

Experiences of Anesthesiologists in Managing Blood and Blood Product Transfusions: A Multicenter Survey Study

Anestezi Uzmanlarının Kan ve Kan Ürünleri Transfüzyonlarını Yönetme Deneyimleri: Çok Merkezli Anket Çalışması

Aysim Erturk¹, Alev Saylan², Duygu Kara³, Busra Tezcan², Aslı Z Demir⁴, Umit Karadeniz⁴, Aysegul Ozgok⁴

¹Elazığ Fethi Sekin City Hospital, Clinic of Intensive Care, Elazığ, Türkiye

²Ankara Etlik City Hospital, Clinic of Anesthesiology and Reanimation, Ankara, Türkiye

³Adnan Menderes University, Faculty of Medicine, Department of Anesthesiology and Reanimation, Aydın, Türkiye

⁴Ankara Bilkent City Hospital, Clinic of Anesthesiology and Reanimation, Ankara, Türkiye

ABSTRACT

Objective: Perioperative blood transfusion management is an increasingly important area focused on improving patient outcomes. Anesthesiologists play a vital role in this process and work collaboratively with the surgical team in administering blood transfusions. The aim of this survey is to gather information on the general trends and preferences among anesthesiologists regarding the use of blood products in our country's anaesthesia practice, and to increase awareness among anesthesiologists about blood transfusion management.

Method: The survey included anesthesia residents studying in the field of Anesthesiology and Reanimation, as well as anesthesiology specialists with varying levels of professional experience and/or academic titles. The surveys were completed during face-to-face interviews or sent as printed or electronic forms to be filled out. The questionnaire consisted of 30 questions regarding demographic information, hospital organization, and transfusion practices.

Results: A total of 501 anesthesiologists representing the entire country participated in the study. Of the participants, 79% reported having received training on blood products, and 60.3% stated that they were familiar with the relevant guidelines. It was found that the transfusion decision was primarily made jointly by the anesthesiologist and surgeon (71.2%), and that pre-anesthesia evaluations were mainly conducted within three days before surgery (58.5%). In different scenarios, the hemoglobin (Hb) threshold values selected for transfusion varied according to the physicians' experiences. The most frequently used parameter for intraoperative blood loss was Hb/haematocrit levels, and the most common method to reduce intraoperative blood transfusion was controlled hypotension.

ÖZ

Amaç: Perioperatif kan transfüzyonu yönetimi, hasta sonuçlarını iyileştirmeye odaklanan ve önemi giderek artan bir alandır. Anestezi uzmanları bu süreçte hayati bir rol oynamakta ve kan transfüzyonlarının uygulanmasında cerrahi ekiple işbirliği içinde çalışmaktadır. Bu anketin amacı, ülkemiz anestezi pratiğinde kan ürünlerinin kullanımına ilişkin anestezi uzmanları arasındaki genel eğilimler ve tercihler hakkında bilgi toplamak ve anestezi uzmanları arasında kan transfüzyonu yönetimi konusunda farkındalığı artırmaktır.

Yöntem: Ankete Anesteziyoloji ve Reanimasyon alanında eğitim gören anestezi asistanlarının yanı sıra farklı düzeylerde mesleki deneyime ve/veya akademik unvanlara sahip anesteziyoloji uzmanları da dahil edildi. Anketler yüz yüze görüşmeler sırasında dolduruldu veya doldurulmak üzere basılı veya elektronik formlar olarak gönderildi. Anket demografik bilgiler, hastane organizasyonu ve transfüzyon uygulamaları ile ilgili 30 sorudan oluşuyordu.

Bulgular: Çalışmaya tüm ülkeyi temsilen toplam 501 anestezi uzmanı katılmıştır. Katılımcıların %79'u kan ürünleri ile ilgili eğitim aldığını, %60,3'ü ise ilgili kılavuzlara aşina olduğunu belirtmiştir. Transfüzyon kararının primer olarak anestezi uzmanı ve cerrah tarafından ortaklaşa verildiği (%71,2) ve anestezi öncesi değerlendirmelerin ağırlıklı olarak ameliyattan önceki üç gün içinde (%58,5) yapıldığı tespit edildi. Farklı senaryolarda, transfüzyon için seçilen hemoglobin (Hb) eşik değerleri hekimlerin deneyimlerine göre değişmiştir. İntraoperatif kan kaybı için en sık kullanılan parametre Hb/hematokrit düzeyleriydi ve intraoperatif kan transfüzyonunu azaltmada en sık kullanılan yöntem kontrollü hipotansiyondu.

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*Corresponding author: Alev Saylan • alevdr@hotmail.com

Aysim Erturk 0000-0001-7736-0790 / Alev Saylan 0000-0002-3261-1004

Duygu Kara 0000-0003-3325-2565 / Busra Tezcan 0000-0001-8914-0234

Aslı Z Demir 0000-0003-3053-0443 / Umit Karadeniz 0000-0002-0067-6938

Aysegul Ozgok 0000-0002-0105-3388

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Conclusion: Our study suggests that participants need to adhere more closely to guidelines regarding transfusion practices. To ensure that practices are correct and standardized, training programmes at all stages should be expanded, updated according to guidelines, and training materials should be readily accessible.

