Near-patient testing: the advantages of C-Reactive Protein in haematological testing

by Prof. J-F Rossi

C-Reactive Protein (CRP) is an acute-phase protein that has long been recognised as a marker of systemic inflammation. Its assay is commonly used as a clinical laboratory test, as CRP measurement can complement a range of diagnostic markers to monitor infection and direct treatment. However, as economic rationalisation becomes a necessity throughout the healthcare sector, it is apparent that such areas of frequent laboratory testing may need careful consideration and revision. Haematology is just one of these areas that deserves attention. We assess whether near-patient testing cannot only reduce costs, but also improve patient diagnosis, treatment and recovery time.

Complete Blood Count (CBC) and CRP measurement are two possible haematological tests that could be relocated from the clinical laboratory to the patient’s bedside. CBC forms an integral part of the semiology in haematology and guides numerous therapeutic interventions.

CRP, an acute-phase plasma protein, is phylogenetically highly conserved and produced by hepatocytes. It is involved in the innate inflammatory response and is a well known marker of systemic inflammation. CRP is secreted rapidly, within a few hours of the immunological insult, upon activation by specific cytokines. These cytokines can work directly or indirectly on hepatocytes to stimulate secretion, e.g. by interleukin 6 (IL-6) or Tumour Necrosis Factor (TNF) under the control of IL-6, respectively. CRP is, therefore, a particularly sensitive and interesting tool for monitoring inflammatory conditions and has numerous clinical applications. CRP measurement is used in the monitoring of adult and neonatal infection and immune disorders, and is also an approved risk marker for cardio-vascular disease.

Clinical situations

CBC and CRP measurement are useful tests which are carried out, on average, 15 times during the period of a patient’s hospitalisation, particularly during intensive chemotherapy. The risk of aplasia is associated with chemotherapy, with the subsequent threat of infection and possible need for blood transfusion.

Aplasia

Bone marrow aplasia is defined by the presence of pancytopenia in the peripheral blood compartment and is detected with a CBC. The severity of bone marrow aplasia is defined by two parameters: the extent and the duration of cytopenias, particularly neutropenia. There is a clear relation between these two parameters and the incidence of infection, which is high after one week of polynuclear levels below 500/mm³. The same applies to thrombopenia and the risk of bleeding, which increases with platelet counts below 30,000/mm³, and becomes more serious as counts drop further. A distinction is made between short-term aplasia (<1 week) and long-term aplasia (>1 week).

Anti-infection strategies take into account the expected duration of the aplasia, its conditions of onset (e.g. during leukaemia induction therapy, which may be associated with a pre-existing infection), and fever monitoring, associated with pathogen identification in 25–30% of cases only, leading to emergency requirements in some instances.

This is where the experience of haematology intensive care centres is essential. Based on permanent clinical analysis and a few simple laboratory tools, such as CBC and CRP measurement, concise decisions on patient management can be made.

CRP measurement is an excellent tool for use in monitoring infection profiles as its increase in expression correlates with temperature fluctuations during fever [Figure 1]. This allows a dynamic analysis of the infection progression and can consequently lead to more accurate and prompt administration of antibiotic treatment, or withdrawal of antibiotic therapy if required [1]. Conversely an observed drop in CRP levels and a rise in white blood cells (WBC) [Figure 2] can allow an earlier patient discharge. The combination of CRP and CBC analyses can therefore improve the follow-up of aplasia patients who may have other haematological diseases.

Thus, relocating these simple laboratory tests “closer to the patient’s bedside” is very straightforward as it provides reliability, simplicity and a quick turnaround of samples. Used as part of a cost-control plan, near patient CRP and CBC testing can reduce the costs associated with inappropriate antibiotic treatment and prolonged hospital stays. Moreover, results are comparable to those achieved in a laboratory.

Recent data [1] comparing results of near-patient and centralised laboratory-based tests for CRP and CBC analysis have demonstrated a clear correlation between the two, as well as a significant reduction in the turnaround time from sampling to result delivery in the former [Figures 3, 4]. Thus the relo-
cation of such tests would not compromise the accuracy of results, but may offer distinct advantages compared with centralised laboratory-based tests.

Transfusion management

Blood transfusions are performed regularly in patients with chronic bone marrow failure such as myelodysplasia. The management of conventional chemotherapy, with procedures such as blood transfusions, is based on a certain number of laboratory results. Transfusion strategies (red blood cells and platelet concentrates) rely on almost daily CBC monitoring in addition to screening for irregular agglutinins in transfusion cases or measuring markers of other vital functions in chemotherapy cases. In this context, the processing of such fundamental aids to decision making as the CBC and the CRP test may benefit from being closer to the patient, and there may be situations where CBCs must be double-checked or combined with a CRP assay.

Recent evidence [1] has implied that the rapid results obtained from near-patient testing can offer sound economic benefits in addition to improving patient care and prognosis. The percentage of unjustified red blood cell or platelet transfusions can potentially be reduced through a more precise monitoring system, which can provide options for alternative treatments [Figure 5]. Administration of haematopoietic growth factor (G-CSF) is one such option. Results obtained from near-patient testing could allow both the length of time before G-CSF is prescribed and the duration of hospitalisation to be shortened [Figure 6]. In this way, both the associated risk of transfusion and its unnecessary cost are reduced.

In a day hospital, most laboratory procedures are indeed dispatched to nearby laboratories. This privileged communication helps anticipate decisions, but nonetheless, near-patient testing appears to offer a range of both clinical and economic advantages.

The advantages of such laboratory relocations: speed and improved nurse time management

The advantages can be exemplified by considering a patient with aplasia whose blood sample was taken early in the morning. Let us assume that the sample was transported under optimal conditions to a haematology laboratory, and that the results were provided promptly. Consider how long the time interval is between taking the blood sample and initiating transfusion, and compare this figure with current practice. In short, the answer is simple: relocating haematology tests, as well as blood gas testing in pneumology or intensive care situations, is beneficial.

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1. Delocalised biology for sequential measurements of C-reactive protein (CRP) and cell blood counts (CBC) has potential clinical and economic impact on the management of patients having high dose therapy (HDT). Rossi JF , Kanouni T, Bouhya S, Haematology-Oncology Department, University Hospital Montpellier, 375 avenue Doyen Giraud, 34295 Montpellier, France.
Daures JP , Department of Statistics University of Montpellier, France.
Milian P, HORIBA ABX, Montpellier, France.

This study was carried out with patients undergoing intensive chemotherapy from the Conventional and Intensive Care Units of the Haematology Department in the Montpellier University Hospital, France. Both CRP and CBC tests were carried out using whole blood samples in the ABX Micros CRP200 (HORIBA ABX).