CORRELATION BETWEEN PROCALCITONIN AND EFFICACY OF ANTIBIOTIC THERAPY

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ABSTRACT

In this paper we have examined the case of a patient admitted to the ICU for about four months with initial diagnosis of severe respiratory failure, which in the course of hospital stay was subject to multiple outbreaks. We dosed daily procalcitonin, whose values have always correlated with the patient's infectious status allowing, together with clinical and microbiological data, prompt antibiotic treatment and a highlight of the phenomenon of antibiotic resistance.

***Key words**: Infection, bacteremia, monitoring, resistance, antibiotic therapy.*

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Introduction

The procalcitonin (PCT), pro-hormone of calcitonin, secreted by many somatic cells in response to an inflammatory stimulus of bacterial origin, is subjected to a strict regulation which causes an increase only in response to a stimulus of inflammatory origin, with induction times ranging between 2-6 hours[1]. Its plasma concentration in healthy individuals is very low, <0,05 ng/mL, while all values above are considered pathological[2]. The values that exceed 2 ng or 10 ng/mL, arouse even more concern because, if corroborated by clinical data, form the basis for suspecting a worsening of prognosis[3-4]. The daily dosage of PCT led, whenever are used algorithms of administration PCT guided[5], to a real reduction in the time of antibiotic treatment, that are passed from an average of 8,3 to 6,6 days with a reduction of the costs of 17,8%[6]. The aim of our work was to highlight how the dosage of PCT, routinely performed, early correlated with the infection status of the patient examined, allowing us, in conjunction with clinical and microbiological data, to modulate early antibiotic therapy.

Case report

A caucasian patient 74 years old, weight 70 kg, height 155 cm, came to our observation at the Intensive Care Unit (ICU) of the AOU Policlinico-Vittorio Emanuele of Catania in February 2013, with diagnosis of severe respiratory failure. The patient was transferred from P.S. of AO Garibaldi, where she arrived at 05:30, carried by 118, for respiratory arrest with ventricular repolarization disturbance with T negative, but there is no documentation on the duration of the arrest. When the patient was admitted she presents afebrile, intubated by the oral-tracheal tube and connected to a mechanical ventilator, hemodynamically stable, with dieresis present although pharmacologically boosted. We proceed, therefore, the monitoring of the vital signs, administration of drug therapy and routine blood tests. It establishes, in addition, empirical antibiotic treatment with broad-spectrum molecules. In this regard we also perform nasal and pharyngeal swabs, bronchial aspirate, urine culture and blood culture.The latter showed an infection with methicillin-resistant staphylococcus aureus (MRSA), in agreement with the overall clinical state of the patient, so we start immediately targeted

antibiotic therapy. As the first infection takes over, however, in the second week, the patient developed an Acinetobacter baumannii complex infection, isolated initially only in swab and then, subsequently, also in blood culture. The positivity to this bacterium continues throughout the duration of hospitalization, because of multiple resistance phenomena, due to the characteristics of the germ present.

In agreement with the results of susceptibility testing, therefore, has been repeatedly modified therapy with the use of different antibiotics;

- Piperacillina - Tazobactam / Claritromicina
- Rifampicina / Colistina
- Tigeciclina / Gentamicina
- Ciprofloxacina / Colistina

Given the continued severity of the clinical status, the patient undergoes exitus for cardiac arrest after nearly 4 months of hospitalization. Throughout his stay in the ICU were performed repeated doses of PCT to establish the correlation of this data with the infection status and any changes in antibiotic therapy. For the quantitative determinations of PCT was used the tool VIDAS BRAHMS PCT of Biomérieux, which uses an immunometric method, and can provide results in 20 minutes with a high degree of specificity and sensitivity. The samplings were performed daily on serum tube, using 200 micro/L of plasma.

Discussion

The hospitalization of the patient turns out to be long and complex, but through the tests performed regularly we can identify 4 peaks in the dosage of PCT, all related to the aforementioned phenomena of resistance and therefore of poor antibiotic efficacy. In order, also, to make the results more evident a comparison between the curves of PCT and those of white blood cells (WBC) was performed. The first graph (Figure 1) shows us the evolution of PCT and white blood cells in a period between 8 and 15 February.

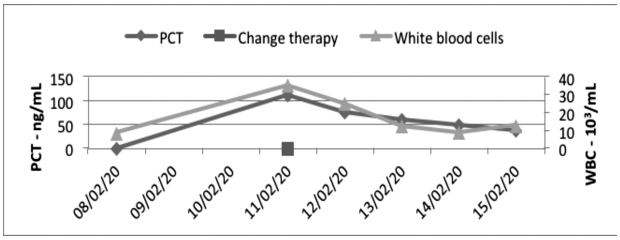

Figure 1: Graph inherent in the first peak of PCT detected in 62 Matchday.

During this period, both values examined reach their maximum concentration 11th of the same month, then decrease gradually. The change of trend is probably due to the modification of antibiotic therapy occurred more day 11, based on the results of bacteriological analysis, which confirmed the presence of Acinetobacter baumannii complex (throat swab, nasal and bronchial aspirate) and Escherichia coli (blood culture).

Like its predecessor, the chart below (Figure 2) examines PCT and white blood cells, but this time in a period between 15 and 25 February. It is always recognizable a strong correlation between the performance of PCT and white blood cells, since both decrease gradually after the change of antibiotic carried out on 19. The choice of the new antibiotic was performed following bacteriological analysis that has established the presence of Acinetobacter baumannii complex in throat swab, nasal and bronchial aspirate.