Keywords: Anesthesia, transfusion medicine, questionnaire, blood transfusion, blood components transfusion

Sonuç: Çalışmamız, katılımcıların transfüzyon uygulamaları ile ilgili kılavuzlara daha yakından uymaları gerektiğini göstermektedir. Uygulamaların doğru ve standartlaştırılmasını sağlamak için tüm aşamalardaki eğitim programları genişletilmeli, kılavuzlara göre güncellenmeli ve eğitim materyalleri kolayca erişilebilir olmalıdır.

Anahtar sözcükler: Anestezi, transfüzyon tıbbı, anket, kan transfüzyonu, kan bileşenleri transfüzyonu

INTRODUCTION

As the number of surgical procedures increases today, the importance of managing blood transfusions has also grown. Blood transfusion first appeared in the early 20th century as a quick and easy treatment for anemia and bleeding, becoming widely used in medical practice and often described as “life-saving” (1). The term blood transfusion is defined as “the administration of blood components to a patient, including whole blood, red blood cell concentrate, red blood cell suspension, fresh frozen plasma, platelet concentrate, cryoprecipitate, coagulation factors, albumin, immunoglobulins, and similar products” (2).

Operating rooms and intensive care units, where physicians in the field of Anesthesiology and Reanimation work, are among the main locations where blood and blood products are frequently used. Perioperative blood transfusion management is becoming increasingly important to improve patient outcomes. This process involves assessing the patient’s medical condition, including the risk of bleeding and possible transfusion needs in the preoperative period, providing appropriate anesthesia, preventing or minimizing blood loss during the intraoperative period, and ensuring the patient’s recovery in the postoperative period (3,4).

Perioperative blood management is a collaborative effort involving multiple disciplines. Anesthesiologists play a vital role in this team, with their primary responsibilities including the proper clinical use of blood products in coordination with the surgical team. This survey study aims to assess the knowledge, attitudes, and behaviors regarding the use of blood and blood products in anesthesia practice in our country, identify issues in current practices, and gather insights into overall trends and preferences among anesthesiologists. Additionally, it seeks to raise awareness about blood transfusion management among physicians working in the field of Anesthesiology and Reanimation.

MATERIAL and METHODS

This survey study included resident doctors studying in the field of Anesthesiology and Reanimation at various hospitals in Türkiye, as well as anesthesiologists with different levels of professional experience and/or academic titles. The study

was approved by the Clinical Research Ethics Committee of Ankara Türkiye High Specialization Training and Research Hospital (Decision number and date: 29/28.11.2014) and the Education Planning Coordination Committee, and informed consent was obtained from the participants.

To assess the survey’s feasibility and identify potential issues during implementation, a preliminary study was conducted with 20 volunteer physicians from various hospitals. Afterwards, the surveys were distributed to the participants, who completed them either during face-to-face interviews or via printed or electronic forms. Additionally, the surveys were handed out by researchers to anesthesiologists attending the 48th Turkish Anesthesiology and Reanimation Congress in Ankara, and responses were collected.

The survey included 30 questions divided into three sections: demographic information, hospital organization, and blood transfusion practices.

Statistical Analysis

For the statistical analysis, SPSS (Statistical Package for the Social Sciences) version 11.5 software was used. Descriptive statistics were presented as numbers and percentages for categorical variables and as mean $\pm$ standard deviation for numerical variables. We employed Chi-square and Fisher’s exact tests to compare the groups. A p-value less than 0.05 was considered statistically significant.

RESULTS

A total of 501 physicians practicing in anesthesiology and reanimation participated in our survey. The demographic and professional characteristics of the participants are shown in Table I.

In summary, the participant group mainly consisted of female physicians, with the largest portion aged between 31 and 40 years old. Most participants were specialist doctors with extensive experience in their field. They primarily worked at university or training and research hospitals and participated in multiple units within these institutions.

The personal characteristics of the participants, along with the aspects related to blood and blood product use in their hospitals, are shown in Table II.

