

Restrictive vs liberal transfusion for upper gastrointestinal bleeding: A meta-analysis of randomized controlled trials

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Abstract

AIM: To compare the outcome of upper gastrointestinal bleeding (UGIB) between patients receiving restrictive and liberal transfusion.

METHODS: PubMed, EMBASE, and Cochrane Library databases were employed to identify all relevant randomized controlled trials regarding the outcome of UGIB after restrictive or liberal transfusion. Primary outcomes were death and rebleeding. Secondary outcomes were length of hospitalization, amount of blood transfused, and hematocrit and hemoglobin at discharge or after expansion.

RESULTS: Overall, 4 papers were included in this

meta-analysis. The incidence of death was significantly lower in patients receiving restrictive transfusion than those receiving liberal transfusion (OR: 0.52, 95%CI: 0.31-0.87, $P = 0.01$). The incidence of rebleeding was lower in patients receiving restrictive transfusion than those receiving liberal transfusion, but this difference did not reach any statistical significance (OR: 0.26, 95%CI: 0.03-2.10, $P = 0.21$). Compared with those receiving liberal transfusion, patients receiving restrictive transfusion had a significantly shorter length of hospitalization (standard mean difference: -0.17, 95%CI: -0.30--0.04, $P = 0.009$) and a significantly smaller amount of blood transfused (standard mean difference: -0.74, 95%CI: -1.15--0.32, $P = 0.0005$) with a lower hematocrit and hemoglobin level at discharge or after expansion.

CONCLUSION: Restrictive transfusion should be employed in patients with UGIB.

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Key words: Upper gastrointestinal bleeding; Blood transfusion; Meta-analysis; Randomized controlled trial

Core tip: Current international consensus recommends restrictive transfusion for upper gastrointestinal bleeding. However, this recommendation is largely based on expert opinions. We have performed the present meta-analysis of randomized controlled trials, which potentially supported the superiority of restrictive over liberal transfusion for upper gastrointestinal bleeding.

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INTRODUCTION

Acute upper gastrointestinal bleeding is a common cause for emergency hospitalization with a relatively high annual incidence of 50-200/100000 population and a mortality of 10%-30%^[1-3]. Red blood cell transfusion is often required in such patients due to the reduction of tissue perfusion after acute blood loss^[4-6]. Current international consensus on the management of upper gastrointestinal bleeding recommends that the threshold for initiating blood transfusion is a hemoglobin level of 70 g/L or less in patients with nonvariceal upper gastrointestinal bleeding^[5] and a hemoglobin level of 80 g/L or less in patients with variceal bleeding^[6]. However, these recommendations are largely based on expert opinions or international guidelines regarding transfusion requirement in critically ill patients without upper gastrointestinal bleeding^[7-9]. Accordingly, the grade of evidence for these recommendations is low^[5,6].

A previous Cochrane Collaboration systematic review of three randomized controlled trials has shown a tendency in decreasing the mortality of patients with upper gastrointestinal bleeding after restrictive transfusion^[10,11]. But a small number of participants and a high proportion of missing data limit the significance of these findings^[10,11]. These authors concluded that their review might not provide useful data regarding outcomes following red blood cell transfusion for acute upper gastrointestinal bleeding^[10,11]. Recently, several large-scale observational studies demonstrated that blood transfusion after non-variceal upper gastrointestinal bleeding might increase the rate of mortality and rebleeding^[12,13]. More recently, a large and well-organized randomized controlled trial showed a significant benefit of restrictive transfusion strategy in improvement of outcome in patients with upper gastrointestinal bleeding^[14].

Herein, we performed an updated meta-analysis of randomized controlled trials to compare the outcome of upper gastrointestinal bleeding between patients treated with restrictive and liberal transfusion. Primary outcomes were death and rebleeding. Secondary outcomes were length of hospitalization, amount of blood transfused, and hematocrit and hemoglobin at discharge or after expansion.

MATERIALS AND METHODS

This work was performed according to the PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions^[15].

