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Original Article

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Maximum surgical blood order schedule in urology surgery

Abstract

Aim: To improve patient blood management (PBM), a special system of collecting and testing blood units has been developed. It defines the maximum number of allogeneic red blood cell components necessary for certain surgical interventions. This system is referred to as "The Maximum Surgical Blood Order Schedule" (MSBOS). The aim of the study was to evaluate the rationality of red blood cell consumption during urological surgeries.
Materials and Methods: During the course of one year, a retrospective study was conducted on 617 patients. The study included 185 women and 432 men, with a median age range of 60 years old (ranging from 45 to 75 years old). The consumption of red blood cell units was evaluated in relation to the primary indication and type of surgery, preoperative data on hemoglobin values, and coagulation tests.
Results: The overall C:T ratio was 4.2, which corresponds to 24% of transfused units in relation to the number of cross-match tests performed. A statistically significant difference in the average related to the age was observed between the subjects in whom there was irrational (64.65±9.49 years) and those in whom there was a rational use of red blood cells. A statistically significant difference was also observed in the frequency of different primary diagnoses according to the International Diseases Classification) and in relation to the values of hemoglobin and prothrombin time (PT) between the group with rational and irrational use of red blood cells.
Conclusion: The obtained data showed unreasonable use of RBC based on the C:T ratio and therefore the necessity of introducing of PBM system as well the necessity to revise the existing protocols for red blood cell demand according to indications and to improve patient preparation in order to minimize the use of allogeneic red blood cells.

Keywords: Patient blood management, maximum surgical blood order schedule

INTRODUCTION

Regardless of all the benefits and risks that blood transfusion carries, the problem that is increasingly pressing all health systems in the world is the shortage of blood and blood component units. Unlike most other products used in all areas of medicine, blood, and blood components can only be obtained from blood donors. For this reason, the health systems of most countries in the world are organized in such a way as to ensure a sufficient amount of safe blood for the treatment of all patients. On the other hand, the requirements for blood components are constantly growing due to the aging of the general population and the expansion of both surgical and non-surgical indications (1). Also due to the progress and complication of the procedure of collection of tests, blood processing costs are also increasing, which are around 5% of the entire budget of the country's health system (2).

Based on experience with Jehovah's Witnesses, a balance between the need for blood and the ability of the health system to meet that need was established in the 1980s. The data showed that patients not only did survive complex cardiac, orthopedic, and malignancy procedures without the use of blood, but the results were just as good, if not better, than those patients who received blood (3).

Thanks to the development of medical science, contemporary health systems in the world increasingly place patients in their centers and develop the Patient Blood Management (PBM) system (4).

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PBM is an evidence-based multidisciplinary approach to the patient that includes preoperative, perioperative, and postoperative treatment of anemia and blood transfusion (5). A special aspect of PBM is the determination of the maximum number of allogeneic red blood cell units necessary for certain surgical procedures ("The Maximum Surgical Blood Order Schedule", MSBOS) (6-8).

Modern blood banks are faced with increasing demands for blood, and only 30% of cross-matched blood units are used (9). Adequate implementation of MSBOS significantly reduces the number of required, tested, and unused blood units during the surgical treatment of patients (10). The initial proposal of MSBOS has been modified until today and adapted to the special needs of each health institution (11).

There are several parameters that must be taken into account during MSBOS implementation, such as projected blood loss during surgery, preoperative hemoglobin values, and relative risk of using O, Rh- blood group during unexpected hemorrhage. The basic parameter that is calculated is the ratio of the number of blood units with which cross-match tests were performed and the number of actually transfused blood components (C:T ratio) for a given procedure. Ideally, C:T is equal to 1, but a C:T ratio of 2 or less is considered efficient consumption of red blood cell components (12). The second parameter is the probability of transfusion (%T) and represents the ratio of the number of transfused patients and the number of patients in whom the cross-match test was performed, and multiplied by 100 (13).

Based on our previously published results, the necessity of introducing procedures that would enable a more rational use of blood was pointed out (14).

The research aimed to assess the degree of rationality of blood administration in patients undergoing elective urological surgical procedures as well as to evaluate the qualitative and quantitative expediency of the use of red blood cells concerning the type of surgical intervention, blood count values , and biochemical parameters through assessment of C:T.

MATERIALS AND METHODS

This retrospective study included 617 patients, (185 women and 432 men), median range age 60 years, who underwent the urological surgery procedures that were performed during the period from July 2019–July 2020.