Table I. Demographic and Professional Characteristics of the Participants

	n	%
Age		
≤ 30	78	15.6
31-40	223	44.5
41-50	147	29.3
> 50	53	10.6
Gender		
Male	199	39.7
Female	302	60.3
Title		
Anesthesia residents	98	19.6
Specialist doctor	294	58.7
Assistant professor	43	8.6
Associate professor	32	6.4
Professor	34	6.8
Number of years of Anesthesiology and Reanimation		
Research assistant	2.51 ± 1.13	
Specialist doctor	9.15 ± 6.72	
Assistant professor	10.09 ± 4.07	
Associate professor	15.29 ± 5.42	
Professor	23.09 ± 6.05	
Type of hospital		
Public	110	22.0
Education and Research Hospital	166	33.1
University	185	36.9
Private	40	8.0
Which operating room or Intensive Care Unit in your hospital do you mainly work in?		
Cardiovascular Surgery	38	7.9
Transplantation Surgery	6	1.2
Orthopedics and Traumatology	31	6.4
Gynecology and Obstetrics	25	5.2
Oncological Surgery	13	2.7
Neurosurgery	15	3.1
Pediatric Surgery	7	1.4
Intensive Care Unit	53	11.0
Algology	2	0.4
Other	40	8.3
Multiple	254	52.5

Out of the 396 participants who received education on blood and blood products, 60.1% attended seminars, 48% participated in symposiums and conferences, 47.7% took part in in-hospital training programs and presentations, and 26% obtained information from written materials.

Of the 302 participants familiar with blood transfusion guidelines, 84.1% cited the Turkish Society of Anesthesiology and Reanimation (TSAR), 18.5% cited the American Society of Anesthesiologists (ASA), and 17.5% cited the European Society of Anesthesiology and Intensive Care (ESAIC) guidelines as their sources. Most participants work in hospitals that perform blood and blood product transfusions (97.4%) and have

a blood center on site (84.8%). When asked if their institution has a blood transfusion committee, 25.9% answered 'Don't know'; when asked if there is a blood transfusion protocol, 22.6% answered 'Don't know'; and when asked if there is a maximum blood transfusion schedule, which is essential for planning before elective surgeries, 18.8% answered 'Don't know' (Table II).

Our findings showed that preoperative assessment before surgeries with expected bleeding was mainly conducted (58.5%) within three days prior to the operation. Half of the participants (50.9%) reported asking about herbal medications during preoperative consultations. The most commonly

Table II. Table of Questions Regarding Participants' Personal and Hospital Information

	n	%
Have you received any training concerning the use of blood/blood products?		
Yes	396	79.0
Seminar	238	60.1
Symposium-Congress	190	48.0
Hospital in-service training program-presentation	189	47.7
Written material	103	26.0
Other	16	4.0
No	105	21.0
Do you know of any contemporary blood transfusion guidelines?		
Yes	302	60.3
Turkish Society of Anesthesiology and Reanimation (TARD)	254	84.1
The American Society of Anesthesiologists (ASA)	56	18.5
European Society of Anaesthesiology and Intensive Care (ESAIC)	53	17.5
Other	16	5.3
No	199	39.7
Is blood and blood product transfusion performed in your hospital?		
Yes	488	97.4
No	13	2.6
Does your hospital have a blood bank/transfusion center?		
Yes	425	84.8
No	76	15.2
Does your hospital have a transfusion committee?		
Yes	276	55.1
No	95	19.0
Don't know	130	25.9
Does the institution you work for have a blood transfusion protocol?		
Yes	193	38.5
No	195	38.9
Don't know	113	22.6
Does your hospital use a maximum blood demand schedule to determine the amount of blood needing to be prepared prior to elective surgeries?		
Yes	89	17.8
No	318	63.5
Don't know	94	18.8
Who decides on blood transfusion in your hospital?		
Anesthetist	128	26.1
Surgeon	9	1.8
Anesthetist and surgeon together	349	71.2
Other	4	0.8

used herbal medicines were ginkgo biloba (73.6%), ginseng (66.9%), and garlic extract (62%). The rate of obtaining informed consent from patients before transfusion was 67.1%. Red blood cell suspension was the most frequently administered blood product (87.2%), and the rate of always completing the transfusion monitoring form during transfusion was 68.6% (Table III).

We found that when asked about the Hb threshold for initiating transfusions in adult intensive care patients, the ma-

jority (84.6%) reported using a threshold of 7-8 g dL⁻¹. In the postoperative period, 47% of noncardiac adult patients had a threshold of 8 g dL⁻¹, while in pediatric cardiac patients with acute intraoperative bleeding, 50.1% indicated a threshold of 10 g dL⁻¹ (Table IV).

The most commonly used parameter for monitoring intraoperative blood loss was found to be Hb/Hct levels. Controlled hypotension was the most frequently employed technique to reduce intraoperative blood transfusion rates. We observed

Table III. Anesthetists' Preoperative and Intraoperative Approaches to Blood Transfusion

	n	%
How many days on average before surgery expected to involve bleeding do you perform pre-anesthesia evaluation?		
Immediately before surgery	66	13.6
1-3 day	283	58.5
4-7 day	83	17.1
>7 days	52	10.7
Do you ask about herbal medication use in your patients at pre-operative consultation ?		
Yes	255	50.9
Garlic extract	75	62.0
Ginkgo biloba	89	73.6
Ginseng	81	66.9
Other	20	16.5
No	246	49.1
Do you obtain signed patient consent before transfusion?		
Yes	322	67.1
No	158	32.9
Please indicate the blood/blood products you transfuse most frequently, in order,		
Complete blood	20	4.0
Erythrocyte suspension	437	87.2
Fresh frozen plasma	22	4.4
Platelet concentrate	0	0.0
Cryoprecipitate	0	0.0
Other	1	0.2
Multiple	21	4.2
Do you complete a monitoring form during transfusion?		
Always	328	68.6
Usually	64	13.4
Sometimes	28	5.9
Rarely	21	4.4
Never	37	7.7

that clinicians most often used normal saline for dilution during blood product transfusions, and they primarily initiated fresh frozen plasma (FFP) transfusions to replace factor deficiencies. We found that hypocalcemia/citrate toxicity and febrile transfusion reactions were the most commonly reported transfusion complications (Table V).

