REVIEW

doi.org/10.1590/S0004-2803.202301000-16

The use of autologous blood transfusion in digestive tract surgery: a literature review

João Vitor Ponciano **GAMA**[1,2], Rian Magro **FERREIRA**[1], Leonardo Portugal **LIMA**[1], Thaís Rodrigues **NEVES**[1], João Pedro Gonçalves **DIAS**[1] and Gilvando Dias de **SOUSA FILHO**[3,4,5]

[1] Universidade de Vassouras, Pró-Reitoria de Ciências Médicas, Vassouras, RJ, Brasil. [2] Colégio Brasileiro de Cirurgia Digestiva, São Paulo, SP, Brasil. [3] Hospital Universitário de Vassouras, Vassouras, RJ, Brasil. [4] Colégio Brasileiro de Cirurgiões, Rio de Janeiro, RJ, Brasil. [5] Associação Brasileira de Transplante de Órgãos, São Paulo, SP, Brasil.

HIGLIGHTS

- There are no objective and concordant answers among the studies, regarding the use of autologous blood transfusion in digestive tract surgeries.
- There is strong evidence of less recurrence of digestive tumors when using autologous transfusion.
- The autologous blood transfusion contains the immunosuppression associated to the operative trauma, but it may also have complications and higher cost of collection and handling.
- It is suggested that the study of this practice be encouraged, aiming to observe the possible deleterious effects and benefits.

ABSTRACT – Background – The use of autologous blood transfusion in digestive tract surgeries, whether after preoperative blood collection or intraoperative blood salvage, is an alternative to allogeneic blood, which brings with it certain risks and shortage, due to the lack of donors. Studies have shown lower mortality and longer survival associated with autologous blood, however the theoretical possibility of spreading metastatic disease is still one of the limiting factors of its use. **Objective –** To evaluate the application of autologous transfusion in digestive tract surgeries, noting the benefits, damages and effects on the spread of metastatic disease. **Methods –** This is an integrative review of the literature available in the PubMed, Virtual Health Library and SciELO databases, by searching for "Autologous Blood Transfusion AND Gastrointestinal Surgical Procedures". Observational and experimental studies and guidelines published in the last five years in Portuguese, English or Spanish were included. **Results –** Not all patients benefit from blood collection before elective procedures, with the time of surgery and hemoglobin levels some of the factors that may indicate the need for preoperative storage. Regarding the intraoperative salvaged blood, it was observed that there is no increased risk of tumor recurrence, but the importance of using leukocyte filters and blood irradiation is highlighted. There was no consensus among the studies whether there is a maintenance or reduction of complication rates compared to allogeneic blood. The cost related to the use of autologous blood may be higher, and the less stringent selection criteria prevent it from being added to the general donation pool. **Conclusion –** There were no objective and concordant answers among the studies, but the strong evidence of less recurrence of digestive tumors, the possibility of changes in morbidity and mortality, and the reduction of costs with patients suggest that the practice of autologous blood transfusion should be encouraged in digestive tract surgeries. It is necessary to note if the deleterious effects would stand out amidst the possible benefits to the patient and to health care systems.

Keywords – Blood Transfusion; autologous; digestive system surgical procedures; neoplasms.

Received: 21 July 2022
Accepted: 14 September 2022

Declared conflict of interest of all authors: none
Disclosure of funding: none

Corresponding author: João Vitor Ponciano Gama. E-mail: jvpongama@hotmail.com

INTRODUCTION

The autologous blood transfusion procedure, also known as autotransfusion, is related to volume replacement with the patient's own blood. Although it is not so common, it consists of a strategy that allows safe transfusion and less use of heterologous (allogeneic) blood, which brings particular complications and is scarce due to the lack of donors. Autotransfusion is performed through two main techniques: blood collection in the preoperative period, with subsequent transfusion during elective procedures, and intraoperative blood salvage, in which the blood lost by the patient during the surgery is collected and processed by a specific automated equipment, allowing reinfusion during the same surgery[1-3]. In surgeries of the digestive tract, such as resection of metastasis/cancer and transplants, the use of allogeneic blood transfusions carries certain risks, such as the transmission of infectious disease, immunomodulation, tumor recurrence, anaphylaxis, hemolytic reaction and transfusion-related acute lung injury. For that matter, the interest in developing various modalities of autotransfusion aims to reduce the use of allogeneic blood[1,3].

A study related to biliary cancer showed significantly lower mortality and longer survival (46% in 5 years) in patients transfused with autologous blood, when compared to patients who received allogeneic blood (survival of 24% in 5 years)[2].

