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Receiving of SARS-CoV-2/COVID-19 convalescent plasma in 2020–2021 in context of activity of Regional Center of Blood Donation and Blood Treatment in Bydgoszcz, Poland

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Abstract

Introduction: We analyzed SARS-CoV-2/COVID-19 convalescent plasma (CCP) production in the process of qualifying donors-convalescents, plasma collection and dispensing from the Regional Center of Blood Donation and Blood Treatment (RCKiK, *Regionalne Centrum Krwiodawstwa i Krwiolecznictwa*) in Bydgoszcz in the light of Polish national data.

Material and methods: This retrospective analysis based on the RCKiK documentation covers the first year of convalescent plasma production and use, i.e. from 1 May 2020 to 30 April 2021. Evaluations of the qualifying process for convalescent donors, plasma collection, and dispensing to hospitals were carried out. The data was analyzed in relation to data from all over Poland provided by the National Blood Center.

Results: In the 12 months ending on 30 April, 2021, 121,896.2 CCP units were acquired in total in 21 Regional Blood Donation and Treatment Centers. Of these, 14,683 units (12%) were acquired in Bydgoszcz, which places RCKiK Bydgoszcz in first place in Poland. The majority of donors were men, and most men were multiple donors, but most women were first-time donors. Most donors donated blood once, but 28.8% of donors donated at least twice. Most donations took place between December 2020 and March 2021, i.e. after the peak of the second and during the third wave of the pandemic. Nearly all the CCP preparations were dispensed to 29 hospitals in the Kuyavian-Pomeranian Voivodeship, and about 0.4% to other voivodeships.

Conclusions: In the period from 1 May 2020 to 30 April 2021, the RCKiK in Bydgoszcz was the most active center in Poland for obtaining, producing and distributing plasma from people who were convalescing. In the plasma collection process, a very high level of commitment among of RBC personnel and donors was found, expressed in an increased number of donations. A relatively high proportion of donors were first-time and repeat multiple donors, although most donors gave only one donation. The mean anti-SARS-CoV-2 antibodies titer remained at a comparable level up to 150 days after disease.

Key words: COVID-19 convalescent plasma (CCP), COVID-19, SARS-CoV-2, Regional Blood Donation and Blood Treatment Center

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Introduction

The first cases of severe pneumonia caused by the new type of coronavirus were diagnosed in Wuhan, the capital of Hubei province in central China, in November/December 2019. The name of the disease COVID-19 as an abbreviation of 'coronavirus disease 2019' was announced by the World Health Organization (WHO) on 11 February, 2020, in the WHO situation report [1] (02/11/2020). The virus that causes this disease, which according to the International Committee on Taxonomy of Viruses — The Coronaviridae Study Group (ICTV-CSG; https://talk.ictvonline.org) belongs to an existing coronavirus species associated with acute respiratory syndrome, was named 'severe acute respiratory syndrome coronavirus 2' (SARS-CoV-2) (Table I).

On 4 March, 2020, the first case of infection with the new coronavirus was diagnosed in Poland. Due to the rapid virus spread and high mortality, WHO on 11 March declared the COVID-19 outbreak to be a global pandemic [1] (11/03/2020).

On 20 March, the Regulation of the Minister of Health was published, declaring a state of epidemic in the territory of the Republic of Poland. Worldwide, measures were being taken to prevent the spread of infections.

On 8 April, 2020, after consultations with authorities competent for blood and blood components, i.e. the European Center for Disease Prevention and Control (ECDC) and the European Blood Alliance (EBA), the European Commission published the 'EU program of COVID-19 convalescent plasma collection and transfusion' [European Commission Directorate — General For Health And Food Safety; An EU program of COVID-19 convalescent plasma collection and transfusion. Version 1.0; 4 April, 2020; Ref. Ares(2020)1993684], which recommended considering COVID-19 convalescent plasma (CCP), an immediately available, low-risk, experimental therapy, as an urgent priority and monitoring the outcome of its use. This document provided guidance to blood services and clinicians on the collection, testing, processing, storage, distribution and monitoring of CCP, and was updated in line with scientific developments.