When we evaluate the participants' answers according to the type of hospital they work in, significant differences are observed between institutions, especially in the evaluation

made 1-3 days before anesthesia for surgeries where bleeding is expected (Table VI).

When preoperative patient evaluations and attitudes towards blood transfusion were examined according to title, it was observed that the frequency of asking questions about herbal medicines, obtaining written consent before transfusion, and filling out the follow-up form during transfusion differed among seniority groups (Table VII).

Table IV. Level of Knowledge Among Anesthetists Participating in the Study Regarding Threshold Hemoglobin Levels for Transfusion in Varying Clinical Conditions

	n	%
What is your threshold hemoglobin level for starting blood product transfusion in adult patients in intensive care?		
≤6 g dL ⁻¹	19	4.0
7 g dL ⁻¹	199	42.0
8 g dL ⁻¹	202	42.6
9 g dL ⁻¹	26	5.5
10 g dL ⁻¹	28	5.9
What is your threshold hemoglobin level for starting blood product transfusion in non-cardiac adult patients in the postoperative period?		
≤6 g dL ⁻¹	14	3.0
7 g dL ⁻¹	161	34.1
8 g dL ⁻¹	221	47.0
9 g dL ⁻¹	40	8.5
10 g dL ⁻¹	36	7.6
What is your threshold hemoglobin level for starting blood product transfusion in patients in the geriatric age group?		
≤6 g dL ⁻¹	7	1.5
7 g dL ⁻¹	68	14.3
8 g dL ⁻¹	148	31.1
9 g dL ⁻¹	132	27.7
10 g dL ⁻¹	121	25.4
What is your threshold hemoglobin level for starting blood product transfusion in adult patients throughout cardiopulmonary bypass?		
≤6 g dL ⁻¹	19	4.6
7 g dL ⁻¹	123	29.5
8 g dL ⁻¹	126	30.2
9 g dL ⁻¹	41	9.9
10 g dL ⁻¹	107	25.7
What is your threshold hemoglobin level for starting blood product transfusion in non-cardiac pediatric patients with acute intraoperative bleeding?		
≤6 g dL ⁻¹	10	2.2
7 g dL ⁻¹	69	15.4
8 g dL ⁻¹	150	33.6
9 g dL ⁻¹	113	25.3
10 g dL ⁻¹	105	23.5
What is your threshold hemoglobin level for starting blood product transfusion in cardiac pediatric patients with acute intraoperative bleeding?		
≤6 g dL ⁻¹	0	0.0
7 g dL ⁻¹	28	6.7
8 g dL ⁻¹	63	15.3
9 g dL ⁻¹	114	27.7
10 g dL ⁻¹	206	50.1

Table V. Knowledge and Behavioral Attitudes of Anesthetists Participating in the Study Regarding Intraoperative Blood Transfusion, Based on the Most Frequently Used Parameters (Number of Times Each Parameter is Marked in the First Row)

	n	%
Please indicate the intraoperative blood loss parameters you use most frequently, in order, 1 highest, 2 next highest etc.		
Hemoglobin/haematocrit value	283	56.5
Tissue oxygenation parameters (lactate, base excess etc.)	13	2.6
Blood loss volume and rate	131	26.1
Patient's clinical condition (tachycardia, hypotension, dyspnea, arrhythmia etc.)	50	10.0
Multiple	24	4.8
Please mark the methods you use to reduce intraoperative blood transfusion levels, in order of frequency, 1 highest, 2 next highest etc.		
Autologous blood transfusion	41	8.2
Blood collection and application device (cell-saver) use Pre-perioperative normovolemic haemodilution in selected patients	17	3.4
Coagulation monitoring (ROTEM – thromboelastometry / TEG - thromboelastography)	89	17.8
Controlled hypotension	4	0.8
Antifibrinolytic drug use (aprotinin, tranexamic acid, ε-aminocaproic acid)	202	40.3
Encouraging the use of bleeding-reducing surgical methods	9	1.8
Heating the patient and the fluids administered	66	13.2
Other	19	3.8
Multiple	2	0.4
What fluids do you use for dilution in blood product transfusion? (You may indicate more than one)		
Saline solution	52	10.4
Ringer lactate	439	90.5
5% dextrose solution	174	35.9
Albumin	26	5.4
Other	29	6.0
Please mark your indications for beginning fresh frozen plasma transfusion in order of frequency, 1 highest, 2 next highest etc.		
Turning off volume expansion and using fresh frozen plasma as a volume enhancer	34	7.0
Replacing factor deficits	154	30.7
Use of albumin for replacement purposes	291	58.1
At the request of the surgical team	17	3.4
To support haemodynamics before diuretic administration	5	1.0
Other	2	0.4
Multiple	8	1.6
Please mark the blood/blood product transfusion reactions or complications you encounter in order of frequency, 1 highest, 2 next highest etc.		
Hyperkalemia	24	4.8
Hypocalcemia/citrate toxicity	77	15.4
Acute haemolytic transfusion reaction	175	34.9
Febrile transfusion reactions	20	4.0
Urticaria and anaphylactic reactions	128	25.5
Transfusion-related lung injury	51	10.2
Post-transfusion purpura	6	1.2
Infectious complications	11	2.2
Other	2	0.4
	31	6.2

