BMC Public Health

RESEARCH

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Seroprevalence of hepatitis C, hepatitis B, hiv and syphilis among blood donors at a tertiary care hospital in Mogadishu-Somalia in 2020–2022: a retrospective study

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Abstract

Background The safety of blood donation requires screening for transfusion-transmitted infections, including human immunodeficiency virus (HIV), syphilis, hepatitis B virus (HBV) and hepatitis C virus (HCV). This study aimed to determine the seroprevalence of HIV, HBV, HCV and syphilis in blood donors of Mogadishu Tertiary Care Hospital, Somalia from 2020 to 2022.

Methods The records of 109,385 blood donors who attended our blood center in Mogadishu-Somalia between 2020 and 2022 were examined retrospectively. Serum samples of donors; HBsAg, anti-HCV, anti-HIV and syphilisscreening tests were studied using the microparticleEnzyme-Linked ImmunoSorbent Assay (ELISA)(Vitros, Ortho-Clinical Diagnostics, U.S) method.The distribution of HBsAg, anti-HCV, anti-HIV and syphilis positivity rates of 109,385 blood donors according to years, gender and age were examined. Kolmogorov Smirnov, Skewness, Kurtosis tests and histogram were used for normality analysis. Chi-squared test ($\chi 2$) and Fisher Exact test were used to analyze categorical data. Categorical variables were expressed as frequency (percentage). Analysis of continuous data was performed with the Mann Whitney U test. $P < 0.05$ value was considered statistically significant.

Results HBsAg positivity was found in 0.6% of the donors, anti-HCV positivity in 0.01%, anti-HIV positivity in 0.03% and syphilispositivity in 0.3%. The results showed that among the blood donors, the prevalence of syphilis, HIV, Hepatitis B, and Hepatitis Cwas notably low.

Conclusion The prevalence of HBV, HCV, HIV, and syphilis among blood donors in Somalia was found to be quite low. Even if our found seroprevalence rates are low, to guarantee the safety of blood for recipients, strict selection of blood donors and thorough screening of donors' blood using accepted procedures are strongly advised.

Keywords Blood donors, Seroprevelance, HBV, HCV, HIV, Syphilis, Somalia

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Introduction

Transfusion-associated infections, particular, hepatitis B virus (HBV), hepatitis C virus (HCV), human immunodeficiency virus (HIV) and syphilis are the most common diseases among blood donors. Blood transfusion practices worldwide emphasize on safety and protection of human life. Infections such as HIV, HBV, HCV are of great concern because of their prolonged viraemia and carrier or latent state. Blood safety is still a major public health issue in sub-Saharan Africa as a result of inadequate national blood transfusion regulations, services, infrastructure, qualified employees, and financial resources [1].

Because of their protracted blood presence and carrier or latent status, HIV, HBV, and HCV are of more concern. They are the main factors in persistent, life-threatening abnormalities and mortality. In sub-Saharan Africa, blood transfusions cause 5–10% of HIV infections [2].

Viral hepatitis is one of the most common infectious diseases transmitted through blood [3]. The impact of the HBV infection on the world's health is ten times greater than that of AIDS. 350 million people are HBV chronic carriers worldwide. One-fourth of them are dying from cancer or liver cirrhosis [4, 5]. HCV, which has a lower prevalence than HBV, is thought to be responsible for 70% of chronic hepatitis in developed countries. Identifying HBV and HCV carriers is very important because these infections can become chronic and cause cirrhosis or hepatocellular carcinoma [6].Numerous studies have revealed that West African nations have the highest rates of HBV, HCV, HIV, and syphilis among blood donors [7–9].

Treponema pallidum, the pathogen responsible for the systemic disease syphilis, can also be transmitted through blood transfusion and sexual intercourse [10]. Syphilis continues to be a major public health issue in sub-Saharan Africa. Between the African nations, Tanzania had the highest prevalence of active syphilis infection at 12.8% while Kenya had the lowest at 3.8% [11, 12].

Transfusion safety saves human lives and this requires screening for infections transmitted by blood transfusion such as HBV, HCV, HIV and syphilis [13].The World Health Organization (WHO) recommends that these 4 disease agents transmitted through blood transfusion be screened with reliable quality tests and that effective quality control systems be implemented to increase blood transfusion safety [14]. In many regions of Africa, these are regularly checked on all donated blood to assure the safety of the receivers. Each unit of blood collected is subjected to stringent screening procedures [15].