There is a theoretical worry that intraoperative blood collection would bring cancer cells and that autotransfusion would result in the spread of metastatic disease. Even though blood filtration has been shown to remove cancer cells, this concern limits the use of autologous transfusions across the board[1,3].

Thus, the aim of this study was to asses the use of autologous transfusion in digestive tract surgeries and to observe, when compared to allogeneic transfusions, its benefits and damages, besides the effects of autotransfusion on the spread of metastatic diseases.

METHODS

This is an integrative review of the most recent literature using the PubMed, Virtual Health Library and SciELO search engines. The Health Sciences Descriptors "Autologous Blood Transfusion" and "Gastrointestinal Surgical Procedures" and the Boolean operator "AND" were used in the search. The time interval was limited to publications corresponding to the last 5 years (2017–2022). Inclusion criteria were observational or experimental studies or guidelines published in English, Portuguese or Spanish. The exclusion criteria were duplicate articles, case reports, reviews, other publications with methodology different from that sought and studies that did not address the use of autologous blood transfusion in digestive tract surgery. The articles found were initially screened by reading their titles and abstracts.

RESULTS

After delimiting the time interval of publications, 26 articles were found. After applying the inclusion and exclusion criteria and reading the titles and abstracts, 10 articles were finally selected and used for this literature review.

Transfusion of blood collected preoperatively

Onoe et al. (2018)[2] involved 646 patients with biliary tract cancer undergoing major hepatectomy (resection of three or more Couinaud segments) with extrahepatic bile duct resection and observed that autologous transfusion, compared with allogeneic transfusion, can reduce postoperative total bilirubin levels but does not reduce morbidity and mortality risks, and there is no significant difference in the incidence of liver failure and overall survival. For this study, autologous blood was collected once or twice in one month before surgery in patients with hemoglobin (Hb) above 11 g/dL and without infection or severe cardiovascular/cerebrovascular diseases, with daily iron supplementation provided after collection and, if the total volume was 800 mL, recombinant human erythropoietin.

Another retrospective study, with living liver donors who donated one unit of autologous blood at an average of 17.3 days before hepatectomy, observed that there was a drop in Hb levels after blood donation, resulting in lower values on the day of surgery. In this study, 42.2% of patients were transfused, and the preoperative Hb rates were predictors of transfusion (average of 11.7 g/dL). It was assessed

that, theoretically, donation should stimulate erythropoiesis, but the period for this would be longer than the expiration date of stored autologous blood[4].

Tomimaru et al. (2017)[5] assessed that the proportion of patients undergoing pancreatoduodenectomy who required allogeneic blood was lower among those who had donated autologous blood before the procedure. The authors concluded that not all patients would benefit from autologous blood storage and transfusion, with the duration of surgery, Hb levels before collection and the need of portal vein resection being noticeable factors for the need of storage.

Transfusion of intraoperative salvaged blood (ISB)

Four studies assessed patients undergoing liver transplantation. Ivanics et al. (2021)[3] observed in 15 adults with hepatocellular carcinoma that the risk of tumor cell reintroduction can be reduced using only one Leukodepletion Filter. Although evidence states that perioperative transfusion results in immunosuppression and supply tumor growth factors, which could increase postoperative mortality and tumor recurrence, this does not occur in the model studied. Weller et al. (2021)[6] observed in 51 patients also transplanted for hepatocellular carcinoma that the transfusion of ISB was not associated with increased tumor recurrence. Even with the detection of tumor cells in the surgical field in 91 to 93% of cases, ISB had significantly lower tumor recurrence at 5 years compared to allogeneic blood. Nevertheless, such results are possible only if the blood is irradiated, in a place next to the operating room, with a duration of the process (from irradiation to transfusion) of less than 20 minutes.

Tan et al. (2021)[7] followed up, in the long term, patients transplanted for indications other than hepatocellular carcinoma, although all had the diagnosis of neoplasia made in the explanted liver. Of 110 patients, 69.1% were transfused with ISB, which demonstrated that there was no significant impact on survival and recurrence in liver transplant patients. Likewise, Pinto et al. (2021)[8] also observed that the use of ISB dos not offer relevant potential for dissemination or recurrence of hepatocellular carcinoma after liver transplantation. In their study, there was no statistical difference between those transfused with ISB or not, regarding overall survival and disease-free survival. The 5-year survival, however, was slightly lower than in other published studies, which may be attributed to the high incidence of hepatitis C virus in the sample.