Following the guidelines of the European Commission, on 10 April, the Polish Ministry of Health informed the country's Blood Donation Centers about the possibility of launching a COVID-19 convalescent plasma collection program, and at the same time providing for the implementation of the relevant COVID-19 convalescent plasma collection procedure developed by the National Consultant in Transfusiology and agreed by the public blood service continuity management working group operating in the National Blood Center, including representatives of the Institute of Hematology and Transfusion Medicine, and RCKiKs in Białystok, Bydgoszcz, Katowice, Opole, Poznań, Warsaw, Wrocław and Zielona Góra.

The aim of this study was to evaluate the production of SARS-CoV-2/COVID-19 convalescent plasma in the process of donors-convalescents qualification, plasma collection, and dispensing from the Regional Center of Blood Donation and Blood Treatment (RCKiK, *Regionalne Centrum Krwiodawstwa i Krwiolecznictwa*) in Bydgoszcz in the context of nationwide data.

Material and methods

Study design

This research project was aimed at the evaluation of SARS-CoV2/COVID-19 convalescent plasma (CCP) production in RCKiK in Bydgoszcz from 1 May 2020 to 30 April 2021, i.e. in the first 12 months of using this method in Poland. The study was carried out retrospectively. The reasons for taking the decision to start the CCP program at RCKiK in Bydgoszcz in April 2020 included: the developing COVID-19 pandemic, the high rates of mortality in Western Europe and the USA, the lack of effective methods of preventing and treating this disease, and historical experience about the feasibility of convalescent plasma use. Running a CCP production program became one of the most important treatment options for COVID-19 patients from mid-2020.

The nationwide data was provided by the National Blood Center (NCK, *Narodowe Centrum Krwi*) to the Regional Blood Donation and Treatment Centers. All Regional Blood Donation and Blood Treatment Centers in Poland joined the convalescent plasma collection program.

Table I. Naming of coronavirus-induced diseases in 21st century [acc. to International Committee on Taxonomy of Viruses (ICTV)]

Year	Virus	Virus species (according to ICTV-CSG)	Disease (according to WHO)	Name of disease (in Polish)
2003	SARS-CoV	Severe acute respiratory syndrome-related coronavirus	Severe acute respiratory syndrome (SARS)	Ciężki ostry zespół oddechowy
2012	MERS-CoV	Middle East respiratory syndrome-related coronavirus	Middle East respiratory syndrome (MERS)	Bliskowschodni zespół niewydolności oddechowej
2019	SARS-CoV-2	Severe acute respiratory syndrome-related coronavirus 2	Coronavirus disease 2019 (COVID-19)	Ciężki ostry zespół oddechowy

CSG — Coronaviridae Study Group; WHO — World Health Organization

The National Consultant in Transfusiology took over the coordination and supervision of the project in cooperation with the National Blood Center.

Donor acquisition

The following activities were carried out proactively: a wide-ranging information campaign, contacts with hospitals and the sanitary and epidemiological service, and telephone contact with convalescents. The procedure of qualifying for donating blood and/or its components included: pre-selection, registration, laboratory tests and physical examination. All the qualification and blood collection procedures were the same at the RCKiK headquarters in Bydgoszcz as at local branches and the Blood Donation Mobile Unit.

Donor eligibility criteria

The criteria were in line with the Regulation of the Minister of Health of 11 September, 2017, on the conditions for collecting blood from candidates to be blood donors and from blood donors, and with the Notice of the Minister of Health of 6 March, 2019, on the requirements of good practice in collecting blood and its components, testing, preparation, storage, dispensing and transport for organizational units of the public blood service. The eligibility criteria for candidates to be blood donors or for blood donors to donate blood were applied (Table II). The doctor was also obliged to exclude the occurrence of any circumstances causing a temporary or permanent deferral of the blood donor in accordance with the above legal acts.

Time of donation after SARS-CoV-2 infection

Convalescents initially had to wait 28 days from completing isolation or 14 days from obtaining double-negative results of a COVID-19 PCR test. Along with the expansion of knowledge about the kinetics of infectivity, this period was shortened to 14 days from completing isolation, without the need to perform tests to confirm virus elimination.