This study aimed to determine the seroprevalence of HIV, HBV, HCV and syphilis in blood donors of Mogadishu Tertiary Care Hospital, Somalia from 2020 to 2022.

Methodology

Study design

The records of donors who applied to the blood center of a 250-bed Tertiary Hospital in Mogadishu, Somalia between 2020 and 2022 were examined retrospectively. Data were recruited from the electronic medical records in the hospital information system.

Study setting

This study was conducted in Mogadishu, the capital and largest city of Somalia. Mogadishu is located in the southeast of Somalia, in the Indian Ocean region. It has served as an important port for centuries and has an urban population of approximately three million. It has a dry and hot climate.

Study population

Totally 109,385 blood donors between the ages of 18–65 were included in the study. People who applied to the blood center as donors first filled out the blood donor health questionnaire. After the form was evaluated by the responsible doctor, blood donors who met the eligibility criteria were included in the donation process. The criteria for donating blood are as follows: People between the ages of 18–65, who have not had surgery within one year, who have not had skin piercing applications such as acupuncture, whose body weight is over 50 kilos, who are physically healthy, who answer the questions in the Donor Information Form correctly and who are deemed suitable, can be blood donors.İndividuals with known chronic illnesses, hypertension, anemia, and addicted to intravenous or oral drugs were excluded from the scope of donation. Ethical approval was received from the Ethics Committee ofMogadishu Somalia Turkey Recep Tayyip Erdoğan Training and Research Hospital.Nevertheless, informed consent was not acquired from the study subjects because of the nature of the investigation (retrospective review of blood donors' records).

Serological analysis

Venipuncture was used to obtain blood samples from the donors aseptically. Venous blood taken from the blood donor was collected in blood collection tubes. As per standard procedures, the samples were examined for blood group, HIV, HBV, HCV and syphilis. HBsAg, anti-HCV, anti-HIV and VDRL donor screening tests; It was studied using the microparticle ELISA (Vitros, Ortho-Clinical Diagnostics, U.S.) method and Ortho-Clinical Diagnostics kits (HBsAg and anti-HCV 3rd generation, anti-HIV, 4th generation, VDRL 1st generation). Samples giving HBsAg, anti-HCV, anti-HIV and VDRL positive reactions were studied a second time with the same kit. Bloods that gave a positive reaction the second time was not used as donor blood because there was no further

Table 1 Age group, gender, blood group distribution and HBsAg, anti-HCV, anti-HIV and syphilis seropositivity in blood donors

Parameter	*N*	%
Years		
2020	29,363	26,8
2021	38,290	35,0
2022	41,732	38,2
Gender		
Male	109,109	99,7
Female	276	0,3
Age groups		
Mean-SD	28,8 ± 7,19	100
Min-Max	18–65	
18–30	70,854	64,8
31–40	31,693	29
41–50	6338	5,8
51–64	500	0,5
ABO blood groups		
0	62,471	57,1
A	30,102	27,5
B	14,854	13,5
AB	1958	1,9
Rhesus (Rh) type		
Positive	103,950	95,05
Negative	5435	4,95
HBsAg		
Positive	639	0,6
Negative	108,746	99,4
Anti-HCV		
Positive	17	0,01
Negative	109,368	99,09
Anti-HIV		
Positive	41	0,03
Negative	109,344	99,97
VDRL		
Positive	289	0,3
Negative	109,096	99,7
Total109385		100

testing such as a Western Blot confirmation test in our hospital.However, blood that gave a negative reaction was considered safe and used as donor blood, since the second test, which works on a different principle, was not used in our hospital.ABO and Rhesus (Rh) blood groups were determined on a slide using monoclonal blood grouping antisera. The manufacturer's instructions (BIOTEC Laboratories Ltd, Great Britain) were used for the use of antisera with anti-A, anti-B, anti-AB and anti-D.

Statistical analysis

The analysis of the data was done with the jamovi project (2022), jamovi (Version 2.3.26) [Computer Software] statistical program. Kolmogorov Smirnov, Skewness, Kurtosis tests and histogram were used for normality analysis.