Table VI. Preoperative Patient Assessments and Intraoperative Attitudes Towards Blood Transfusion Among Anesthetists Participating in the Study (According to the Type of Hospital They Work in)

	Public	Education and Research Hospital	University	Private	p
	n (%)	n (%)	n (%)	n (%)	
How many days on average before surgery expected to involve bleeding do you perform pre-anesthesia evaluation?					
Immediately before surgery	23 (21.7)	15 (9.4)	24 (13.3)	4 (10.5)	0.002
1-3 day	59 (55.7)	88 (60.0)	108 (60.0)	28 (73.7)	
4-7 day	12 (11.3)	43 (26.9)	24 (13.3)	4 (10.5)	
>7 days	12 (11.3)	14 (8.8)	24 (13.3)	2 (5.3)	
Do you ask about herbal medication use in your patients at pre-operative consultation ?					
Yes	51 (46.4)	87 (52.4)	94 (50.8)	23 (57.5)	0.625
No	59 (53.6)	79 (47.6)	91 (49.2)	17 (42.5)	
Do you obtain signed patient consent before transfusion?					
Yes	63 (60.6)	100 (63.3)	128 (71.5)	31 (79.5)	0.062
No	41 (39.4)	58 (36.7)	51 (28.5)	8 (20.5)	
Indicate the blood/blood products you transfuse most frequently, in order					
Complete blood	5 (4.5)	5 (3.0)	0 (5.4)	0 (0.0)	0.683
Erythrocyte suspension	91 (82.7)	148 (89.2)	161 (87.0)	37 (92.5)	
Fresh frozen plasma	8 (7.3)	5 (3.0)	7 (3.8)	2 (5.0)	
Other	0 (0.0)	1 (0.6)	0 (0.0)	0 (0.0)	
Multiple	6 (5.5)	7 (4.2)	7 (3.8)	1 (2.5)	
Do you complete a monitoring form during transfusion?					
Always	65 (64.4)	110 (70.1)	123 (68.0)	30 (76.9)	0.105
Usually	16 (15.8)	20 (12.7)	28 (15.5)	0 (0.0)	
Sometimes	9 (8.9)	8 (5.1)	9 (5.0)	2 (5.1)	
Rarely	8 (7.9)	5 (3.2)	5 (2.8)	3 (7.7)	
Never	3 (3.0)	14 (8.9)	16 (8.8)	4 (10.3)	

DISCUSSION

One of the most critical areas of interest for anesthesiologists is perioperative blood management. Perioperative blood management encompasses blood transfusion as well as adjunctive therapies, including medications and techniques that reduce or eliminate the need for transfusion (5). Anesthesiologists, in collaboration with surgeons, play a vital role in this process. In our study, 71.2% of participants reported that the decision to undergo a blood transfusion was made jointly by anesthesiologists and surgeons. In comparison, 26.1% indicated it was created solely by anesthesiologists, and 1.8% by surgeons alone. Similarly, a survey by Nuttall et al. among ASA members found that 67% of participants reported joint decision-making between anesthesiologists and surgeons, 33% reported that anesthesiologists made decisions alone, and

less than 1% reported that surgeons made decisions alone (6).