Criteria for qualifying convalescents

The three criteria included in the COVID-19 convalescent plasma collection procedure developed by the National Consultant for Transfusiology's team and agreed by the public blood service continuity management working group (Table III) had to be met. These criteria were established based on European recommendations, including European Commission Directorate — General For Health And Food Safety of 4 April, 2020, and the criteria evolved as the pandemic progressed.

Donation

Donors were directed to plasma or whole blood donation. In exceptional cases, when there was a high demand for platelet concentrate, donors were directed to collect platelets and an additional unit of plasma by apheresis. In the case of convalescents, the first three plasma donations could be collected every seven days. However, after donating whole blood, the donor could donate plasma after four weeks. Routinely, the donor was scheduled for two donations. The first was usually by plasmapheresis, and the second was after a week, when the type of donation depended on anti-SARS-CoV-2 antibodies titer determined at the first donation

Table II. Eligibility criteria for blood donor or blood donor candidates for blood donation

Age 18–65 years
Body weight ≥50 kg for blood or blood components donor
Blood pressure should not exceed 180/100 mm Hg
Regular heart rate, with a frequency of 50–100/min
Hemoglobin level for blood donor candidate or female blood donor ≥125 g/L, and for male blood donor ≥135 g/L
Total protein serum level for blood donor or blood donor candidate for regular plasma collection by apheresis: 60–80 g/L
Platelet count for blood donor or blood donor candidate at least 150 × 10^9/L
White blood cell count: 4–10 × 10^9/L

Table III. Additional mandatory eligibility criteria for donors after coronavirus disease 2019 (COVID-19) or infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus as of 10 April, 2020

Criterion I
Men with no history of transfusion, or
Women with no history of pregnancy or transfusion, or
Individuals without alloantibodies to HLA/HPA/HNA antigens (in the next version: individuals without alloantibodies to HLA antigens)
Criterion II
Individuals considered healthy after COVID-19, at least 14 days after repeatedly negative NAT test, or
Individuals after SARS-CoV-2 infection, with anti-SARS-CoV-2 antibodies developed, at least 14 days after repeatedly negative NAT test, or
Individuals after SARS-CoV-2 infection, at least 28 days after symptoms disappeared or end of isolation (this point was in force from 1 September 2020; from 7 December 2020, this period was changed to be at least 14 days from the end of isolation), or
Individuals with anti-SARS-CoV-2 antibodies and no previous symptoms of COVID-19, at least 14 days after antibody positive test (this point was in force from 1 September 2020)
Criterion III
Donor consent to use plasma in clinical trials and to dispense to a fractionator

HLA/HPA/HNA — human leukocyte/platelet/neutrophil antigens

(i.e. high antibody titer indicated plasmapheresis, and low antibody titer indicated whole blood collection).

Receipt of CCP

The obtained plasma, as well as the plasma collected by the automated plasmapheresis, was divided, inactivated and shock-frozen in a HOF60 freezer by HOF Sonderanlagenbau GmbH, where at –60°C the plasma reached the temperature of –30°C within 45 minutes. The freezing process was carried out in a time that enabled the maintenance of the functional state of the labile coagulation factors, i.e. up to 24 hours from collection, thus obtaining fresh frozen plasma (FFP). The obtained CCP components have become an important element of COVID-19 therapy [2].

Inactivation of CCP

Two methods were used: with methylene blue (Theraflex-MB Plasma by Macopharma) and with riboflavin (Mirasol by Terumo). Most coronaviruses are susceptible to inactivation with amotosalen or riboflavin and ultraviolet light, solvent detergent, methylene blue and light, and ultraviolet C light alone when applied to platelets and fresh frozen plasma [2–5]. Recent studies have shown that the method with riboflavin and ultraviolet light use can reduce SARS-CoV-2 in plasma and platelets concentrate below the detection limit in tissue culture [6].