Table 2 Relationship between gender and HBsAg, anti-HCV, anti-HIV and syphilis seropositivity

Eliza		Gender		*p* value
		Male *N*, (%)	Female *N*, (%)	
HBsAg	Positive	634 (0,6)	5 (0,005)	0,007
	Negative	108,474 (99,2)	271 (0,2)	
Anti-HCV	Positive	17 (0,02)	0 (0)	1,000
	Negative	109,091 (99,7)	276 (0,3)	
Anti-HIV	Positive	41 (0,03)	0 (0)	1,000
	Negative	109,067 (99,7)	276 (0,3)	
VDRL	Positive	289 (0,3)	0 (0)	1,000
	Negative	108,819 (99,5)	276 (0,3)	

Chi-squared test ($\chi 2$) and Fisher Exact test were used to analyze categorical data. Fisher-Freeman-Halton test was used to compare test results according to age groups. Categorical variables were expressed as frequency (percentage). Analysis of continuous data was performed with the Mann Whitney U test. $P<0.05$ value was considered statistically significant.

Results

In our study, our blood donor rates were found to be 26.85% ($n=29363$) in 2020, 35% ($n=38290$) in 2021 and 38.15% ($n=41732$) in 2022.A total of 109,385 blood donors, 109,109 (99.7%) were men and 276 (0.3%) were women. The ages of the donors were between 18 and 65 years old, and the mean age (Mean ± SD) was 28.8 ± 7.19. HBsAg positivity was found in 0.6% of the donors, anti-HCV positivity in 0.01%, anti-HIV positivity in 0.03% and VDRL positivity in 0.3%. The blood group of the majority of the participants (57.1%) was "O positive", followed by "A positive" (27.5%), "B positive" (13.5%) and "AB positive" (1.9%) blood groups. Of all donors, 103,950 (95.05%) were Rh positive and 5435(4.95%) were Rh negative (Table 1).

When the relationship between donor gender and ELISA results was examined, it was determined that HBsAg result had a significant relationship with gender ($p=0.007$), while there was no significant relationship between men and women in other ELISA results (Table 2).

When donors' ELISA results are evaluated according to age groups; there is no difference between the distributions of anti-HCV + and anti-HIV + positive statuses (p values 0.647, 0.772, respectively). The distribution of HBsAg + positive cases differs significantly according to age groups ($p<0.001$). The positivity rate was found 0.531% in the 18–30 age group, 0.65% in the 31–40 age group, 1.025% in the 41–50 age group, and 1.2% in the 51–64 age group. The distribution of VDRL + positive cases differs significantly according to age groups ($p<0.001$). The positive rate of the 18–30 age group was found 0.157%, the 31–40 age group was 0.413%, the

Table 3 Comparison of test results according to age groups

		18–30 age groups	31–40 age groups	41–50 age groups	51–64 age groups	Total	Chi-squared test (χ2)	*p***
Anti-HCV+								
Negative	n(%)	70,843(99,984)	31,688(99,984)	3708(99,973)	500(100)	106,739(99,984)	1,787	0,647
Positive	n(%)	11(0,016)	5(0,016)	1(0,027)	0(0)	17(0,016)		
HBsAg+								
Negative	n(%)	70,478(99,469)	31,487(99,35)	3671(98,975)	494(98,8)	106,130(99,414)	19,777	**< 0,001**
Positive	n(%)	376(0,531)[a]	206(0,65)[ab]	38(1,025)[b]	6(1,2)[ab]	626(0,586)		
Anti-HIV+								
Negative	n(%)	70,828(99,963)	31,680(99,959)	3707(99,946)	500(100)	106,715(99,962)	0,970	0,772
Positive	n(%)	26(0,037)	13(0,041)	2(0,054)	0(0)	41(0,038)		
VDRL+								
Negative	n(%)	70,743(99,843)	31,562(99,587)	3675(99,083)	495(99)	106,475(99,737)	104,120	**< 0,001**
Positive	n(%)	111(0,157)[a]	131(0,413)[b]	34(0,917)[c]	5(1)[bc]	281(0,263)		

* Fisher-Freeman-Halton test, a-c; There is no significant difference within each line with the same letter

