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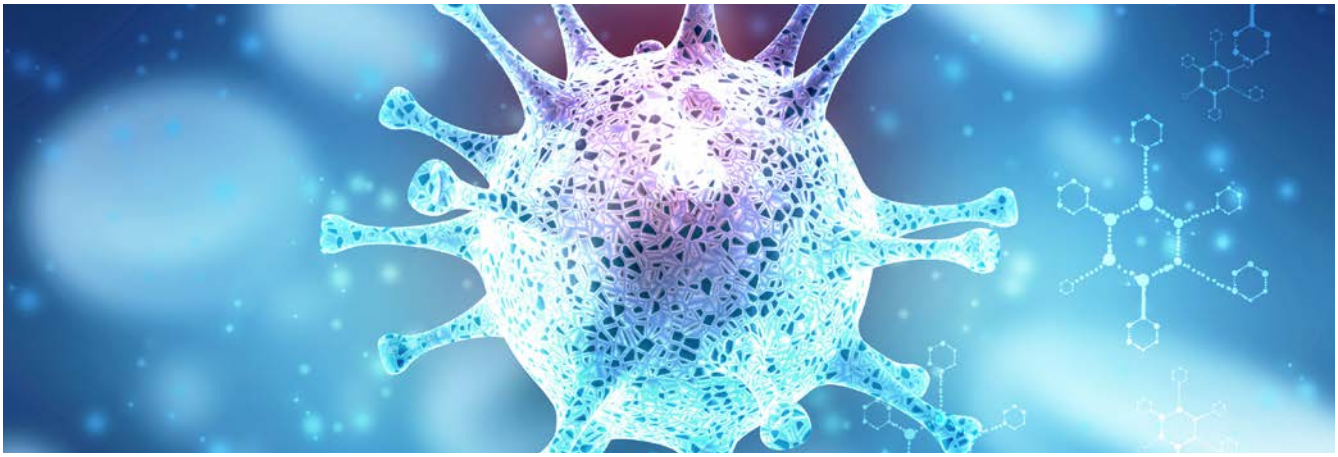
HAEMATOLOGY | April 2022

CASE REPORT

Infection

COVID-19 infection including COVID-19 prognostic score



The immune response to viral infections

- The innate immune system recognises virus particles based on Pathogen-Associated Molecular Patterns (PAMP), i. e. non-specific but common signature molecules of the virus. These can be proteins, lipoproteins or nucleic acids [1].
- Clinical phases described in patients with COVID-19 [2]
  - Asymptomatic incubation period between 2 and 14 days, virus can be transmitted during this time
  - Viraemia phase (day 1–7)
  - Acute phase (pneumonia phase) (day 7–14)
  - Recovery phase (day 14–20)
- Innate immune response to SARS-CoV-2 infection [2, 3]
  - Increased neutrophils and decreased lymphocytes correlate with disease severity and death
- Adaptive immune responses to SARS-CoV-2 infection [2, 3]
  - Humoral immune response, especially production of neutralising antibody, plays a protective role by limiting infection at later phase and prevents re-infection in the future.
  - Delayed and weak antibody response are associated with severe outcome.