Serological testing of CCP

The convalescent plasma, like all blood components, was subjected to serological tests and tests for the presence of blood-borne infectious agents [e.g. hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV), spirochete *Treponema pallidum*). Each time, an anti-SARSCoV-2 antibodies titer was determined. The time from disease onset was analyzed, and in multiple donors also the number of consecutive donations. Convalescents donating blood at the RCKiK in Bydgoszcz initially had immunoenzymatic ELISA tests performed with the use of a EUROIMMUN Medizinische Labordiagnostika AG analyzer (from 10 April 2020 to 21 October 2020 at the RCKiK in Białystok, from 22 October to 3 November 2020 at the RCKiK in Poznań, and from 4 November 2020 to 9 February 2021 at the RCKiK in Bydgoszcz). On the other hand, from 10 October 2020, a chemiluminescence test was performed at the RCKiK in Bydgoszcz with use of a SNIBE Maglumi analyzer. The qualifying result, i.e. an antibodies titer of 500, was set at the ratio ≥4.4 for the first method, and 27.4 AU/mL for the second method. In the Maglumi analyzer, the upper titer limit was 1,825, and higher titers were marked as >1,825.

Definitions

Donation — blood or its components collected during a single donor visit; the volume and number of units collected during a single donation depends on the type of procedure used and the component taken.

First-time donor — a donor who volunteers to donate blood and/or blood components for the first time.

Multiple donor — a donor who regularly donates blood and/or its components.

Repeat multiple donor — a donor who volunteers to donate blood and/or blood components 24 months after the last donation.

Recoverer (convalescent) — a person who has been infected with the SARS-CoV-2 virus asymptomatically or symptomatically, with varying degrees of COVID-19 symptoms severity, which has been confirmed by the available molecular or antigen tests.

COVID-19 convalescent plasma (CCP) — plasma collected from a person who has been infected with the SARS-CoV-2 virus asymptomatically or symptomatically with varying degrees of severity of COVID-19 symptoms, which has been confirmed by the available molecular or antigen tests. This is plasma obtained from whole blood or by automated plasmapheresis. A unit of FFP typically has a volume of c. 200 ml, depending on the preparation method used.

Statistical methods

The results were evaluated with statistical analysis. Non-categorical variables were compared using the Mann-Whitney test for two groups and the Kruskal-Wallis test where there were more than two groups; categorical variables were compared using the chi-square test, with simultaneous calculation of the odds ratio (OR) with corresponding 95% confidence interval (CI). P <0.05 was considered statistically significant. The analysis was performed using the statistical package SPSS 27.0 (IBM SPSS Statistics).

Results

Donations collected from COVID-19 convalescents in Poland

Data on the number of donations collected, the plasma therapeutic units obtained from them, and the number of plasma units dispensed for clinical use since the beginning of the pandemic to 30 April, 2021, according to the individual RCKiK, was provided by the NCK (Table IV).

During that time, a total of 57,625 donations of whole blood and its components from convalescents were collected in Poland, which resulted in obtaining 121,896.2 therapeutic units of convalescent plasma. The Regional Center of Blood Donation and Blood Treatment in Bydgoszcz obtained the largest amount of plasma in the country, as many as 14,683 units, which is 12% of the total number of plasma units in Poland. At that time, 81,386.5 units of convalescent plasma were dispensed for treatment across the country. Also in this context, the Kuyavian-Pomeranian Voivodeship clearly stands out, with 9,330 units dispensed

Table IV. General data on number of donations collected from convalescents in Bydgoszcz in context of national data from National Blood Center of 30 April, 2021