** Significant level at a p-value < 0.05

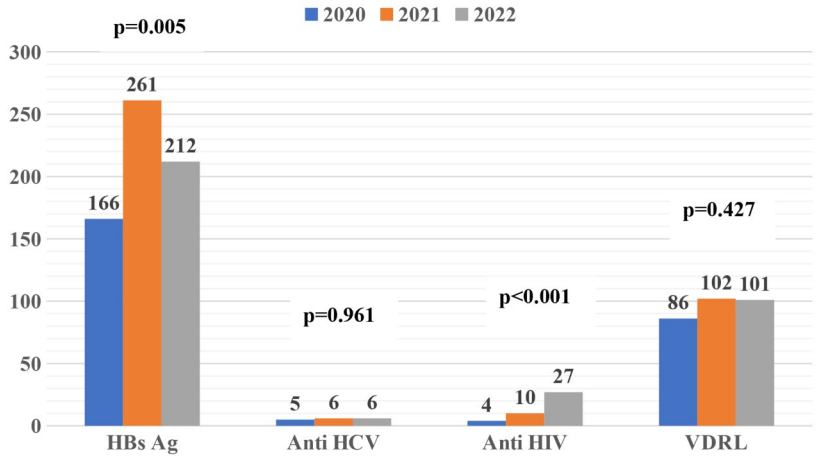

Fig. 1 Number of ELISApositivity by years

41–50 age group was 0.917%, and the 51–64 age group 1.00% (Table 3).

When the ELISA results of donors are evaluated according to years; While it was determined that HBV and HIV results showed significant differences according to years, HCV and syphilis did not show significant differences (Fig. 1).

Discussion

At the present time safe blood transfusion is the primary goal of all blood centers. It has become mandatory for physicians to inform patients who will undergo transfusion about the risks of transfusion. Thanks to measures such as screening tests, raising awareness of blood donors about infection risks and healthy lifestyles, sterilization of the equipment used, data tracking systems, expert personnel and correct labeling, blood donations are made much safer today than in the past.However, it does not seem possible to reset the transmission rate of infectious agents, and the risk of contamination continues, although small. Window period blood donations, variant viruses, atypical seroconversion and laboratory inaccuracies are shown as the reasons for this [16]. But mitigation is possible to minimize this with vaccination, donor education, Pre and Post donation counseling and Newer technology like Chemiluminescence immunoassay (CLIA), Nucleic acid test(NAT) etc. NAT, It is a screening test technology that can detect the presence of viral DNA/RNA in a shorter window period, thus greatly improving blood safety [17]. The examination performed using NAT can also shorten the window period of the disease by detecting the presence of the virus before antibodies form in the body [18, 19]. The CLIA method is a type of biochemical immunoassay that measures the concentration of a substance, usually in blood serum, by looking at the reaction of antibodies against the antigen [20].It is a well-established fact that HIV, HBV and HCV are global pathogens that contribute to mortality and morbidity at all ages [21]. In a study conducted in Pakistan, HBsAg positivity among blood donors was found to be 6.2% [22],

0.2%in Mexico [23], 8.8%in Tanzania [24], and 9.4%in Ethiopia [25]. In our study, HBsAg positivity was found to be 0.6%. An epidemiological study conducted in 2018 states that there was a significant reduction in transmission through transfusion with routine screening of blood donors for HBV, which is transmitted through blood and body fluids [26]. In particular, the transmission of sexually transmitted syphilis through blood transfusion has been almost completely eliminated by modern screening procedures [27]. In another study, the prevalence of active syphilis infection among African countries was found to be 12.8% in Tanzania and 3.8% in Kenya [11, 12]. The results of our study are consistent with the observed trend of decreasing HIV prevalence among blood donors in Ethiopia between 1995 and 2002 (from 15.7% in 1995 to 4.3% in 2002) [28].

In a study conducted on 6827 blood donors in Ethiopia between 2010 and 2014, the incidence of hepatitis C was found to be 0.7% [25], and in another study conducted on 427 blood donors in Nigeria in 2010, this rate was found to be 5.71% [29].In our study, this rate was found to be 0.01%. An anti-HCV seroprevalence of 0.9% was estimated for the general Somali population in a report released by the WHO in November 2020 [30]. In a 2019 study looked at policy indicators in 66 countries and 11 regions with the highest rates of viral hepatitis infection in order to achieve the goal of eliminating the disease; In terms of HBV, Somalia scored lowest, and in terms of HCV (no policy indicator), Somalia, Sudan, and Yemen scored lowest (no policy indicator) [31].