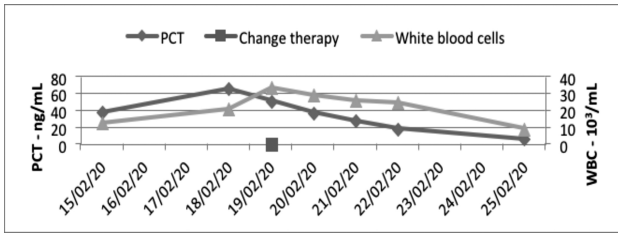

Figure 2: Graph inherent in the second peak of PCT detected in 69 Matchday.

The third graph (Figure 3) in question refers, instead, for a period ranging from 11 to 18 March. The PCT reflects what has been said up to now and it decreases when therapy changes, but this time there is no correlation with white blood cells, which have a more fluctuating trend, depending on their non-specificity. The bacteria found were Pseudomonas aeruginosa and Acinetobacter baumannii complex, whose presence is confirmed by throat swab, nasal and bronchial aspirate.

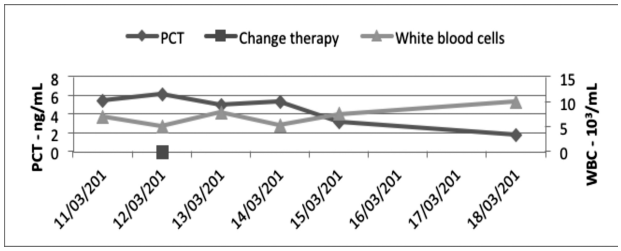

Figure 3: Graph inherent in the third peak of PCT detected in 91 Matchday.

The last graph (Figure 4), finally, refers to a period between 18 and 25 March. This is probably the one in which the relationship between PCT and WBC is most visible, since they both reach the peak in 19 and 20 and then decreases immediately after the change of antibiotic occurred on the same dates. Again swabs and bronchial aspirate confirm the presence of Acinetobacter baumannii complex.

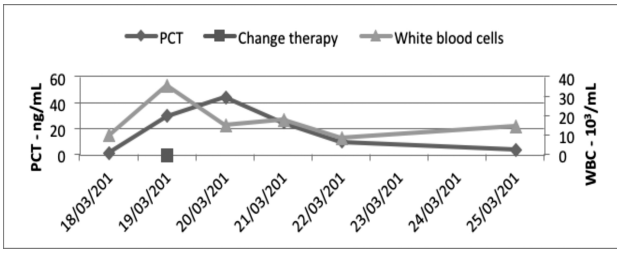

Figure 4: Graph inherent in the fourth peak PCT detected in 99 Matchday.

As is apparent from retrospective data analysis of patient studied, we can observe how the PCT concentration increases proportionally to the onset of bacterial resistance and then decreases once changed the antibiotic. From these graphs it can be seen, therefore, the strong correlation that exists between the two phenomena, since not only the PCT increases in case of resistance, witnessing the spread of bacterial infection, but it decreases after changing therapy, a clear sign that the new antibiotic chosen is working. This is probably due to the fact that once the resistance developed the bacterium is no longer subject to antibiotic action for which begins to multiply, spreading the infection and with it the inflammation.

Conclusions

Thanks to our experience in the clinical case study we were able to observe and validate the importance of daily assessment of the PCT assumes in patients in ICU[7]. The increase or decrease of it can be of help then, in conjunction with clinical data, to monitor antibiotic therapy, both optimizing the duration, both highlighting in an early and sensitive any phenomena of antibiotic resistance, frequently present in this type of patients[8].

References

1) Panteghini M. "*Procalcitonina: tra evidenze e criticità*", Biochimica Clinica, 2013, *12-14*.
2) G. La Camera e coll. "V*alutazione del livello plasmatico di procalcitonina in pazienti neutropenici con iperpiressia*", Atti XXIX Congresso Nazionale AIEOP – su Quaderni di Pediatria vol. 1- n.2- 2002, Montesilvano (Pescara), Maggio 2002.
3) G. La Camera e coll. "*Prognostic role of procalcitonin in the early detection of patients at risk of post-operative infection*", Acta Medica Mediterranea, vol XXVIII, N 2, 2012.
4) Rücker G, Schumacher M."*Procalcitonin as diagnostic marker for sepsis*", Lancet Infect Dis, 2013 Dec, 13(12): 1012-3. doi: *10.1016/S1473 - 3099(13)70303-7*.
5) Agarwall R, Schwartz D. "*Procalcitonin to Guide Duration of Antimicrobial Therapy in Intensive Care Units: A Systematic Review*", Healthcare Epidemiology, 2011 Aug 15, *379-387*.
6) Schuetz P, Chiappa V, Briel M, Greenwald JL. "*Procalcitonin algorithms for antibiotic therapy decisions: a systematic review of randomized controlled trials and recommendations for clinical algorithms*", Arch Intern Med, 2011 Aug 8, *1322-31*.
7) G. La Camera e coll. "*Il dosaggio della PCT quale parametro di monitoraggio e prognostico per malattie a rischio in UTI*", Atti 4° Congresso Regionale A.S.D.A - Siracusa, Ottobre 2000.
8) Annane D, Maxime V, Faller J, Mezher C, Clec'h C, Martel P, Gonzales H, Feissel M, Cohen Y, Capellier G, Gharbi M, Nardi O. "*Procalcitonin levels to guide antibiotic therapy in adults with non-microbiologically proven apparent severe sepsis: a randomized controlled trial*", BMJ Open, 2013 May 8.

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