RCKiK	Total number of donations taken [donations] n = 57,625 (100%)	Number of units obtained [units] n = 121,896.2 (100%)	Number of units dispensed for clinical use in own area [units] n = 75,858.3	Total number of units dispensed from RCKiK [units] n = 81,386.5 [%]
RCKiK in Białystok	3,907 (6.8)	8,308 (6.8)	5,047	5,159 (6.3)
RCKiK in Bydgoszcz	6,751 (11.7)	14,683 (12.0)	9,330 (26 units dispensed on 30 April 2021)	9,369 (11.5)
RCKiK in Gdańsk	3,046 (5.3)	6,056 (5.0)	4,473	5,187 (6.4)
RCKiK in Kalisz	1,510 (2.6)	4,072 (3.3)	1,892.5	3,207 (3.9)
RCKiK in Katowice	4,016 (7.0)	6,591.8 (5.4)	6,371.3	6,477 (8.0)
RCKiK in Kielce	1,122 (1.9)	2,358 (1.9)	2,611	2,611 (3.2)
RCKiK in Krakow	5,181 (9.0)	6,933 (5.7)	3,977	4,086.5 (5.0)
RCKiK in Lublin	3,360 (5.8)	7,338 (6.0)	5,188.5	5,216.5 (6.4)
RCKiK in Łódź	1,595 (2.8)	4,414 (3.6)	3,283	3,335 (4.1)
RCKiK in Olsztyn	1,906 (3.3)	5,576 (4.6)	3,432	3,560 (4.4)
RCKiK in Opole	707 (1.2)	1,091 (0.9)	1,286	1,317 (1.6)
RCKiK in Poznań	3,844 (6.7)	8,638 (7.1)	4,402	4,437 (5.5)
RCKiK in Racibórz	1,726 (3.0)	4,454 (3.7)	1,686	2,437 (3.0)
RCKiK in Radom	1,389 (2.4)	3,691 (3.0)	2,856	3,031 (3.7)
RCKiK in Rzeszów	3,432 (6.0)	7,564.5 (6.2)	4,091	4,141 (5.1)
RCKiK in Słupsk	832 (1.4)	2,310 (1.9)	1,379	1,379 (1.7)
RCKiK in Szczecin	1,922 (3.3)	5,697.4 (4.7)	1,694.5	2,207.5 (2.7)
RCKiK in Wałbrzych	708 (1.2)	1,395 (1.1)	1,320	1,320 (1.6)
RCKiK in Warsaw	4,348 (7.5)	8,588 (7.0)	5,584.5	6,336.5 (7.8)
RCKiK in Wrocław	5,083 (8.8)	9,660.5 (7.9)	3,992	4,577.5 (5.6)
RCKiK in Zielona Góra	1,240 (2.2)	2,477 (2.0)	1,962	1,995 (2.5)

RCKiK (*Regionalne Centrum Krwiodawstwa i Krwiolecznictwa*) — Regional Center of Blood Donation and Blood Treatment

for treatment, which constitutes 12.3% of all plasma transferred to hospitals in Poland.

Results of plasma collection at RCKiK in Bydgoszcz

Donors' data

In the period from 1 May 2020 to 30 April 2021, a total of 34,133 donors donated blood and its components at the RCKiK in Bydgoszcz, including 10,691 women (31.3%) and 23,442 men (68.7%), with a mean age of 34.1 years (range: 18 to 71). There were 7,988 first-time donors, i.e. 23.4% of all donors, and 5,786 repeat multiple donors (17.0% of all donors). There were 20,359 multiple donors, which accounted for 59.6% of all donors. Only 45.1% (15,433) of blood donors made only one donation during that period. Among the donors who donated blood and/or blood components during this period, 4,079 (12%) were convalescents (Table V). The mean age of survivors was slightly higher than that of the other donors, i.e. 38.5 years (range: 18 to 67). Almost 70% of donors after COVID-19 were men, which was similar to other groups of donors. The distribution by blood group was similar to the population distribution. The biggest difference was observed in group 0, which was represented by 29.6% of plasma donors, and which is found in approximately 37% of the entire Polish population.

People who donated blood for the first time constituted a much larger group among convalescents (39.8%) than among other blood donors (23.4%, p <0.001). This was especially noticeable among women, of whom as many as 51.7% were first-time donors. Similarly, the number of repeat multiple donors, i.e. those who donated blood more than two years after their last donation, was noticeably higher among convalescents than other donors (19.8% vs. 17.0%, p <0.001, OR = 1.2, 95% CI = 1.1–1.3). Characteristic for the group of convalescents is also the fact that as many as 71.2% of them made only one donation at that time, while among the other blood donors it was only

Table V. Data on convalescents donating plasma and/or whole blood in RCKiK in Bydgoszcz from 1 May 2020 to 30 April 2021