The HIV prevalence found in our study (0.03%) is lower than the 2.9% and 3.8% seroprevalence levels found in Cameroon and Ghana, respectively [32, 33].Previous research from several parts of the world has shown that HIV-seroprevalence is independently correlated with a lower level of education [34].Conversely, lower educational attainment was associated with a higher likelihood of engaging in commercial sex (drugs or money) and thus an increased risk of acquiring HIV [35]. Among the reasons for the low seroprevalence of HIV, HBV, HCV and syphilis in blood donors in our study; Our high sample size, pre-donation counseling, vaccination, screening of previous donations of repeat donors, the dominance of Muslim cultural characteristics in Somalia, donor training in our blood center, extremely careful execution of donor selection forms and donor screening tests, etc. reasons can be listed. In addition, the social position and gender roles of the female and the prevalence of traditional treatment methods and limited access to modern health services also contribute to the low prevalence of HIV.

In our study, 99.7% of blood donors were men. Consistent with the results of our study, in a similar study conducted in the same region of Somalia in 2024, most of the participants (93.9%) were men [36].In Nigeria, 98.7% of the 24,979 potential donors screened during the 2005-2016study period were male donors [37]. There have been reports of similar trends in Ethiopia(86.8%) [38], Pakistan (99.62%) [39], and India (95.20%) [40]. This observation can be explained by the social belief and social pressure that women should not donate blood because they lose blood every month due to menstruation. [37]. Furthermore, the current study and studies with similar trends were comprised mostly of paid donors. Male donors have been reported to be motivated by altruism and remuneration benefits [41]. The United States of America (51.7%) [42], Spain (54.0%), Portugal (57.0%), Belgium (54.6%), Netherlands (50.0%), Denmark (50.0%), France (50.0%), United Kingdom (47.0%), and Finland (45.0%) [41]all reported values that were nearly equal for both sexes, in contrast to this observation. This lack of gender disparity may be explained by the fact that most blood donations in these developed nations were made voluntarily and were motivated primarily with altruism, which is a trait shared by both sexes. Compared to men, who donate for both altruism and financial gain, women are reportedly driven primarily by altruism.The underrepresentation of the female gender in blood donation can lead to incomplete data on blood donation, making it difficult to evaluate and improve the effectiveness of health policies and strategies. It can also prevent health policies and donor strategies from achieving their goals of achieving gender equality and increasing inclusion. For these reasons, specially designed programs and health policies should be developed and implemented to ensure greater representation of women in blood donation.

In our study, when the relationship between donor gender and ELISA results was examined, it was found that HBsAg result was significantly related to gender ($p=0.007$) and HBV seroprevalence was found to be significantly higher in men (0.6%) than women (0.005%) (Table 2). The reason for this increase is that 99.7% of donors applying to our blood center are men.In a study, HBV seroprevalence in Burkina Faso was found to be significantly higher in men (10.5%) than in women (7.8%) [43]. In Gabon, a country located in the central part of the African continent, HBV seroprevalence was found to be 2 times higher in men than in women (OR=1.90 (95% CI: 1.75–2.06), $P<0.001$) [44]. Contrary to these studies, In a study conducted in the Jimma blood bank of southern Ethiopia in 2022, HBV test positivity was higher in women (3.7%) than in men (3.54%), although it was not statistically significant [45].This result might result from women seeking medical attention during pregnancy having easier access to the HBV immunization. It could also be linked to the fact that men and women have distinct T-cell immunity; women have been shown to respond more strongly than men do to antigenic stimulation,

vaccination, and infection in terms of humoral and cell-mediated immunity [43].

The illnesses under investigation are largely behavior- and age-dependent. People between the ages of 20 and 40 are the most sexually active and economically active group, and HIV has a high prevalence in these groups [21]. In a study, HIV prevalence was found to be highest in the 46–55 age group compared to the 26–35 age group [25]. This is concerning since the age segment of the population that is most productive and economically viable is the one that is most negatively impacted.It is noteworthy that in another study conducted in Burkina Faso, the frequency of HCV in donors between the ages of 30 and 40 (4.25%) was lower than in donors under the age of 20 (10.54%) and over the age of 40 (11.11%) [46]. In a study conducted in Nigeria, there was an increase in HBV seroprevalence in the 26–35 and 36–45 age groups compared to the age group over 45 years of age [47].