Eligibility criteria

(1) randomized controlled trials were included, if they compared the outcome of upper gastrointestinal bleeding between patients treated with restrictive and liberal blood transfusion; (2) no publication date, publication language, or publication status was restricted; (3) basic studies were excluded; (4) comments, editorials, or letters were excluded; (5) introductions for Cochrane groups were excluded; (6) narrative reviews, systematic reviews, or meta-analyses were excluded; (7) study design reports, case reports, non-

comparative case series were excluded; (8) non-randomized comparative studies were excluded; and (9) randomized controlled trials unrelated to our topics were excluded.

Literature selection

Studies were identified using a search strategy in the PubMed, EMBASE, and Cochrane Library databases. Search items were listed as follows: (“gastrointestinal” [All Fields] OR “digestive” [All Fields] OR “peptic” [All Fields] OR “alimentary tract” [All Fields] OR “esophageal” [All Fields] OR “esophagus” [All Fields] OR “gastric” [All Fields] OR “stomach” [All Fields] OR “duodenal” [All Fields] OR “duodenum” [All Fields]) AND (“hemorrhage” [All Fields] OR “haemorrhage” [All Fields] OR “bleeding” [All Fields] OR “bleed” [All Fields] OR “melena” [All Fields] OR “melaema” [All Fields] OR “hematemesis” [All Fields] OR “haematemesis” [All Fields]) AND (“transfusion” [All Fields] AND (“blood” [All Fields] OR “red cell” [All Fields]) AND (“randomized” [All Fields] OR “randomized” [All Fields] OR “randomly” [All Fields])). The last search was performed on January 5, 2013. Study eligibility was independently judged by two authors. In cases of disagreement between the two authors, they would be discussed with another author. When two or more studies were conducted by one affiliation, only the studies with more complete data and more extensive interval of enrollment were included in the meta-analysis.

Data extraction

We developed a data extraction sheet, including the authors, journal, publication year, whether articles were published in peer-reviewed journals or not, regions where the study was conducted, period of enrollment, study design, target population, study endpoints, eligibility criteria, sample size, and demographic data (age and sex), source of upper gastrointestinal bleeding, hematocrit, and hemoglobin of two groups. Data were independently extracted by two authors. In cases of disagreement between the two authors, they would be discussed with another author. We used Google to translate the information in the non-English language full-texts.

Assessment of study quality

Quality of included randomized controlled trials was scored by Jadad composite scale^[16,17], in which the description of randomization, blinding, and withdrawals were assessed. The quality scale ranged from 0 to 5 points. If the score was 2 or less, the quality of the study would be considered lower. If the score was beyond 2, the quality of the study would be high.

Statistical analysis

Data were collected, using Microsoft Office Excel 2003. For the dichotomous variables (*i.e.*, incidence of death and rebleeding), number of events and total patients were extracted from these included studies. Then, OR with 95%CI was calculated. For the continuous variables (*i.e.*, length of hospitalization, amount of blood transfu-