Parameter	Convalescents donating plasma and/or whole blood, n = 4,079
Age — median (range) [years]	38.5 (18–67)
Sex	
Female, n [%]:	1,248 (30.6)
• first-time (% of women)	645 (51.7)
• multiple (% of women)	359 (28.8)
• repeat multiple (% of women)	244 (19.6)
Male, n [%]:	2,831 (69.4)
• first-time [%]	978 (34.5)
• multiple [%]	1,291 (45.6)
• multiple repeat [%]	562 (19.9)
Blood group, n [%]	
0 RhD negative	209 (5.1)
0 RhD positive	1,001 (24.5)
A RhD negative	292 (7.2)
A RhD positive	1,368 (33.5)
AB RhD negative	63 (1.5)
AB RhD positive	320 (7.8)
B RhD negative	144 (3.5)
B RhD positive	682 (16.9)
Type of donor	
First-time [%]	1,623 (39.8)
Multiple [%]	1,650 (40.4)
Repeat multiple [%]	806 (19.8)
Number of donations made, mean (range)	1.7 (1–21)
Number of donors who donated	
Only a single donation [%]:	2,905 (71.2)
• by plasmapheresis [%]	964 (33.2)
• whole blood [%]	1,939 (66.7)
• thrombapheresis with one plasma unit [%]	2 (0.1)
Two donations [%]	574 (14.1)
Three or more donations [%]	600 (14.7)
Donors by type of donation	
Only whole blood [%]	2,006 (49.2)
Only plasma [%]	1,570 (38.5)
Only thrombapheresis with an additional plasma unit [%]	2 (0.05)
Whole blood and plasma [%]	499 (2.2)
Plasma and thrombapheresis with an additional plasma unit [%]	2 (0.05)

RCKiK (*Regionalne Centrum Krwiodawstwa i Krwiolecznictwa*) — Regional Center of Blood Donation and Blood Treatment

45.1%. A total of 28.8% of convalescents made two or more donations. The highest number, 21 donations, were made by a man with a very high anti-SARS-CoV-2 antibodies titer maintained all the time. The majority of survivors gave only one type of donation: 49.2% of them donated only whole blood, and 38.5% donated only plasma by plasmapheresis.

Among the donors who made their first donation, antibody titers were comparable over the period of six months after the onset of disease. There was a slight increase in anti-SARS-CoV2 antibody titer up to 150 days after disease onset, then the titer gradually decreased; the differences were statistically significant (p <0.001, Kruskal-Wallis test, data not shown).

Donations data

Until 30 April, 2021, in the Kuyavian-Pomeranian Voivodeship, 6,751 donations were collected from convalescents, including 4,131 plasma donations, 2,616 whole blood donations, and four platelets and plasma donations. After preparation and division, this allowed a total of 14,758 therapeutic units of convalescent plasma to be obtained. 77% of donations (5,200 donations) were made by men, and 23% (1,551 donations) by women.

A decrease in the antibody titer was noted with the second donation. With subsequent donations, mean titers increased (p <0.001, Kruskal-Wallis test); however, before the third and subsequent CCP donations, donors with low or no antibody titers were disqualified.

Donation analysis according to collection date

The largest number of donations from convalescents was obtained between January and April 2021 (Figure 1). During this period, the number of convalescents in the Kuyavian-Pomeranian Voivodeship increased significantly, as did, accordingly, the number of people willing to donate plasma. This meant it was possible to qualify for subsequent donations only those convalescents with a high titer of anti-SARSCoV-2 antibodies at the first donation. As a result, the obtained blood components had the highest anti-SARS-CoV-2 antibody titer, both in terms of the antibody titer (p <0.001) and the percentage of donation with a titer >100 U (p <0.001).

Expenditure of convalescent plasma

In the period from 1 May 2020 to 30 April 2021 from the RCKiK in Bydgoszcz a total of 9,395 packages (9,352.5 units) of convalescent plasma were dispensed for clinical purposes, including a total of 9,356 packages (9,313.5 units) for 7,182 patients in 29 hospitals in our voivodeship, and 39 packages (39 units) to another centre outside our voievodship. Hospitals received plasma collected mainly in the RCKiK in Bydgoszcz, and only 34 CCP units obtained from another RCKiK. Among plasma dispensed for