In a retrospective study of 125 patients undergoing laparoscopic hepatectomy, Li-Hua et al. (2019)[9] compared autologous blood transfusion to Pringle's maneuver, a widely used method of hepatic inflow occlusion to prevent bleeding, on recovery of liver function and outcomes after the procedure. Transfused patients had longer operation duration, greater blood loss and significantly lower levels of total and indirect bilirubin, aspartate aminotransferase and alanine aminotransferase. Although the bleeding has a high postoperative mortality rate, it can be managed by autotransfusion, which can also reduce ischemia-reperfusion injury induced by Pringle's maneuver and promote faster recovery of liver function.

Kang et al. (2018)[1] involved patients undergoing partial hepatectomy due to colorectal cancer metastasis and used a Cell Saver to filter the blood collected from the operative field and transfuse when the volume of 200 mL was reached. The duration of the surgery, blood loss and extent of resections were greater in the group that received the intraoperative salvaged blood, but survival was 5 months longer (totaling 59 months) when compared to the group that did not receive any transfusion, leading the authors to conclude that ISB does not have deleterious effects nor does it increase the recurrence rates of metastatic disease, and that the results were similar regarding overall survival and recurrence-free survival.

Zacharias et al. (2018)[10] conducted a case-control study on the influences of autologous transfusion in 96 right or repeated hepatectomy procedures. The group that had intraoperative blood salvage showed no difference in morbidity and mortality compared to the control group. However, the transfusion rate was lower, as well as the number of allogeneic erythrocyte units transfused. It was concluded that the transfusion with leukocyte filter was effective, except when the tumors were ruptured. In contrast, it was observed that the time for blood recovery and filtration limits the flow to be transfused, which may make allogeneic transfusion necessary.

Benefits and risks

Manuel et al. (2019)[4] assessed that the complication rates of autologous blood use are similar to those of allogeneic blood, but other studies included in this review showed differences. The average cost and hospital stay of autologous transfusion are lower compared to Pringle's maneuver, and there is no association with complications in resections of benign liver neoplasms[9]. The autologous blood transfusion contains the immunosuppression associated to the operative trauma, but it may also have complications, such as contamination, and dispose patients to dilutional coagulopathy and hypothermia, when large volumes are transfused, besides being maintained the risks of fluid overload and administrative errors, in relation to allogeneic blood[1,2,5]. Tomimaru et al. (2017)[5] also observed complications related to blood collection, such as hypotension, dizziness, chills and fever.

The transfusion of salvaged blood reduces the need for allogeneic transfusions and presents lower risk of anaphylaxis, hemolytic reaction, transfusion-associated acute lung injury, immunomodulation and recurrence of neoplasia, besides improving the cost-benefit ratio. Nevertheless, there is divergence regarding the risk of infectious disease transmission: some authors claim there is a lower risk, while others say it is maintained[2,3,5,7].

Disadvantages

The cost for collection and handling of autologous blood can be much higher than that of allogeneic blood, and autologous blood cannot be included to the general donation pool, since it presents a higher infection rate and less stringent selection criteria. In addition, not all patients like the benefits, since preoperative donation increases the propensity to need transfusion in people who would not need it[2,4,5]. Many times, still, transfusion of allogeneic blood becomes necessary due to the fact that intraoperative recovered blood is not available in time for the patient's maintenance[10].

Alternatives

Procedures such as hepatectomy in living liver donors with minimal blood loss have been described, making the need for perioperative transfusion increasingly rare. In these cases, it is suggested to reconsider the use of autologous blood transfusion and explore alternatives for high-risk donors, such as preoperative iron supplementation, erythropoietin and intraoperative blood salvage[4]. For Tomimaru et al. (2017)[5], it is necessary to establish which patients will benefit from autologous blood storage, based on the characteristics of the surgical procedure, through a scoring system.

DISCUSSION

The studies with transfusion of blood collected before the surgical procedure show that autologous blood can reduce postoperative bilirubin levels compared to allogeneic blood, but it has not been shown to reduce morbidity and mortality or to have a difference in survival. In addition, Hb rates after donation had a decrease and were predictor of transfusion. Other studies also point to a reduction in Hb levels and hematocrit both after donation and postoperatively, with this decrease being earlier and accompanied by lower serum erythropoietin levels in patients receiving autologous blood. Therefore, iron and recombinant human erythropoietin supplementation should be considered in anemic or non-anemic patients, in order to prevent preoperative anemia and reduce the need for allogeneic transfusion[11-14].