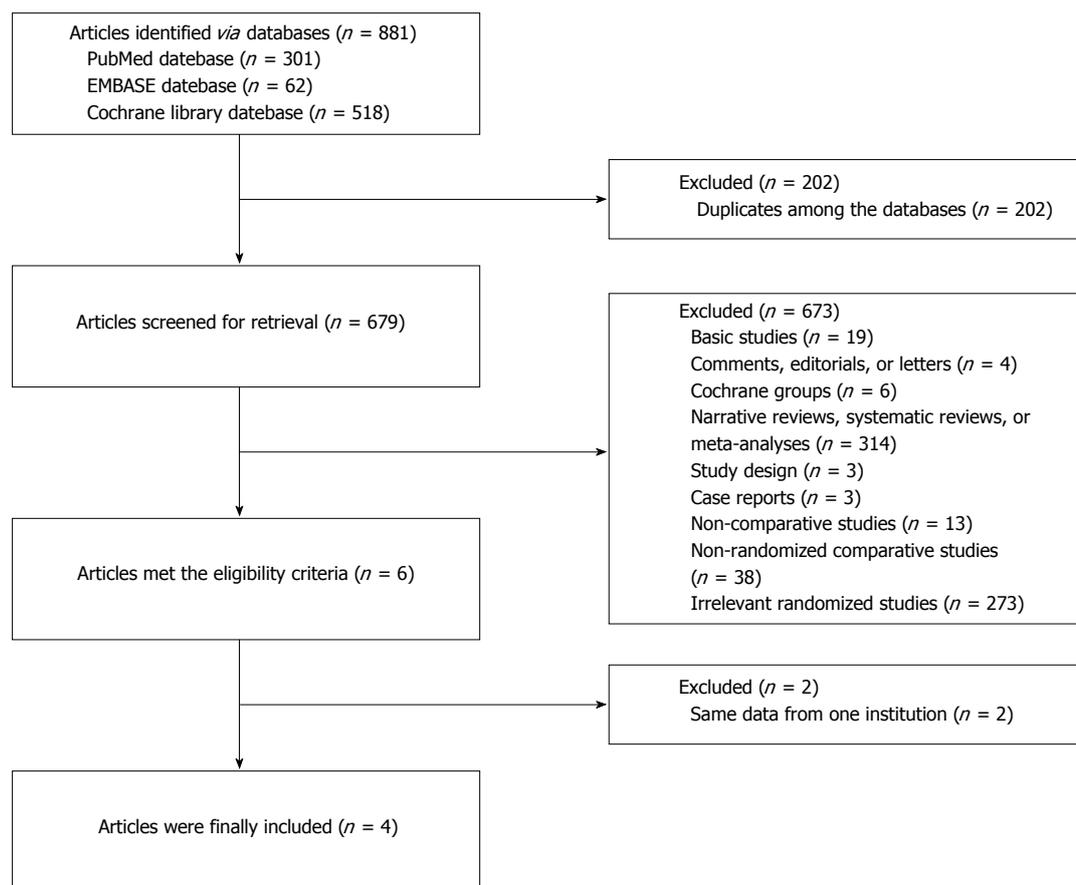


Figure 1 Flowchart of study inclusion.

sion, and hematocrit and hemoglobin), mean value and standard deviation were extracted from these included studies. Then, standard mean difference with 95%CI was calculated. Finally, the OR and standard mean difference of each study were pooled, using both fixed-effects (Mantel-Haenszel method)^[18] and random-effects model (DerSimonian-Laird method)^[19]. When heterogeneity was not significant, the pooled data using fixed-effects model were considered appropriate. When significant heterogeneity was observed, only the pooled data using random-effects model were considered appropriate. Heterogeneity between studies was assessed by using the I^2 statistic ($I^2 > 50\%$ was considered as having substantial heterogeneity) and the χ^2 test ($P < 0.10$ was considered to represent significant statistical heterogeneity)^[20]. Funnel plots were not performed due to a small number of included studies. Sensitivity analyses were done to assess the reliability of meta-analysis. All analyses were conducted using the statistical package Review Manager version 5.1 (Copenhagen, The Nordic Cochrane Center, The Cochrane Collaboration, 2011).

RESULTS

Literature selection

Overall, 881 papers were initially identified by the search strategy. Among them, six papers met eligibility crite-

ria^[14,21-25]. Of note, three papers were reported by the same one affiliation^[14,21-22]. Among them, two papers with a smaller number of patients were excluded^[21,22]. Thus, four randomized controlled trials were finally included in the meta-analysis^[14,23-25] (Figure 1), in which 982 patients with upper gastrointestinal bleeding were treated with restrictive or liberal blood transfusion.

Description of these included studies

All of four randomized controlled trials were single-center studies, and were published in peer-reviewed journals between 1986 and 2013 (Table 1). Three randomized controlled trials were published in three English-language priority journals^[14,24,25], and another one was published in one Spanish-language journal^[23]. Target population was patients with upper gastrointestinal bleeding from variceal or non-variceal source. Of note, a total of 60 patients were randomized in one study^[23], but only 27 patients were finally observed (restrictive transfusion, $n = 14$, and liberal transfusion, $n = 13$). The detailed eligibility criteria of these studies were described in Table 2. The baseline characteristics were comparable between the two groups (Table 3).