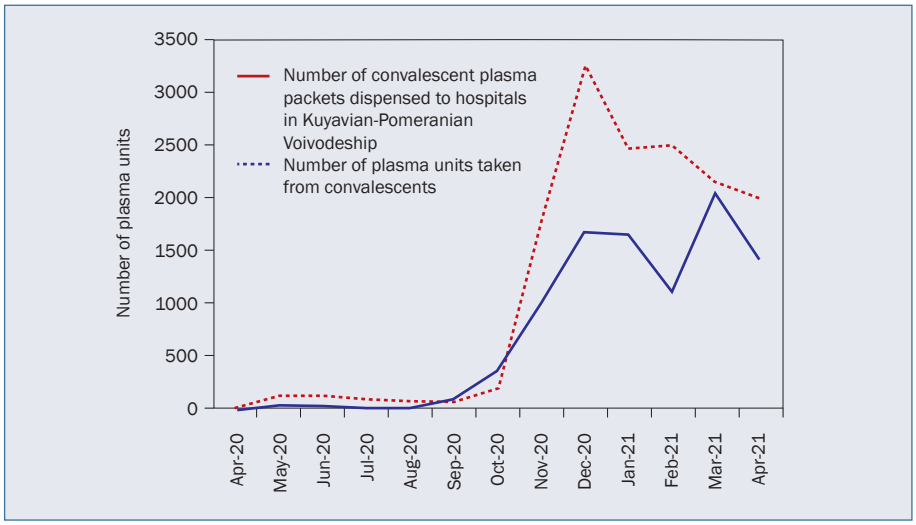

Figure 1. Number of plasma units collected from convalescents and its expenditure by months

treatment, there was a lower amount of group 0 plasma than it would appear from the population distribution of blood groups (Figure 2).

Discussion

This research project was aimed at assessing the use of SARS-CoV-2/COVID-19 convalescent plasma (CCP) in the first year of obtaining and using convalescent plasma in Poland, i.e. from 1 May 2020 to 30 April 2021, in the light of the activities of the Regional Center of Blood Donation and Blood Treatment (RCKiK) in Bydgoszcz. The analysis presents data from Bydgoszcz in relation to data from all over Poland, according to information obtained from the National Blood Center, and presents data on the donors-convalescents qualification process, and the collection and dispensing of convalescent plasma from the RCKiK in Bydgoszcz to hospitals mainly in the Kuyavian-Pomeranian Voivodeship.

The most important results of this analysis show that in the period 1 May 2020 to 30 April 2021, the RCKiK in Bydgoszcz was the most active center in Poland for obtaining, producing and dispensing convalescent plasma to patients, with a high commitment of donors to the process of obtaining plasma.

During the first year of the COVID-19 pandemic, the RCKiK in Bydgoszcz obtained the largest number of convalescent plasma units in the country (12%, i.e. more than one ninth of the national resources). These highly efficient donations depended on three factors: firstly — the prompt start of working on this therapeutic method, immediately after the decision by the Minister of Health. The acquisition of CCPs for therapeutic purposes began when there was a lack of other effective therapeutic methods, and huge social concerns related to the risk of infection and full lockdown in the country. The second factor was the enormous

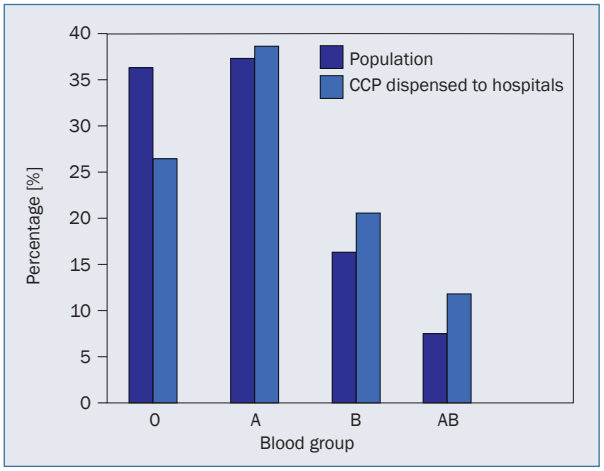

Figure 2. Expenditure of COVID-19 convalescent plasmas (CCPs) by blood group in relation to blood group distribution in population

commitment of RCKiK staff to acquiring CCP, including proactively persuading convalescents to donate plasma for use in the therapy of other people. The third factor was the positive attitude of donors, most often first-time donors, and their willingness to help society.