Anesthesiologists' knowledge of transfusion guidelines, the existence of transfusion committees at their hospitals, transfusion protocols, and maximum blood order schedules are significant factors influencing the transfusion management process. In our survey, nearly all participants (97.4%) reported that their hospitals performed blood transfusion procedures, and most (84.8%) indicated that their hospitals had a blood bank or blood center. However, only 55.1% of participants confirmed the existence of a transfusion committee, 38.5% reported having a transfusion protocol, and 17.8% stated that a maximum blood order schedule was in use. In Nuttall et al.'s study (6), 82% of participants reported the presence of a transfusion committee at their hospitals, while 52% were unaware of a maximum blood order schedule. These find-

Table VII. Preoperative Patient Assessment for Blood Transfusion According to Title and Behavioral Attitudes Towards Blood Transfusion

	Anesthesia residents	Specialist doctor	Assistant professor	Associate professor	Professor	p
	n (%)	n (%)	n (%)	n (%)	n (%)	
How many days on average before surgery expected to involve bleeding do you perform pre anesthesia evaluation?						
Immediately before surgery	13 (13.8)	38 (13.4)	8 (19.0)	5 (15.6)	2 (6.2)	0.411
1-3 day	48 (51.1)	167 (58.8)	27 (64.3)	17 (53.1)	24 (75.0)	
4-7 day	19 (20.2)	51 (18.0)	3 (7.1)	5 (15.6)	5 (15.6)	
>7 days	14 (14.9)	28 (9.9)	4 (9.5)	5 (15.6)	1 (3.1)	
Do you ask about herbal medication use in your patients at pre-operative consultation ?						
Yes	45 (45.9)	136 (46.3)	29 (67.4)	23 (71.9)	22 (64.7)	0.002
No	53 (54.1)	158 (53.7)	14 (32.6)	9 (28.1)	12 (35.3)	
Do you obtain signed patient consent before transfusion?						
Yes	42 (44.7)	210 (74.5)	27 (65.9)	22 (68.8)	21 (67.7)	0.001
No	52 (55.3)	72 (25.5)	14 (34.1)	10 (31.2)	10 (31.2)	
Please indicate the blood/blood products you transfuse most frequently, in order,						
Whole blood	5 (5.1)	11 (3.7)	4 (9.3)	0 (0.0)	0 (0.0)	0.423
Erythrocyte suspension	80 (81.6)	259 (88.1)	36 (83.7)	32 (100.0)	30 (88.2)	
Fresh frozen plasma	8 (8.2)	11 (3.7)	2 (4.7)	0 (0.0)	1 (2.9)	
Other	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	
Multiple	5 (5.1)	12 (4.1)	1 (2.3)	0 (0.0)	3 (8.8)	
Do you complete a monitoring form during transfusion?						
Always	52 (56.5)	213 (75.5)	29 (69.0)	17 (53.1)	17 (56.7)	0.001
Usually	23 (25.0)	27 (9.6)	5 (11.9)	7 (21.9)	2 (6.7)	
Sometimes	4 (4.3)	16 (5.7)	2 (4.8)	3 (9.4)	3 (10.0)	
Rarely	7 (7.6)	6 (2.1)	2 (4.8)	4 (12.5)	2 (6.7)	
Never	6 (6.5)	20 (7.1)	4 (9.5)	1 (3.1)	6 (20.0)	

ings highlight significant gaps in our country, underscoring the need to prioritize the establishment of active transfusion committees, the development of comprehensive transfusion protocols, and the implementation of maximum blood order schedules.

In our study, 79% of participants reported receiving education on blood product use, and 60.3% claimed to have up-to-date knowledge of current guidelines. Among those familiar with the guidelines, 84.1% referred to TSAR guidelines, 18.5% to ASA guidelines, and 17.5% to ESAIC guidelines, with the TSAR's "Transfusion Guidelines for Blood and Blood Products in Anesthesia and Intensive Care" being the most frequently used (2).

Additionally, the Ministry of Health in Türkiye has published "The Clinical Use of Blood Guide" and six national "Patient Blood Management Guidelines" between 2019 and 2022, outlining standards and procedures for blood transfusions (7). In Nuttall et al.'s study, 72% of participants were aware of ASA guidelines, but only 55% found them somewhat helpful, and just 36% found them very useful (6). Similarly, Likosky et al. reported that while 78% of anesthesiologists had read transfusion-related guidelines or summaries, only 20% reported institutional discussions about these guidelines, and 14% mentioned the establishment of institutional monitoring groups (8). These findings highlight the need for increased efforts to improve guideline utilization.

Preoperative evaluations aim to identify potential risks and assess the need for transfusion in patients undergoing surgery. The goal is to recognize risks specific to the type of surgery or the patient's clinical condition, minimize intraoperative and postoperative complications, reduce hospital stays, and ultimately lower mortality and morbidity (9). Anemia, a common perioperative condition that negatively impacts patient outcomes, must be addressed during preoperative assessments (10). The role of anesthesiologists in managing perioperative anemia has gained significant importance over the past two decades. The implementation of "Patient Blood Management" programs has further increased anesthesiologists' involvement in anemia treatment (11). A multicenter study in Türkiye revealed that one-third of patients undergoing elective major surgery (33%) were anemic during preoperative evaluations (12). In our study, 58.5% of participants reported conducting preoperative assessments within three days before surgery, highlighting the importance of addressing anemia during this period.