Quality of these included studies

In the four studies, double-blinding technique was not feasible due to the nature of interventions. Two studies were scored as 3 points and considered to be of higher

Table 1 Characteristics of included studies

Ref.	Design	Regions	Target population	Intervention	Outcome measures
Blair <i>et al</i> ^[25]	Single center RCT	London, United Kingdom	Acute severe UGIB; no esophageal varices	Early transfusion group (liberal transfusion): at least 2 units of blood No transfusion group (restrictive transfusion): no blood transfusion unless hemoglobin fell below 8 g/dL or they were shocked	Observed results: coagulation results (impedance clotting time, kaolin cephalin clotting time); haematological results (hematocrit); eventual blood transfused; number of rebleed; number of death
Elizalde <i>et al</i> ^[24]	Single center RCT	Barcelona, Spain	Liver cirrhosis with an acute variceal bleeding episode	PRC group (liberal transfusion): 2 units of packed red cells PPL group (restrictive transfusion): 500 mL of a 5% plasma protein solution	Observed items: hemodynamic measurements (cardiopulmonary pressures, cardiac output, wedged and free hepatic venous pressures, mean arterial blood pressure, systemic vascular resistance); hormonal measurements (plasma renin activity, aldosterone levels, norepinephrine); rheological parameters (plasma volume, blood viscosity)
Villarejo <i>et al</i> ^[23]	Single center RCT	Buenos Aires, Argentina	Acute digestive hemorrhage with stable haemodynamics	Treatment group (restrictive transfusion): patients underwent normovolemic hemodilution with crystalloid solutions, and the hematocrit value was maintained as $\geq 21\%$ and $< 28\%$; red cell transfusion was given if angina, shock, hemodynamic instability, or hematocrit $< 21\%$ Control group (liberal transfusion): the target of transfusion in these patients was the hematocrit value of $\geq 28\%$	Observed results: organ failure, hospital stay, APACHE II score, red cell transfused, hematocrit, haemoglobin
Villanueva <i>et al</i> ^[14]	Single center RCT	Barcelona, Spain	Upper gastrointestinal bleeding	Liberal transfusion: the hemoglobin threshold for transfusion was 9 g/dL, with a target range for the post-transfusion hemoglobin level of 9-11 g/dL Restrictive transfusion: the hemoglobin threshold for transfusion was 7 g/dL, with a target range for the post-transfusion hemoglobin level of 7-9 g/dL	Primary endpoints: the rate of death from any cause within the first 45 d Secondary endpoints: the rate of further bleeding and the rate of in-hospital complications

PPL: Plasma protein solution; PRC: Packed red cells; RCT: Randomized controlled trial; UGIB: Upper gastrointestinal bleeding.

Table 2 Eligibility criteria of included studies

Ref.	Eligibility criteria
Blair <i>et al</i> ^[25]	Consecutive patients with acute severe upper gastrointestinal haemorrhage were prospectively randomized on arrival to receive during their first 24 h in hospital Only known cases of oesophageal varices were excluded as they frequently have abnormal coagulation due to liver disease
Elizalde <i>et al</i> ^[24]	The study population consisted of patients with cirrhosis of the liver admitted for the management of an acute variceal bleeding episode Only patients in whom hemostasia had been achieved within the previous 24-72 h by means of endoscopic sclerotherapy, and who were still anemic (hematocrit $< 30\%$) and normovolemic as defined by clinical parameters (systolic pressure > 100 mmHg, right atrial pressure > 2 cm H ₂ O, heart rate < 100 beats/min, and urine output > 0.5 mL/kg per hour) were eligible for the study Age < 18 or > 80 yr, renal failure as defined as serum creatinine > 2 mg/dL, portal thrombosis, diffuse or multinodular hepatocellular carcinoma, arterial hypertension, peripheral vasculopathy, previous surgical or transjugular intrahepatic portosystemic shunt, bacterial infection, and use of vasoactive drugs to prevent or treat portal hypertension-related bleeding were considered exclusion criteria
Villarejo <i>et al</i> ^[23]	Inclusion criteria: acute high digestive haemorrhage with stable haemodynamics and any aetiology; age > 15 yr old Exclusion criteria: history of angina; shock not responsive to volume expansion; requirement of surgery; established renal insufficiency; poliglobulina; bleeding diathesis; acute or chronic liver dysfunction; chronic anemia; pregnancy; sepsis; acute or chronic respiratory failure; haematocrit $< 20\%$ on admission; religious objection to transfusion
Villanueva <i>et al</i> ^[14]	Patients older than 18 yr of age who had hematemesis (or bloody nasogastric aspirate), melena, or both, as confirmed by the hospital staff, were considered for inclusion Patients were excluded if they declined to undergo a blood transfusion Additional exclusion criteria: massive exsanguinating bleeding, an acute coronary syndrome, symptomatic peripheral vasculopathy, stroke, transient ischemic attack, or transfusion within the previous 90 d; a recent history of trauma or surgery; lower gastrointestinal bleeding; a previous decision on the part of the attending physician that the patient should avoid specific medical therapy; and a clinical Rockall score of 0 with a hemoglobin level > 12 g/dL