Illustrative time course of immune response to viral infection

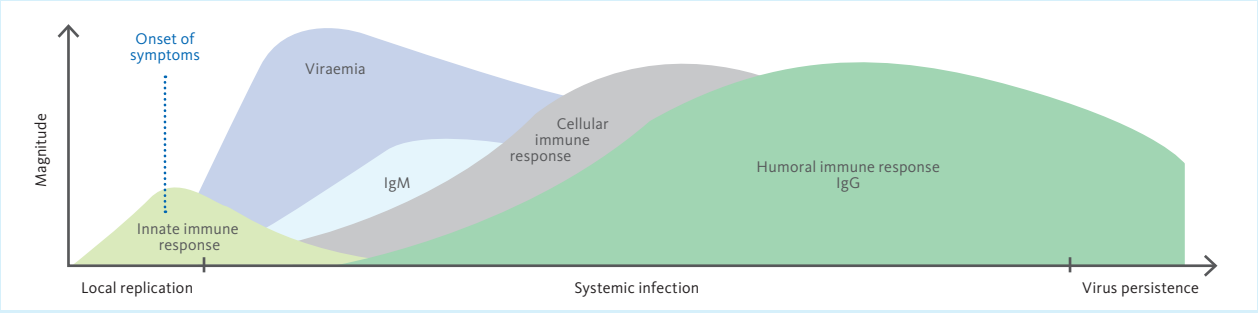
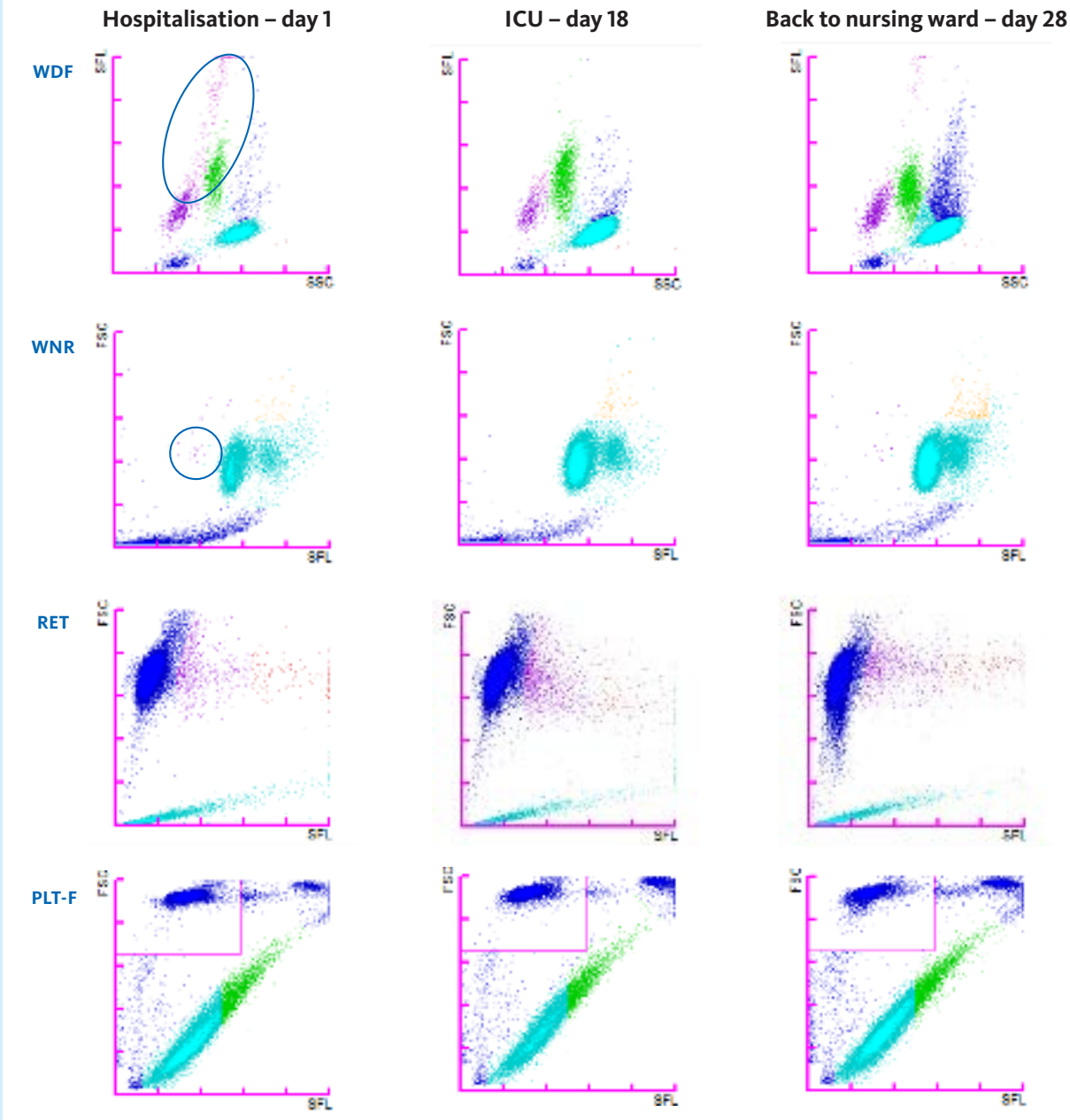


Fig. 1 *Schematic representation of virus infection and immune response time course*

Clinical case information

- 55-year-old patient with a blank page of medical history was admitted to the emergency department with
  - positive SARS-CoV-2 PCR test five days prior
  - COVID-19 symptoms present for about 1.5 – 2 weeks
  - first, mild symptoms which worsened over time: increasing shortness of breath, cough and fever.
- The first day of illness was approximately 12 days ago.
- The oxygen saturation at admission was 74 %.
- After 17 days of hospital stay, the patient got transferred to the intensive care unit (ICU) and respiratory support was started, firstly with nasal high flow oxygen followed then by intubation two days after.
- After a one week stay under intensive care treatment, the patient was detubated and discharged to a nursing ward.

