prediction of death, with sensitivity 81.25%, 100%, 93.75% at T6, T12, T24 respectively and specificity 83.33%, 66.67%, 37.5% at T6, T12, and T24 respectively (Table 6 and Diagram 8).

Diagram (7): Receiver operating characteristic curve (ROC) for Pcv-a CO\textsubscript{2} Gap at T6 and T12 as predictors for mortality

Diagram (8): Receiver operating characteristic curve (ROC) for Pcv-aCO\textsubscript{2}/Ca-cvO\textsubscript{2} ratio at T6, T12 and T24 as predictors for mortality.
Combination of central veno-arterial carbon dioxide gap with arterio-venous oxygen content …

Table (6): Receiver operating characteristic curve (ROC) for Ratio at T6 and T12 and T24 as predictors for mortality

<table>
<thead>
<tr>
<th>Cut off point</th>
<th>AUC</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6</td>
<td>&gt;1.9</td>
<td>0.883</td>
<td>81.25</td>
<td>76.5</td>
<td>87.0</td>
</tr>
<tr>
<td>T12</td>
<td>&gt;1.6</td>
<td>0.845</td>
<td>100.0</td>
<td>66.7</td>
<td>100.0</td>
</tr>
<tr>
<td>T24</td>
<td>&gt;1.3</td>
<td>0.637</td>
<td>93.75</td>
<td>37.5</td>
<td>90.0</td>
</tr>
</tbody>
</table>

DISCUSSION:

We studied a cohort of patients during the very early phases of septic shock who were subjected to a comprehensive resuscitation aimed to target the usual hemodynamic and oxygen metabolism parameters. Our study found that patients with persistently high Pcv-aCO2 gradient at T6 [8.64 ± 1.66] developed more organ dysfunction and have had a higher mortality rate (61.1%).

In concordance with our study, Ospina and his colleagues studied 108 patients with septic shock, they measured Pcv-aCO2 gradient at time 0 and after 6 hours, they found that those with persistently high Pcv-aCO2 gradient at T6 [7.0 (5.8 to 9.7)] developed more organ dysfunction assessed by SOFA score at day-3 (P <0.001), than patients evolving with normal Pcv-aCO2 gradient during the first 6 hours of resuscitation [4.4 (2.7-5.4)]. Additionally, they observed that persistently high Pcv-aCO2 gradient were associated with a lower survival at day-28 (9).

On the other hand, a study done by Van Beest and his colleagues recruited 60 patients with septic shock. They measured Pcv-aCO2 gradient at time 0 and after 6 hours. They found a higher Pcv-aCO2 gradient at Time 0 (6.5±3.0 vs. 3±1.8, P <0.001) and Time 6 (8±4 vs. 3±2, P <0.001) in non survivors vs. survivors respectively (5).

Regarding Pcv-aCO2/ Pa-vO2 ratio:

Our study showed that the persistently elevated Pcv-aCO2/ Pa-vO2 ratio at time 6 was associated with a mortality rate of 73.7% of the patients. While decreasing of Pcv-aCO2/ Pa-vO2 ratio within the first 6 hours of resuscitation was associated with a survival rate of 90.5%.

Monnet and his colleagues found that ratio of the central venous-to-arterial CO2 tension difference (ΔPCO2) over the arterial-to-venous oxygen content difference (ΔContO2), predicted an increase in VO2 after a fluid-induced increase in DO2 and thus, can be able to detect the presence of global tissue hypoxia (10).

Our study supports the notion that serial measurements of the Pcv-aCO2/ Pa-vO2 ratio during resuscitation may serve as surrogate markers of the payment of the oxygen debt.

It was also observed in our study that Pcv-aCO2/ Pa-vO2 ratio is superior to Pcv-aCO2 in detecting organ dysfunction and mortality.

In concordance with our study Huai-wu and his colleagues found that The Pcv-aCO2 gap and Pcv-aCO2/ Pa-vO2 ratio were significantly and negatively related to the lactate clearance (11).
Mallat and his colleagues studied eighty patients with septic shock and found that decreasing Lactate level alone was an independent predictor of 28-day mortality. Also, they found that Monitoring PCO2 may be a useful tool to assess the adequacy of tissue perfusion during resuscitation in combination with lactate level(12).

**Conclusion and recommendations**

Data support the hypothesis that persistence of high PCO2 Gap and high Pcv-aCO2/Pa-vO2 ratio during the early resuscitation of patients in sepsis is associated with significant higher multi-organ dysfunction and poor outcomes in critically-ill patients.