Studies show that patients commonly use herbal supplements and alternative medicines, which clinicians should discuss during preoperative evaluations (13,14). Many herbal medicines can increase bleeding risk and need to be stopped well before surgery, based on their half-lives (e.g., garlic 7 days prior, ginkgo biloba 36 hours prior, ginseng 7 days prior) (2,14). In our study, 50.9% of participants reported asking patients about their use of herbal supplements during preoperative consultations. Ginkgo biloba (73.6%), ginseng (66.9%), and garlic extract (62%) were the most frequently reported supplements. Clinicians should add reminders about herbal supplement use to preoperative assessment forms to ensure comprehensive evaluations.

Patients may have differing perceptions, knowledge gaps, or prejudices about the risks associated with blood transfusions (15-17). Therefore, providing information and obtaining informed consent before transfusions is essential. In our study, 67.1% of participants reported obtaining informed consent, but this rate was significantly lower (44.7%) among residents, potentially due to their high workload. Improved planning of work conditions and educational programs during residency is necessary (Table VII).

Many factors influence the decision to transfuse in surgical cases, including the patient's age, type of surgery, the volume and speed of blood loss, and comorbidities. Hemoglobin and hematocrit levels are key parameters for starting and monitoring transfusions.

For surgical procedures where bleeding is anticipated, preoperative anemia is defined as $\text{Hb} < 13 \text{ g dL}^{-1}$ for both male and female patients. A preoperative Hb level below 13 g dL^{-1} increases the risk of postoperative complications (18).

Perioperative transfusions are seldom needed in stable patients with $\text{Hb} \geq 10 \text{ g dL}^{-1}$ but are often necessary when Hb levels drop near 7 g dL^{-1} (19).

Hemoglobin threshold values for transfusion may vary in different patient groups (20). Our study analyzed the Hb thresholds considered by anesthesiologists for initiating transfusion across different patient groups. For stable adult ICU patients without significant comorbidities, a threshold of 7 g dL^{-1} is recommended (2). In our study, 42% of participants indicated a threshold of 7 g dL^{-1} , while 42.6% preferred 8 g dL^{-1} .

For noncardiac surgical patients with preoperative anemia, even mild anemia is associated with higher 30-day postoperative mortality and morbidity compared to non-anemic patients (21). After surgery, transfusion decisions should consider the patient's clinical condition if Hb levels are between $6\text{--}10 \text{ g dL}^{-1}$ (2). In our study, 47% of participants reported using 8 g dL^{-1} as the Hb threshold for initiating transfusion in postoperative noncardiac adult patients.

In our study, the most commonly reported Hb threshold for initiating blood transfusion in geriatric patients was 8 g dL^{-1} (31.1%). Studies report that intraoperative blood transfusion reduces 30-day postoperative mortality in geriatric patients undergoing major noncardiac surgery who have preoperative anemia ($\text{Hct} < 24\%$) or experience massive intraoperative bleeding (22). However, there are also circumstances where postoperative transfusion increases morbidity and mortality risks in geriatric patients (23). Clinicians must carefully consider comorbidities when determining transfusion thresholds in geriatric patients, and planning should involve a multidisciplinary approach.

Perioperative bleeding is common in surgeries performed with cardiopulmonary bypass (CPB), often necessitating the use of various blood products, which increases the risk of morbidity and mortality (24,25). According to TSAR guidelines, if $\text{Hb} > 12 \text{ g dL}^{-1}$ at the start of cardiac surgery, approximately one unit of blood collected during the operation should be returned after terminating extracorporeal circulation. During extracorporeal circulation, maintaining haematocrit levels at 20–22% with red blood cell transfusion is recommended (2). In our study, 30.2% of participants reported an Hb threshold of 8 g dL^{-1} as the threshold for initiating transfusion during CPB in adult patients, and 29.5% reported 7 g dL^{-1} as the threshold for initiating transfusion during CPB in adult patients. These findings indicate that threshold values for blood management in cardiac surgery patients may vary depending on the experience of anesthesiologists.

In pediatric patients, Hb thresholds for blood transfusion differ from those for adults. Further differences exist between the neonatal period and the post-four-month infant/child-

hood period (2). According to ESAIC guidelines, a perioperative Hb level of 7 g dL⁻¹ is considered adequate for stable, critically ill children. In children with massive bleeding, Hb should be maintained at ≥ 8 g dL⁻¹ (26). After noncardiac surgery, a threshold of 7 g dL⁻¹ appears safe in pediatric patients (27). In our study, the most frequently reported Hb threshold for intraoperative transfusion in acutely bleeding noncardiac pediatric patients was 8 g dL⁻¹ (33.6%).

In our study, 50.1% of participants reported 10 g dL⁻¹ as the Hb threshold for initiating transfusion in acutely bleeding pediatric cardiac patients during surgery. A hemoglobin threshold of 7 g dL⁻¹ is considered safe for non-cyanotic pediatric patients undergoing cardiac surgery, while 9 g dL⁻¹ is safer for cyanotic patients. Clinicians recommend higher hemoglobin levels for patients with unstable conditions. Nevertheless, improved criteria for transfusion thresholds in children with cardiac conditions are needed (27).