In the analysis of tumor recurrence in ISB transfusions, no increase in recurrence of hepatocellular carcinoma or colorectal cancer metastasis was observed, even if the perioperative transfusion generates immunosuppression and provides tumor growth factors. Weller et al. (2021)[6] further stated that less recurrence of tumors is possible only if the blood is irradiated. Busch et al. (1995)[15] had pointed out in 1995 that there is a relationship between blood transfusions and increased local recurrence of colorectal cancer (but not of metastasis), with no difference between autologous and allogeneic blood. However, the authors concluded that the circumstances leading to transfusion determine prognosis more than the transfusions themselves.

It has been shown that autologous blood transfusion is able to contain the immunosuppression generated by surgical trauma and provides less risks

regarding immunomodulation. For that matter, other studies have observed that plasma concentrations of IL-6, IL-8, TNF-α, IFN-γ and T lymphocytes are higher in patients receiving autologous blood, with the possibility that this transfusion technique is beneficial for patients who are immunocompromised preoperatively[16-18].

Although the autologous blood cannot be added to the general donation pool, due to its higher infection rate and less rigorous selection, which increases its discard, the authors demonstrated that the risks of transmission of infectious diseases is the same, if not lower, compared to allogeneic blood. Regarding this, Heiss et al. (1993)[19] and Duffy and Neal (1996)[20] demonstrated that the postoperative infection rate increases according to the number of units transfused, being strongly associated with allogeneic blood.

Tomimaru et al. (2017)[5] have assessed that the patients who will benefit from autologous transfusion should be established, proposing a scoring system. Likewise, in 2007, the British Committee for Standards in Hematology did not recommend the use of blood collected before surgery unless under exceptional clinical circumstances, such as difficulty in obtaining allogeneic blood for rare blood groups and lack of patient consent for allogeneic transfusion[21]. In 2006, the Seville Consensus Document pointed out that autologous transfusion would be indicated for elective surgeries, with blood collected before surgery when the risk of needing a transfusion was greater than 20–30%, as well as in patients with difficulty for allogeneic transfusion, while ISB was used when bleeding greater than 1.500 mL was anticipated and at least 1.5–2 units of packed red blood cells could be recovered[22]. Guidelines from the Association of Anesthetists of Great Britain and Ireland (2018) recommend intraoperative blood salvage when the likelihood of allogeneic transfusion and severe postoperative anemia are expected to be reduced[23]. In addition, depletion filter use is considered in cases of operative field infection and cancer, as pointed out by Ivanics et al. (2021)[3] and Zacharias et al. (2018)[10].

Over the past few years, the donation of autologous blood in the preoperative period has been reduced due to the lower risk of disease transmission in allogeneic blood transfusion, the adoption of measures to avoid the need for intraoperative transfusion and the increasing cost in preoperative donation programs. Vassalo et al. (2015)[24] recommend that, for its use, in addition to the circumstances pointed out above, donors should be able to donate multiple units, and the last collection should be 3 to 4 weeks apart from the procedure.

CONCLUSION

The results of this integrative review show that there are still many questions about the use of autologous blood transfusion in digestive tract surgeries, since the concern with factors related to tumor growth, the mortality and the appropriate collection and selection of blood still lack objective and consonant answers among the studies presented.

However, due to the strong evidence of the relationship between autologous transfusion and less recurrence of digestive tumors, the possible changes in patient morbidity and mortality and the reduction of costs with such patients, it is suggested that the study of this practice be encouraged, aiming to observe whether the possible deleterious effects would really stand out among the possible benefits that these transfusion techniques would provide to the patient and, somehow, to health systems.

Authors' contribution

Gama JVP: bibliographic research, selection and review of articles, data collection, manuscript writing, final review. Ferreira RM: review of articles, data collection, manuscript writing. Lima LP: review of articles, data collection, manuscript writing. Neves TR: review of articles, data collection, manuscript writing. Dias JPG: review of articles, data collection. Sousa Filho GD: final review. All authors approved the final version.

Orcid

João Vitor Ponciano Gama: 0000-0001-5979-2928.
Rian Magro Ferreira: 0000-0002-9298-6211.
Leonardo Portugal Lima: 0000-0003-0603-1775.
Thaís Rodrigues Neves: 0000-0001-6931-1112.
João Pedro Gonçalves Dias: 0000-0002-3621-8701.
Gilvando D de Sousa Filho: 0000-0002-2189-5320.