**References:**

استخدام الفرق بين ضغط ثاني أكسيد الكربون الوريدي المركزي الشرياني والفرق بين محتمي الأكسجين الشرياني- الوريدي خلال الإعاص كعمل تتنوي لاحل الأعضاء الوظيفي في مرضى الإصابة التسممية

عمرو محمد السيد، عادل محمد الأنصاري، محمد عبد السلام الجندى، هالة صلاح الدين العزيرى:

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مقدمة: يعتبر زيادة فرق ضغط الدم الوريدي، الشرياني ثاني أكسيد الكربون جزءاً دائماً مهمًا في تقييم قيمة على نقص أكسجة الأنسجة في حالات الصدمة (نقص الأكسجة الدماغية) الصعوبة المتزايدة في الناتج النهائي لها من علاقة عكسية مع مؤشر القلب. تشير البيانات الأخيرة أن ارتفاع فرق ضغط الدم الوريدي، الشرياني ثاني أكسيد الكربون سواء في تحديد مرضى الصدمة التسممية الذين لم يتم اكتشافهم بشكل كاف على الرغم من تحقيق أهداف عملية اضطراب الأكسجين، كما يتم اكتشاف الكتل في أكسجة الأنسجة بشكل عام أو بشكل موضعياً خذل السلبية فق الكبد من أجل الجسم، والنظر إلى نسبة الفرق بين محتمي الأكسجين الشرياني الوريدي، على ضغط الدم الوريدي، الشرياني ثاني أكسيد الكربون يمكن أن يتم كصلاحية لتكبير الجسم خلال حالات الصدمة المختلفة. وقد وجد أن زيادة فرق ضغط الدم الوريدي، الشرياني ثاني أكسيد الكربون وفرق بين محتمي الأكسجين الشرياني الوريدي على ضغط الدم الوريدي، الشرياني ثاني أكسيد الكربون مرتبط بفشل الأعضاء وزيادة معدل الوفيات لمرضى الحالات الحمراء.

الهدف من العمل: تهدف هذه الرسالة إلى تقديم قيمة التغير في فرق ضغط الدم الوريدي، الشرياني ثاني أكسيد الكربون وفرق بين محتمي الأكسجين الشرياني الوريدي خلال الإعاص في مرضى التسمم الشديد والصدمة التسممية باعتباره مؤشرًا لحدث إخبار وظيفي للأعضاء ويعزى معدل الوفيات.

المرضى وطرق البحث: تم تنفيذ هذه الدراسة في قسم وحدة العناية المركزية في مستشفى التعليمي بجامعة مصر للعلوم والتكنولوجيا تألفت دراستنا من 150 مريضاً تم حجزهم في وحدة العناية المركزية بحالة من أنتان بالدم، وأنتان ضعيف بالدم وصدمة أنتان. تم الحصول على عينة الدم الشرياني والوريدي المركزية في وقت واحد مساح فرق في الضغط الوريدي، والشرياني لقالي ثاني أكسيد الكربون، نسبة الفرق بين محتمي الأكسجين الشرياني الوريدي على ضغط الدم الوريدي، الشرياني لقالي ثاني أكسيد الكربون واللاكتات في وقت داخل المريض، وبعد ساعتين و 12 ساعة، و 24 ساعة. ثم تم تتبع المرضى عن طريق SOFA score وقش النصائح. وتم حساب الوفيات في اليوم الثاني والعشرين.

النتائج: كشفت نتائجنا أن هناك علاقة قوية بين الفرق في الضغط الوريدي، الشرياني لقالي ثاني أكسيد الكربون، ونسبة الفرق بين محتمي الأكسجين الشرياني الوريدي على ضغط الدم الوريدي، الشرياني لقالي ثاني أكسيد الكربون والنتائج المرتبطة. كما نلاحظ أن نسبة الفرق بين محتمي الأكسجين الشرياني الوريدي على ضغط الدم الوريدي، الشرياني لقالي ثاني أكسيد الكربون يمكن أن تكون فائلاً، ولكن الفترات الفائقة في النتائج comparable

الملاحظات والتصويت: نسبة الفرق بين محتمي الأكسجين الشرياني الوريدي على ضغط الدم الوريدي، الشرياني لقالي ثاني أكسيد الكربون يمكن أن يكون أفضل من الفرق في الضغط الوريدي، الشرياني لقالي ثاني أكسيد الكربون كالة ممتازة في التنبؤ بالوفاة.