The subjects were divided into thirteen categories, based on diagnosis and concerning the International Classification of Diseases (ICD) (15), namely: general congenital and acquired anomalies, states of retention and non-retention of urine in the urinary system, stones and hernias, sepsis, gangrene, and other inflammations, bladder tumors, testicular tumors, penis tumors, tumors of the ureter, prostate hyperplasia, malignant tumors of the renal pelvis, malignant prostate tumors, kidney tumors and other conditions.

For all subjects, clinical data in relation to age, primary diagnosis, and type of surgery were analyzed. Laboratory parameters including hemoglobin values, and hemostasis test values (activated partial thromboplastin time–aPTT, prothrombin time -PT, and platelet count) before surgery were analyzed for all study participants.

The collected data were used to monitor the C:T ratio. The recommended C:T ratio of less than 2.0 (16) was used as the value for comparison of obtained results.

The data referring to the use of red blood cells at the Urology Clinic were collected from the information system "Heliant" of the Clinical Center of Serbia, and the department's electronic database.

Institutional approval for the study was obtained from the Ethics Committee of the Clinical Center of Serbia in accordance with local and international ethical standards under number 57/14, 21.3.2019.

Statistical Analysis

Descriptive and analytical methods were applied using "IBM SPSS Statistics, Version 21.0" (IBM Corp., Armonk, NY, USA). The statistical significance of the difference of continuous variables with a normal distribution was assessed using analysis of variance (ANOVA). The probability $p<0.05$ was considered statistically significant.

RESULTS

Table 1 shows the data on the required red blood cell units, the number of units with which cross-match tests were performed, the number of transfused units per patient group, pointed C:T, and the index in relation to the specified diagnosis. Cross-match tests were performed for 912 units in pre-transfusion testing, and 219 units were used. The overall C:T ratio was 4.2, which corresponds to 24% of transfused individuals in relation to the number of cross-match tests performed (index 0.24).

The highest value of C:T was pointed in patients with kidney tumors (6.3).

Rational use of red blood cells was recorded in 347 (55.6%) patients. The rational use of red blood cells was recorded in 113 female and 234 male respondents, aged 59.45±15.12. No statistically significant difference was observed between the genders, while a statistically highly significant difference was observed concerning the average age between subjects who had irrational use (64.65±9.49 years) and concerning those with rational use of red blood cells, where C:T<2 (59.45±15.12), $P<0.001$ (Table 2).

The analysis of primary diagnoses revealed a statistically significant difference in the frequency of various primary diagnoses between the group with rational and irrational use of red blood cells, C:T<2 (Table 3). Between the groups with rational and irrational use of red blood cells, there was a significant difference in the frequency of different hemoglobin

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levels. A statistically significant difference was observed in the frequency of hemoglobin levels between 70 and 100 g/L (18.8% vs. 1.5%, P<0.001) and for the frequency between 100 and 135 g/L, a statistically significant difference was observed (52.6% and 62.7%, P=0.023). No statistically significant difference was observed in the frequency of hemoglobin values below 70 g/L (0.6-0.3, P=0.433) as well as for hemoglobin values above 135 g/L (30% vs. 35.8%, P=0.162) (Table 4).

A statistically significant difference was observed in relation to PT frequency values from 10 to 13 s (65.8% vs. 76.1%, P=0.002) and over 13 s of blood (33.0% vs. 20.4 %, P=0.002) between the group with rational and with irrational use, where C:T<2.

For the experimental aPTT and platelet count, no statistically significant difference was observed between patients with rational and irrational use of blood, C:T<2 (Table 5).

Table 1. Number of patients, blood units required. cross-match tests performed, red blood cells units used. determined "Cross-match test to transfusion ratio" (C:T) and indices in relation to different diagnoses

Diagnosis	Number of patients	The number of required units of RBC	Number of cross-match tests	Number of used red blood cell units	C:T	index
General congenital and acquired anomalies	8	2	2	2	1.0	1.0
States of retention and non-retention of urine in the urinary system	32	57	55	17	3.2	0.3
Stones and hernias	92	36	36	10	3.6	0.3
Sepsis, gangrene and other inflammations	9	11	8	8	1.0	1.0
Bladder tumors	174	477	340	64	5.3	0.2
Testicular tumors	24	10	8	2	4.0	0.3
Penis tumors	8	12	10	10	1.0	1.0
Tumors of ureter	15	43	30	7	4.3	0.2
Prostate hyperplasia	44	88	46	11	4.2	0.2
Malignant tumors of the renal pelvis	12	18	18	8	2.3	0.4
Malignant prostate tumors	67	201	134	38	3.5	0.3
Kidney tumors	95	200	200	32	6.3	0.2
Other conditions	37	26	25	10	2.5	0.4
Total	617	1181	912	219	4.2	0.2