Blood transfusion management should follow updated guideline recommendations, and hospital transfusion protocols must specify Hb thresholds.

In our study, the most commonly used parameter for evaluating blood loss was Hb/Hct levels (56.5%), followed by the volume and rate of blood loss (26.1%) and the patient's clinical condition (10%). The TSAR guidelines note that in acute bleeding, Hb/Hct levels may initially appear normal or elevated until plasma volume is restored, making clinical signs and symptoms more critical (2). A survey of ASA members found that 91% assessed blood loss during major abdominal surgery by measuring aspirated blood, 82% used visual estimation, and 81% measured Hb/Hct levels (6).

In blood transfusions, the most commonly used diluent in our study was 0.9% saline (NaCl solution), reported by 90.5% of participants. Similarly, the ASA survey found that 87% of participants used crystalloids (mainly saline) for dilution purposes (6).

The TSAR guidelines identify coagulation factor deficiencies as the main reason for using FFP and advise against its use for volume replacement (2). In our study, the most common reasons for FFP use were coagulation factor deficiencies (58.1%) and volume replacement (30.7%).

Blood transfusions are generally safe, with adverse reactions occurring in less than 1% of patients (28). Acute reactions within 24 hours include hemolytic reactions, febrile non-hemolytic reactions, allergic reactions, and transfusion-related acute lung injury. Delayed reactions, which may happen 24 hours or even weeks after transfusion, include hemolytic transfusion reactions, transfusion-associated graft-versus-host disease, and post-transfusion purpura (29). In our study,

the most commonly reported complication was hypocalcemia/citrate toxicity (34.9%), followed by febrile transfusion reactions (25.5%). Trained healthcare personnel should monitor patients during transfusions to quickly address potential acute complications. In our study, transfusion monitoring forms were always completed by 68.6% of participants, with specialists having the highest rate (75.5%). Completing monitoring forms is essential for patient safety.

Among intraoperative strategies to reduce transfusion needs, controlled hypotension (40.3%) is the most common, followed by pre-perioperative normovolemic haemodilution (17.8%) and the use of surgical techniques to minimize bleeding (13.2%). The TSAR guidelines recommend controlled hypotension, maintaining normothermia by warming the patient and administering fluids, as well as intraoperative blood collection and transfusion to decrease transfusion requirements. They suggest using acute normovolemic haemodilution only in selected patients (2). The ASA survey found that clinicians used intraoperative blood collection and reinfusion in 95% of cases and employed acute normovolemic haemodilution in 31% (6).

Theusinger et al. reported that the main strategies to reduce blood product use include correcting preoperative anemia, minimizing intraoperative blood loss, and using restrictive transfusion triggers (30). To reduce perioperative transfusion requirements in cardiovascular surgery, studies show that applying algorithms incorporating viscoelastic tests and coagulation management based on platelet function tests is effective (31). Restrictive and liberal blood transfusions showed no difference in mortality or complications after hip surgery in high-risk patients (32). In another study, it was reported that the outcomes in patients who received restrictive blood transfusions were similar to or better than those in patients who received liberal transfusions (33). These findings highlight the importance of avoiding unnecessary blood transfusions, and a restrictive strategy should be implemented whenever possible.

In recent years, changes in transfusion practices, updated guidelines and PBM programs have led to significant progress worldwide and in our country. In terms of timing, we should make it clear that the period in which we conducted our survey as a research team is not recent, which is a limitation of our article. However, we believe that the findings of this paper can contribute to the success of current practices by encouraging a reevaluation of existing methods, enabling further development, and increasing awareness of ongoing issues in practical application. These results provide documented evidence that there may still be areas for improvement in current practice. We also feel that the responses and the number of participants during the research contributed sig-

nificantly to raising awareness, which is one of our goals for conducting this survey. As a research team, we believe that blood and blood product transfusion procedures in anesthesia should be compatible with current information and medical developments, and that every contribution to the literature will be valuable for the future of transfusion medicine.

CONCLUSION

As a result, we determined that anesthesiologists in our study must improve compliance with guidelines on blood and blood product transfusion practices. Furthermore, preferences for particular practices clearly vary among clinicians. It is essential to prioritize issues such as anemia and herbal medicine use in preoperative evaluation and to complete patient follow-up forms accurately during the transfusion process. To ensure accurate and standardized blood transfusion management, training programs should be expanded at all levels, regularly updated with current guidelines, and supported by readily accessible training materials. Hospitals must ensure the establishment and effective use of active transfusion committees and blood transfusion protocols, as well as the implementation of maximum blood request tables.

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AUTHOR CONTRIBUTIONS

Conception or design of the work: AS

Data collection: AE

Data analysis and interpretation: DK

Drafting the article: BT

Critical revision of the article: AD

Other (study supervision, fundings, materials, etc): UK, AO

The author (AE, AS, DK, BT, AZD, UK, AO) reviewed the results and approved the final version of the manuscript.

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