In our study, there is no difference between the distributions of anti-HCV+and anti-HIV+positive statuses according to age groups. However, the distributions of HBsAg and VDRL positive statuses show significant differences according to age groups ($p<0.001$) (Table 3).

When studies conducted in various years on blood donors are examined; Koçak et al. [48] According to the results of their research on 1,737,943 blood donors, they determined that HBsAg seropositivity decreased from 5.98 to 2.07% between 1987 and 2003. Kader et al. [49]. reported in their study that while the HBsAg test positivity rate was 0.79% in 2005 among 16,362 donors who applied to the blood center, this rate decreased to 0.37% in 2009. According to the study results, the reason for the decrease in HBsAg test positivity over the years may be the effective use of the donor inquiry form in blood centers, the increase in testing opportunities and the diagnosis and vaccination of people before they become blood donors.When the ELISA results of the donors were evaluated according to years in our study; It was determined that HBsAg and anti-HIV results differed significantly by year, and it was observed that HBsAg positivity and anti-HIV positivity increased especially in 2021 (Fig. 1). The relaxation of quarantine and social distance measures implemented during the Covid-19 pandemic in 2021–2022 has caused an increase in social mobility, and this has also been effective in increasing infections such as HBV and HIV.

Limitations of study

1. It is retrospective record based study hence no improvization could be done.
2. Due to the low number of female donors, a balanced gender distribution cannot be achieved in this study.
3. Due to Covid-19 pandemic there might be some changes in donor selection as Donor population decreased significantly.
4. Retesting of positives with other methods could not done.
5. A negative result from the Eliza test kits used in this study at any time does not eliminate the possibility of latent infection, such as during the window period. Since the region is low-income in our hospital, a more advanced test such as NAT, which can detect the window period before the test becomes reactive, is not studied, so hidden positivity in the window period cannot be detected. Transmission of transfusion-transmitted infections during the serologically negative window period remains a problem.Again for the same reason, confirmatory or complementary tests such as Western Blot and Ag p24 were not performed because they were not included in the blood donation algorithm in our hospital and region. People who tested positive in the second repeat were rejected as blood donors.

Advantages

1. Record based with large number of donors.
2. Study pertaining to period in Covid-19 pandemic.
3. It is one of the limited studies on the subject in this country.

Conclusion

In this study, the prevalence of HBV, HCV, HIV, and syphilis was found to be quite low among blood donors. Even if our found seroprevalence rates are low, to guarantee the safety of blood for recipients, strict selection of blood donors and thorough screening of donors' blood using accepted procedures are strongly advised. Risks arising from transfusion; It can be reduced by being meticulous in donor selection, strict implementation of donor selection criteria, training of blood center personnel, implementation of vaccination programs for HBV, public awareness studies, and avoiding unnecessary transfusions. In addition, it is important to strictly implement screening processes for blood donors and use confirmatory tests. It is also important to conduct future studies that will include more balanced gender representation, use confirmatory tests, and investigate cultural factors.

Abbreviations

HBV	Hepatitis B virus
HCV	Hepatitis C virüs
HIV	Human immunodeficiency virus
VDRL	Venereal Diseases Research Laboratory

ELISA	Enzyme-Linked Immuno Sorbent Assay
Rh	Rhesus
CLIA	Chemiluminescence immunoassay
NAT	Nucleic acid test

Acknowledgements
None.

Author contributions
SD contributed to the study design, retrieval of data and write-up. SMM contributed to the study design, retrieval of data, worked on resources, AMA worked on resources, RYHM, ZO contributed to the supervision of the work and write-up. AD contributed to the statistical analysis.

Funding
This study had no funding sources to declare.

Data availability
No datasets were generated or analysed during the current study.

Declerations

Ethics approval
Before the commencement of the study, we obtained ethical clearance from the ethics committee of Mogadishu Somalia Turkey Recep Tayyip Erdogan Training and Research Hospital (approval number: MSTH/13125) we conducted the study following the Declaration of Helsinki.

Consent for publication
Not applicable.

Informed consent
The consenting process was waived by our hospital's ERB due to the retrospective nature of the study. However, before the study, all participants were made aware that their data might be used in future research and that signed informed consent had been obtained.

Competing interests
The authors declare no competing interests.

Received: 7 December 2023 / Accepted: 20 August 2024
Published online: 10 September 2024

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