Gama JVP, Ferreira RM, Lima LP, Neves TR, Dias JPG, Sousa Filho GD. O uso da transfusão sanguínea autóloga na cirurgia do aparelho digestivo: uma revisão de literatura. Arq Gastroenterol. 2023;60(1):137-43.

RESUMO – Contexto – O emprego da transfusão sanguínea autóloga nas cirurgias do aparelho digestivo, seja através da coleta de sangue no pré-operatório ou da recuperação de sangue no intraoperatório, é uma alternativa ao sangue alogênico, que traz consigo determinados riscos e a escassez, pela falta de doadores. Estudos têm demonstrado menor mortalidade e maior sobrevida associadas ao sangue autólogo, no entanto a possibilidade teórica de propagação de doença metastática ainda é um dos fatores limitantes do seu uso. **Objetivo –** Avaliar a aplicação da transfusão autóloga em cirurgias do aparelho digestivo, observando os benefícios, prejuízos e efeitos sobre a propagação de doenças metastáticas. **Métodos –** Trata-se de uma revisão integrativa da literatura disponível nas bases de dados PubMed, Biblioteca Virtual em Saúde e SciELO, através da busca por "*Autologous Blood Transfusion AND Gastrointestinal Surgical Procedures*". Foram incluídos estudos observacionais e experimentais e guidelines publicados nos últimos 5 anos, nos idiomas português, inglês ou espanhol. **Resultados –** Nem todos os pacientes beneficiam-se da coleta de sangue antes de procedimentos eletivos, sendo o tempo de cirurgia e os níveis de hemoglobina alguns dos fatores que podem indicar a necessidade do armazenamento pré-operatório. Em relação ao sangue recuperado no intraoperatório, observou-se que não há maior risco de recorrência de tumores, mas destaca-se a importância do uso de filtros leucocitários e irradiação sanguínea. Não houve consenso entre os estudos se há uma manutenção ou redução das taxas de complicação, em comparação com o sangue alogênico. O custo relacionado ao uso de sangue autólogo pode ser maior, além de os critérios de seleção menos rigorosos impedirem que seja adicionado ao pool geral de doações. **Conclusão –** Não houve respostas objetivas e concordantes entre os estudos, mas os fortes indícios da menor recorrência de tumores digestivos, a possibilidade de alterações na morbimortalidade e a redução dos custos com os pacientes sugerem que a prática da transfusão sanguínea autóloga seja fomentada nas cirurgias do aparelho digestivo. É necessário observar se os efeitos deletérios se destacariam em meio aos possíveis benefícios ao paciente e aos sistemas de saúde.

Palavras-chave – Transfusão de sangue autóloga; procedimentos cirúrgicos do sistema digestório; neoplasias.