Table 2. The relationship between rational and non-rational use of blood in relation to the sex and age of the subjects

Gender	Rational use N (%)	Non-rational use N (%)	
Female	113 (61)	72 (29)	
Male	234 (54)	198 (46)	
Age X±SD (Range)	59.45±15.12 (35-75)	64.65±9.49 (55-82)	<0.001

Table 3. Frequencies of different primary diagnoses between the group with rational and non-rational use of red blood cells

Primary diagnoses	Rational use N (%)	Non-rational use N (%)
General congenital and acquired anomalies	8 (2.3)	0 (0)
States of retention and non-retention of urine in the urinary system	32 (9.3)	0 (0)
Stones and hernias	92 (26.8)	0 (0)
Sepsis, gangrene and other inflammations	9 (2.6)	0 (0)
Bladder tumors	53 (15.5)	121 (44.2)
Testicular tumors	21 (5.8)	3 (1.1)
Penis tumors	4 (1.2)	4 (1.4)
Tumors of ureter	5 (1.4)	10 (3.6)
Prostate hyperplasia	44 (12.5)	0 (0)
Malignant tumors of the renal pelvis	6 (1.6)	6 (2.2)
Malignant prostate tumors	28 (8.2)	39 (14.2)
Kidney tumors	21 (6.1)	74 (27)
Other conditions	20 (5)	17 (6.2)

Table 4. Ratio of rational and non-rational use of red blood cells in relation to hemoglobin values

Hemoglobin level	Rational use N (%)	Non-rational use N (%)	P-value
Hb<70 g/L	2 (0.6)	1 (0.3)	0.433
Hb 70-100 g/L	63 (18.8)	6 (1.5)	<0.001
Hb 100-135 g/L	184 (52.6)	182 (62.6)	0.023
Hb>135 g/L	98 (30)	87 (35.8)	0.162

Table 5. Ratio of rational and irrational use of red blood cells in relation to the values of hemostatic parameters

Hemostatic parameters	Rational use N (%)	Irrational use N (%)	P-value
Platelets number			
<50*109/l	0 (0)	1 (0.5)	
50-100*109/l	2 (0.5)	0	0.267
>100*109/l	345 (99.5)	275 (99.5)	0.865
PT			
<10s	2 (0.6)	10 (3.6)	
10-13s	224 (65.8)	210 (76.1)	0.002
>13s	115 (33.7)	56 (20.3)	0.002
APTT			
<25s	117 (34.4)	93 (35)	0.873
25-35 s	215 (63.2)	174 (65)	0.686
>35s	8 (2.4)	0 (0)	0.075

PT: prothrombin time, APTT: activated partial thromboplastin time

DISCUSSION

Our study results conducted with patients who underwent urological surgery revealed a significant deviation of the C:T ratio of 4.2 compared to recommended C:T <2.

In the examined period, the analysis of data on the required units of red blood cells, i.e. the number of performed cross-match tests and used units of red blood cells, showed that C:T was 4.2, which is significantly higher than the recommended value of C:T, which is <2. When we further structurally analyzed data the largest C:T deviation was recorded in the group of patients with kidney tumors where the level of C:T was 6.3. C:T values over 5 were determined in patients with bladder tumors (C:T 5.3), while they were over 4 in patients with ureter tumors (C:T 4.3), prostate hyperplasia (C:T 4.2) and testicular tumors (C:T 4.0). In patients with urolithiasis and hernia, C:T was 3.6, with malignant prostate tumors C:T was 3.5, and with states of retention and non-retention of urine, 3.2. An adequate C:T ratio was determined in the group of patients with other conditions C:T 2.5, malignant tumor of the renal pelvis C:T 2.3, with sepsis, gangrene, and other inflammations C:T 1 and penis tumor C:T 1.

Out of a total of 617 patients included in the research, rational use of red blood cells was found in 343 (55.6%), and irrational use in 274 (44.4%). A statistically highly significant difference was observed in relation to the age of the subjects divided into groups with rational and irrational use of red blood cells, whereby patients with irrational use of blood are significantly older (average 64.6 years) compared to those with rational use of blood (59.4 years), P<0.001.