quality, and another two studies were scored as 1 point and considered to be of lower quality (Table 4).

Death

Three studies reported the incidence of death in two

Table 3 Baseline characteristics of patients in included studies

Ref.	Groups	No. Patients	Age (yr)	Sex (male: female)	Source of bleeding	Hematocrit at admission	Hemoglobin at admission (g/dL)
Blair <i>et al</i> ^[25]	Restrictive transfusion	26	60 ± 4.5	2:1	Gastric ulcer (<i>n</i> = 4); duodenal ulcer (<i>n</i> = 13); carcinoma (<i>n</i> = 2); Mallory-Weiss tear (<i>n</i> = 3); not visualized (<i>n</i> = 4)	29 ± 1.6	NA
	Liberal transfusion	24	64 ± 3.6	2:1	Gastric ulcer (<i>n</i> = 2); duodenal ulcer (<i>n</i> = 17); carcinoma (<i>n</i> = 1); Mallory-Weiss tear (<i>n</i> = 2); not visualized (<i>n</i> = 2)	28 ± 1.2	NA
Elizalde <i>et al</i> ^[24]	Restrictive transfusion	8	60 ± 4	5/3	Bleeding from esophageal varices (<i>n</i> = 7); bleeding from gastric varices in the fundus of the stomach (<i>n</i> = 1)	27.0 ± 1.3	91.5 ± 6.8
	Liberal transfusion	8	64 ± 2	4/4	Bleeding from esophageal varices (<i>n</i> = 7); bleeding from gastric varices in the fundus of the stomach (<i>n</i> = 1)	27.0 ± 1.3	90.5 ± 3.96
Villarejo <i>et al</i> ^[23]	Restrictive transfusion	14	56.8 ± 12.8	9/5	Mallory Weiss (<i>n</i> = 2); erosive gastritis (<i>n</i> = 14); erosive gastroduodenitis (<i>n</i> = 4); Forrest gastric ulcer (<i>n</i> = 10); Forrest duodenal ulcer (<i>n</i> = 10); erosive duodenitis (<i>n</i> = 1)	26.9 ± 4.29	8.76 ± 2.47
	Liberal transfusion	13	45.3 ± 14.6	9/4	Mallory Weiss (<i>n</i> = 2); erosive gastritis (<i>n</i> = 14); erosive gastroduodenitis (<i>n</i> = 4); Forrest gastric ulcer (<i>n</i> = 10); Forrest duodenal ulcer (<i>n</i> = 10); erosive duodenitis (<i>n</i> = 1)	28.3 ± 5.59	8.85 ± 2.53
Villanueva <i>et al</i> ^[14]	Restrictive transfusion	444	NA	NA	Peptic ulcer (<i>n</i> = 228); gastroesophageal varices (<i>n</i> = 101); Mallory-Weiss tears (<i>n</i> = 25); erosive gastritis or esophagitis (<i>n</i> = 38); neoplasms (<i>n</i> = 16); other (<i>n</i> = 36)	NA	9.6 ± 2.2
	Liberal transfusion	445	NA	NA	Peptic ulcer (<i>n</i> = 209); gastroesophageal varices (<i>n</i> = 109); Mallory-Weiss tears (<i>n</i> = 30); erosive gastritis or esophagitis (<i>n</i> = 29); neoplasms (<i>n</i> = 20); other (<i>n</i> = 48)	NA	9.4 ± 2.4