REFERENCES

1. Kang R, Seath BE, Huang V, Barth RJ. Impact of autologous blood transfusion on survival and recurrence among patients undergoing partial hepatectomy for colorectal cancer liver metastases. J Am Coll Surg. 2019;228:902-8.
2. Onoe S, Yokoyama Y, Ebata T, Igami T, Mizuno T, Yamaguchi J, et al. Comparison between autologous and homologous blood transfusions in liver resection for biliary tract cancer: a propensity score matching analysis. J Hepatobiliary Pancreat Sci. 2018;25:550-9.
3. Ivanics T, Shubert CR, Muaddi H, Claasen MPAW, Yoon P, Hansen BE, et al. Blood cell salvage and autotransfusion does not worsen oncologic outcomes following liver transplantation with incidental hepatocellular carcinoma: a propensity score-matched analysis. Ann Surg Oncol. 2021;28:6816-25.
4. Manuel SP, Roberts JP, Bakhtary S. Preoperative autologous blood collection in adult living liver donors: are we wasting donor blood and increasing exposure to risk? Transplantation. 2019;103:387-91.
5. Tomimaru Y, Noguchi K, Dono K. Necessity for autologous blood storage and transfusion in patients undergoing pancreatoduodenectomy. Surg Today. 2017;47:568-74.
6. Weller A, Seyfried T, Ahrens N, Baier-Kleinhenz L, Schlitt HJ, Peschel G, et al. Cell salvage during liver transplantation for hepatocellular carcinoma: a retrospective analysis of tumor recurrence following irradiation of the salvaged blood. Transplant Proc. 2021;53:1639-44.
7. Tan JKH, Menon NV, Tan PS, Pan TLT, Bonney GK, Shridhar IG, et al. Presence of tumor cells in intra-operative blood salvage autotransfusion samples from hepatocellular carcinoma liver transplantation: analysis using highly sensitive microfluidics technology. HPB (Oxford). 2021;23:1700-7.
8. Pinto MA, Grezzana-Filho TJM, Chedid AD, Leipnitz I, Prediger JE, Alvares-da-Silva MR, et al. Impact of intraoperative blood salvage and autologous transfusion during liver transplantation for hepatocellular carcinoma. Langenbecks Arch Surg. 2021;406:67-74.
9. Jia LH, Ma XM, Yan QL, Wu XS, Chen Y, Ye QH, et al. Autologous blood transfusion and pringle maneuver in laparoscopic segmental hepatectomy for benign hepatic neoplasms: a retrospective study. J Laparoendosc Adv Surg Tech A. 2019;29:1571-6.
10. Zacharias T, Ahlschwede E, Dufour N, Romain F, Theissen-Laval O. Intraoperative cell salvage with autologous transfusion in elective right or repeat hepatectomy: a propensity-score-matched case-control analysis. Can J Surg. 2018;61:105-13.
11. Avall A, Hyllner M, Bengtson JP, Carlsson L, Bengtsson A. Recombinant human erythropoietin in preoperative autologous blood donation did not influence the haemoglobin recovery after surgery. Acta Anaesthesiol Scand. 2003;47:687-92.
12. Avall A, Hyllner M, Swolin B, Bengtson JP, Carlsson L, Bengtsson A. Increased serum erythropoietin concentration after allogeneic compared with autologous blood transfusion. Transfus Apher Sci. 2002;27:203-10.
13. de Pree C, Mermillod B, Hoffmeyer P, Beris P. Recombinant human erythropoietin as adjuvant treatment for autologous blood donation in elective surgery with large blood needs (> or = 5 units): a randomized study. Transfusion. 1997;37:708-14.
14. Biesma DH, Marx JJ, Kraaijenhagen RJ, Franke W, Messinger D, van de Wiel A. Lower homologous blood requirement in autologous blood donors after treatment with recombinant human erythropoietin. Lancet. 1994;344:367-70.
15. Busch OR, Hop WC, Marquet RL, Jeekel J. The effect of blood transfusions on survival after surgery for colorectal cancer. Eur J Cancer. 1995;31A:1226-8.
16. Avall A, Hyllner M, Bengtson JP, Carlsson L, Bengtsson A. Postoperative inflammatory response after autologous and allogeneic blood transfusion. Anesthesiology. 1997;87:511-6.
17. Xing YL, Wang YC. Influence of autologous and homologous blood transfusion on interleukins and tumor necrosis factor-α in peri-operative patients with esophageal cancer. Asian Pac J Cancer Prev. 2014;15:7831-4.
18. Chen G, Zhang FJ, Gong M, Yan M. Effect of perioperative autologous versus allogeneic blood transfusion on the immune system in gastric cancer patients. J Zhejiang Univ Sci B. 2007;8:560-5.
19. Heiss MM, Mempel W, Jauch KW, Delanoff C, Mayer G, Mempel M, et al. Beneficial effect of autologous blood transfusion on infectious complications after colorectal cancer surgery. Lancet. 1993;342:1328-33.

20. Duffy G, Neal KR. Differences in post-operative infection rates between patients receiving autologous and allogeneic blood transfusion: a meta-analysis of published randomized and nonrandomized studies. Transfus Med. 1996;6:325-8.
21. British Committee for Standards in Haematology, Transfusion Task Force, Boulton FE, James V. Guidelines for policies on alternatives to allogeneic blood transfusion. 1. Predeposit autologous blood donation and transfusion. Transfus Med. 2007;17:354-65.
22. Alberca I, Asuero MS, Bóveda JL, Carpio N, Contreras E, Fernández-Mondéjar E, et al. [The "Seville" consensus document on alternatives to allogenic blood transfusion. Sociedades Españolas de Anestesiología (SEDAR), Medicina Intensiva (SEMICYUC), Hematología y Hemoterapia (AEHH), Transfusión Sanguínea (SETS) Trombosis y Hemostasia (SETH)]. Med Clin (Barc). 2006;127(Suppl 1):3-20.
23. Klein AA, Bailey CR, Charlton AJ, Evans E, Guckian-Fisher M, McCrossan R, et al. Association of Anaesthetists guidelines: cell salvage for peri-operative blood conservation 2018. Anaesthesia. 2018;73:1141-50.
24. Vassallo R, Goldman M, Germain M, Lozano M. Preoperative autologous blood donation: waning indications in an era of improved blood safety. Transfus Med Rev. 2015;268-75.