Although there is not much available data on the application of MSBOS in the field of urological surgery based on protocols and recommendations, a difference in approach can be observed compared to the practice at the Urological Clinic. According to the protocols of health institutions in Great Britain, all patients who are being prepared for elective surgical programs are subjected to type and screen (T/S) tests preoperatively and on the day of surgery, and cross-match tests are performed for nephrectomy, total prostatectomy, total bladder resection with two units of allogeneic red blood cells each (17,18). At the University of Toledo, the protocol is even more restrictive, T/S is done for bladder resection and prostatectomy, while two units of red blood cells are prepared for radical nephrectomy and prostatectomy. For all other elective surgical interventions, only the patient's blood group is determined in the ABO and Rh system (19).

The protocol of the Malaysian UKM University stipulates that for nephrectomy, bladder resection (TURP) procedure, urethroscopy, and urethroplasty only T/S is done and that the cross-match test is performed with two units of red blood cells only for cystectomy, radical nephrectomy, nephrectomy and prostatectomy (20).

In Ireland, only T/S tests are performed for most procedures, while the only indication for T/C is nephrectomy with 4 units of blood (17).

On the other hand, Canadian recommendations differ from valid European recommendations. According to these recommendations, T/S tests are predominantly performed, while cross-match tests with two units of red blood cells are performed for nephrectomy, bladder cancer, cystectomy, and prostatectomy (21).

All the mentioned institutions introduced MSBOS protocols according to which C:T<2.

The results of our research show significant deviations in relation to more or less uniform standards in the world. According to our data, blood is required from the Department of Urology for a large number of indications divided into several categories: other conditions, general congenital and acquired anatomical anomalies, retention and non-retention of urine in the urinary system, stones and hernias, sepsis, gangrene, and other inflammations, tumors of the urinary bladder, tumors of the testicles, penis, ureter, prostate, kidney, prostate hyperplasia. For all these indications, T/S and cross-match tests are performed, on average two units of red blood cells. There are indications of tumors of the bladder, ureter, and prostate, which require an average of 3 units of red blood cells per patient. According to the MSBOS protocols, blood group determination in the ABO/Rh system and screening of irregular antibodies is done for all patients in the elective urological chiropractic program. Cross-match tests are performed for radical nephrectomy and radical prostatectomy total resection of the bladder due to tumors with two units of red blood cells each. One dose of red blood cells is prepared for kidney transplantation if Hb<80 g/L (17-19).

In our research, a statistically highly significant difference was observed in the frequency of hemoglobin levels between 70 and 100 g/L, P<0.001, as well as for the frequency of hemoglobin levels between 100 and 135 g/L, P=0.023. According to American association for blood banking (AABB) recommendations, it is rational to use red blood cells at values of Hb<70 g/L and irrational at values over 135 g/L. These data are consistent with our research. On the other hand, according to the same recommendations, the use of red blood cells at values of Hb 70-80 g/L is justified only in exceptional circumstances, in patients with cardiovascular problems, while there are practically no indications for the use of red blood cells at values of Hb>80 g/L, especially not over 100 g/L (7).

It should be emphasized that the use of blood in therapy for emergency conditions was not monitored during this research and that there were no kidney transplants in the investigated period. During the research, only one patient underwent an autologous transfusion.

For the successful implementation of PBM, the cooperation of all those who participate in the treatment of the patient surgeon, anesthesiologist, internist, and transfusion medicine specialist, who actively participate will influence the application of the postulates of individual therapeutic treatment for each patient. It should be emphasized that during this examination, the Clinic for Urology primarily relied on the transfusion support of the Blood Transfusion Institute of Serbia because it does not have its own department for transfusion nor an implemented PBM system.

Until that goal is reached, as a temporary solution based on the collected data on medical indications, patient age, preoperative hemoglobin, and PT values, the need for blood and blood components can be divided into two groups: the group of patients for whom only T/S tests are performed and group for which, in addition to T/S, cross-match tests are also performed.

During further tests, and to establish the MSBOS system and PBM, it is necessary to determine what are the maximum amounts of blood that are prepared according to individual surgical procedures. When the transplant program is established to a greater extent, that program must also be taken care of.

CONCLUSION

The test results indicate that at the Clinic for Urology of the Clinical Center of Serbia, there is a significant difference in the number of performed cross-match tests and the number of administered blood units in patients who undergo an elective surgical program. Total C:T at the level of the entire Urology Clinic 4.2. compared to recommended C:T <2.

A statistically highly significant difference was observed in relation to age as well as that there is a statistically significant difference in the rational and irrational use of red blood cells in relation to PT values, for PT values of 10-13s and over 13s.