Table 4 Quality assessment of included studies

Ref.	Randomization	Blinding	Withdrawals and dropouts	Jadad Score
Blair <i>et al</i> ^[25]	Yes (inadequate)	No	Unclear	1
Elizalde <i>et al</i> ^[24]	Yes (inadequate)	Unclear	Unclear	1
Villarejo <i>et al</i> ^[23]	Yes (adequate)	Unclear	Clear	3
Villanueva <i>et al</i> ^[14]	Yes (adequate)	Unclear	Clear	3

groups^[14,23,25]. One study did not observe any death during the study period in both groups^[25], so the OR of this study was not estimable. Another two studies showed a higher incidence of death in patients receiving liberal transfusion^[14,25]. Heterogeneity among the three studies was not significant ($I^2 = 0\%$; $P = 0.47$). Using a fixed-effect model, the pooled OR was significant (OR = 0.52, 95%CI: 0.31-0.87, $P = 0.01$) (Figure 2A).

Rebleeding

Two studies reported the incidence of rebleeding in two groups^[14,25]. Both studies showed a higher incidence of rebleeding in patients receiving liberal transfusion. Heterogeneity among the two studies was significant ($I^2 = 74\%$; $P = 0.05$). Using a random-effect model, the pooled OR was not significant (OR = 0.26, 95%CI: 0.03-2.10, $P = 0.21$) (Figure 2B).

Length of hospitalization

Two studies reported the length of hospitalization in two groups^[14,23]. Heterogeneity among the two studies was not significant ($I^2 = 0\%$; $P = 0.99$). Using a fixed-effect model,

the pooled standard mean difference was significant (standard mean difference: -0.17, 95%CI: -0.30--0.04, $P = 0.009$) (Figure 2C).

Amount of blood transfused

Four studies reported the amount of blood transfused in two groups^[14,23,25]. Heterogeneity among the four studies was significant ($I^2 = 54\%$; $P = 0.09$). Using a random-effect model, the pooled standard mean difference was significant (standard mean difference: -0.74, 95%CI: -1.15--0.32, $P = 0.0005$) (Figure 2D).

Hematocrit

Three studies reported the value of hematocrit at discharge or after expansion in two groups^[23,25]. Heterogeneity among the three studies was significant ($I^2 = 85\%$; $P = 0.001$). Using a random-effect model, the pooled standard mean difference was not significant (standard mean difference: -1.07, 95%CI: -2.36-0.21, $P = 0.10$) (Figure 2E).

Hemoglobin

Three studies reported the hemoglobin concentration at discharge or after expansion in two groups^[14,23,24]. Heterogeneity among the three studies was significant ($I^2 = 56\%$; $P = 0.10$). Using a random-effect model, the pooled standard mean difference was significant [standard mean difference: -1.12, 95%CI: -1.73--0.51, $P = 0.0003$] (Figure 2F).