Regular telephone contact between RCKiK doctors and convalescents played a very important role in the acquisition of new plasma donors. This initial preselection allowed the elimination of individuals who did not meet the eligibility criteria for donating blood and/or its components. Via direct conversation it was possible to dispel any doubts harboured by candidates for blood donation. In addition, the high involvement of the media and the families of patients suffering from COVID-19 persuaded people who had never previously donated blood and/or its components, or had not donated for a long time, to go to the RCKiK.

The percentage of first-time donors was significantly higher among convalescents than in the group of honorary blood donors (39.8% vs. 23.4%). Similarly, the percentage of repeat multiple donors, i.e. those who donated blood more than two years after the last donation, was significantly higher among convalescents than other donors (19.8% vs. 17.0%). Characteristic for the group of convalescents was also the fact that as many as 71.2% of them made only a single donation at that time, while among the other blood donors it was only 45.1%. This happened despite the fact that during the first donation donors were already scheduled for their next one. However, for some of them, blood or plasma donation was so stressful that they decided not to donate again. Among those with a single donation, 66.7% were donors who donated whole blood, and for them the 8-week interval after donating whole blood was too long to maintain the strength of the initial motivation. The average age of the convalescents was slightly higher than that of other blood donors. This was due to the fact that it was mainly elderly people who suffered from COVID-19, while a significant proportion of regular blood donors were secondary school or university students.

Importance of anti-SARS-CoV-2 antibody titer in CCP

Observations from other infections indicate that the typical humoral response following an acute viral infection develops rapidly, with the peak occurring 3–4 weeks after infection and then gradually disappearing. In patients with a weak response (100–300), low antibody titers may come back non-immune in a relatively short period of time, while those with a robust response maintain titers >1,000 despite an initial decline [7]. Seven months after the onset of symptoms, COVID-19 convalescents still had high levels of immunoglobulin G [8]. Among first-time donors, the antibody titers were comparable for six months after the onset of the disease. There was a slight increase in anti-SARS-CoV-2 antibodies titer up to 150 days after the onset. The titers of antibodies in convalescents changed over time. A lapse of time and/ /or donation itself negatively affected antibody levels in donors' plasma.

An evaluation of the effectiveness of CCPs in COVID-19 therapy must be carried out in the context of the development of therapeutic methods for this disease and the collection of scientific evidence. CCP was introduced at a time when the first evidence of chloroquine and hydroxychloroquine ineffectiveness was appearing, there were no antiviral drugs effective against the SARS--CoV-2 virus, no scientific evidence of the value of steroids and cytokine inhibitors, and when there were no specific monoclonal antibodies at all, and no information on a possible vaccine against SARS-CoV-2. By the end of 2020, CCP had become one of the main treatment options for patients with symptomatic COVID-19, when the first reports of the effectiveness of this method began to appear. 2021 brought a significant number of reports on this subject, and most of them showed either little or no effectiveness of this method. However, it should be emphasized that, except for the RECOVERY study, most analyses included relatively small numbers of patients, so caution must be deployed regarding conclusions about lack of efficacy. In addition, the RECOVERY study did not resolve many issues, including the effectiveness of very early or early administration of CCPs [9].

Conclusions

From 1 May 2020 to 30 April 2021, the RCKiK in Bydgoszcz was the most active center in Poland for obtaining, producing and distributing convalescent plasma to patients. In the plasma collection process, a very high commitment of donors was found, expressed in an increased number of donations. A relatively high proportion of donors were first-time and multiple repeat RCKiK personnel and donors, although most donors gave only one donation. The mean anti-SARS-CoV-2 antibodies titer remained at a comparable level up to 150 days after the disease [10].

Authors' contributions

KG — sole author.

Conflict of interest

None.

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None.

Ethics

The work described in this article has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans; EU Directive 2010/63/EU for animal experiments; uniform requirements for manuscripts submitted to biomedical journals.

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