XN-Series scattergrams of WDF, WNR, RET and PLT-F measurement channels



Scattergam interpretation

WDF scattergram

- Leucocytosis developped over the course of the infection, most likely due to increased numbers of neutrophils (turquoise) that are responding to bacterial co-infections or developing acute respiratory distress syndrome (ARDS).
- Immature granulocytes (blue) are present and increasing over the course of the stay as well.
- Monocyte population (green) shows an increased fluorescence signal visible by an upward trend of the population.
- The extended inflammation parameters (EIP) show high values for lymphocytes with increased fluorescence signals, especially antibody-synthesizing lymphocytes (upper part of WDF scattergram, blue circle; AS-Lymph/L 17.6 %) [1].

WNR scattergram

- Presence of nucleated red blood cells (NRBC, purple population, blue circle) from day 1

RET scattergram

- Increasing number of reticulocytes (purple and red), reflecting the bone marrow's stress due to the infection

PLT-F scattergram

- Scattergram shows presence of large immature platelet fraction (IPF, green)

COVID-19 prognostic score*

- Based on data from an extended CBC for COVID-19 patients presenting at hospitals, the COVID-19 prognostic score predicts within the first three days of hospital admission who will deteriorate and require intensive care unit care over the following weeks of hospitalisation.
- The score performance was shown to be superior to single parameters or parameter ratios [4].
- The initial measurement of this patient had no flags and was technically correct. The combination of parameters resulted in a high COVID-19 prognostic score, which already predicts that the patient's immune system is ineffective. Moreover, the score result of 11 indicates at admission already a high likelihood that the patient will need intensive care treatment over the course of the hospital stay.

		Variables	Results	Points
Primary variables	1	Immature granulocytes-to-lymphocytes ratio: **IG/L *100**	49	2
	2	Neutrophils-to-lymphocytes ratio: **N/L Ratio**	15.1	2
	3	Reactive monocytes as percentage of monocytes: **RE-MONO/M**	24.2 %	0
	4	Antibody-synthesizing lymphocytes as percentage of lymphocytes: **AS-LYMPH/L**	26.3 %	4
	5	Haemoglobin difference between the Ret and RBC: **Delta-He**	-3.8 pg	0
	6	Nucleated red blood cells: **NRBC**	100/µL	2
Secondary variables	7	Haemoglobin: **HBG**	> 17 g/dL	0
	8	Percentage of hypochromic cells: **HYPO-He**	2.5 %	0
	9	Platelet count: **PLT**	< 85 × 10^3 /µL	0
	10	Immature platelet fraction count: **IPF**	≤ 25 × 10^3 /µL	1
COVID-19 prognostic score				**11**

Footnote

The COVID-19 prognostic score can be made available by Sysmex on a 'Research Use Only' basis in *Extended* IPU, the work area manager of Sysmex. Sysmex will not assume any responsibility or liability for any clinical decision that is made on the basis of the score.

* For research use only.

References

[1] Li G et al. (2020): *Coronavirus infections and immune responses. J Med Virol. 92(4), 424–432.*

[2] Prompetchara E et al. (2020): *Immune responses in COVID-19 and potential vaccines: Lessons learned from SARS and MERS epidemic. Asian Pac J Allergy Immunol. 38(1), 1–9.*

[3] Lin L et al. (2020): *Hypothesis for potential pathogenesis of SARS-CoV-2 infection-a review of immune changes in patients with viral pneumonia. Emerg Microbes Infect. 9(1), 727–732.*

[4] Linssen J et al. (2020): *A novel haemocytometric COVID-19 prognostic score developed and validated in an observational multicentre European hospital-based study. Elife 2020 Nov 26; 9: e63195. Free online https://elifesciences.org/articles/63195.*

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