The study showed that there is non-compliance with the recommendations regarding the threshold of transfusion in relation to the hemoglobin value.

The obtained results of the research show that it is necessary to revise the existing protocols for the use of red blood cells according to the indications, to improve the preparation of patients in order to maximally reduce the use of allogeneic red blood cells, which indicates the need to establish a PBM system at the clinic for urology.

Limitations

The main limitation of the study is that study is retrospective.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
Instittional approval for the study was obtained from the Ethics Committee of the Clinical Center of Serbia in accordance with local and international ethical standards under number 57/14, 21.3.2019.

REFERENCES

1. Western Australia tomorrow: population projections for planning regions 2004-2031 and local government areas 2024 to 2021. Population report (Western Australian planning commission) 2005;6. https://www.wa.gov.au/government/document-collections/western-australia-

tomorrow-population-forecasts access date 09.09.23

2. Thomson A, Faremr S, Hofmann A, et al. Patient blood management – a new paradigm for transfusion medicine?. ISBT Sci Ser. 2009;4:423-35.
3. Bodnaruk ZM, Wong CJ, Thomas MJ. Meeting the clinical challenge of care for Jehovah s Witnesses. Transfus Med Rev. 2004;18:105-16.
4. Thakrar SV, Clevenger B, Mallett S. Patient blood managemet and perioperative anaemia. BJA Education. 2017;17:28-34
5. Spahn DR, Moch H, Hofman A, Isbister JP. Patient blood management: the pragmatic solutionfor the problems with blood transfusion. Anesthesiology. 2008;109: 951-3.
6. Greenwat TJ, Buckwalter JA, Desfrges J, et al. Perioperative red blood cell transfusion. Redblood cell Transfusion-Concensus conference JAMA. 11 November 1988. 2700-3.
7. Carson JL, Grossman BJ, Kleinman S, et al. Red blood cell transfusion. A clinical practice guidline from AABB. Ann Intern Med. 2012;157:49-58.
8. Friedman BA. Oberman HA. Chadwick AR. Kingdon KI. The maximum surgical blood order schedule and surgical blood use in the United States.Transfusion 1976;16:380-7.
9. Sowayan SA. Use of blood in elective surgery; an area of wasted hospital resource. Ann Saudi Med. 1994;14:326-8.
10. Collns RA, Wisniewski MK, Waters JH, et al. Excessive quantities of red blood cells are issued to the operating room. Transfus Med. 2015;25:374-9.
11. Frank SM, Oleyar MJ, Ness PM, Tobian AA. Reducing unnecessary preoperative blood orders and costs by implementing an updated institution specific maximum surgical blood order schedule and a remote electronic blood release system. Anesthesiology. 2014;121:501-9.
12. Krier DB. Richards FE. Transfusion to cross match community comparasion dana. Am J Med Qual. 1996;11:68-72.
13. Ho O. Bo B. Blood utilization in elective surgical procedures in Ilorin. Trop J Health Sci 2006;13:15-7.
14. Lukic V. Zivotic B, Vasiljevic B, et al. Rational red blood cells administration-have we achived a satisfactory level. Srpski arhiv za celokupno zdravstvo. 2020;148:299-303.
15. IlicD, editor. Međunarodna statistička klasifikacija bolest I isrodnih zdravstvenih problema 10th; Institut za javno zdravlje Srbije “Dr Milan Jovanovic Batut; 2010.
16. Guzman JPS, Resurreccion LL, Gepte MB, et al. Use of maximum surgical order schedule (MSBOS) among pediatric patients to optimize blood utilization. Annals of Pediatric Surgery. 2019;15:4.
17. Royal Cornwall Hospitals. MSBOS clinical guidline V7.0. NHS. 2019. https://royalcornwallhospitals.nhs.uk access date 09.09.2023
18. Wuethrich PY, Studer UE, Burkhard FC. Intraoperative Continuous norepinephrine infusion combined with restrictive deferred hydratation significantly reduces the need for blood transfusin in patients undergoing open radical cystectomy: results of a prospective randomised trial. Eur Urol. 2014;66:352-60.
19. Medical center. Policy: maximum surgical blood oredring shedule. The University of Toledo. 2021. https://www.utoledo.edu/policies/utmc/bloodbank/pdfs/3364-108-308.pdf access date 09.09.2023
20. Yee T. Maximum surgical blood order schedule for elective surgery. UKM Medical center, 5th edition. 2019
21. Whitman L. Governmment of Newfoundland and Labrador. Msximum surgical blood ordering schedule, NLBCP-044. Government. 2021