Sensitivity analysis

Sensitivity analyses were performed after one study with

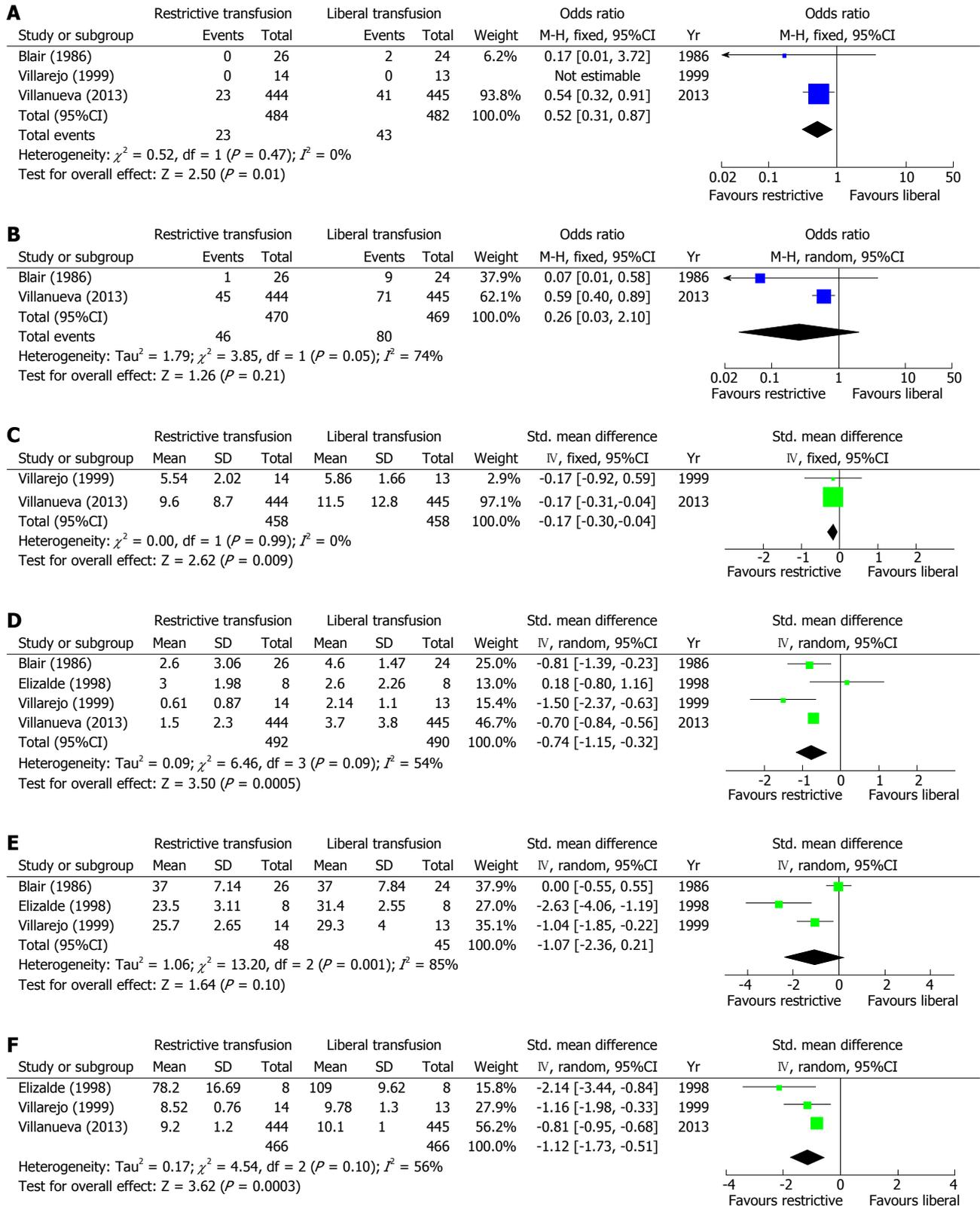


Figure 2 Forest plots comparing the incidence of death (A), incidence of rebleeding (B), length of hospitalization (C), amount of blood transfused (D), and hematocrit (E) and hemoglobin (F) level at discharge or after expansion between patients treated with restrictive and liberal transfusion. Studies are arranged by publication year.

a high proportion of loss to follow-up was excluded^[23]. Results of all meta-analyses were consistent with those of previous meta-analyses. For death, the pooled OR was 0.52

(95%CI: 0.31-0.87, $P = 0.01$). For length of hospitalization, the pooled standard mean difference was -0.17 (95%CI: -0.31--0.04, $P = 0.01$). For amount of blood transfused,

the pooled standard mean difference was -0.64 (95%CI: -0.97--0.30, $P = 0.0002$). For hematocrit, the pooled standard mean difference was -1.23 (95%CI: -3.79-1.34, $P = 0.35$). For hemoglobin, the pooled standard mean difference was -1.31 (95%CI: -2.57--0.06, $P = 0.04$).

DISCUSSION

This updated meta-analysis of randomized controlled trials showed the following important findings. First, restrictive transfusion could significantly decrease the incidence of death in patients with upper gastrointestinal bleeding. The survival benefit of restrictive transfusion might be attributed to a lower incidence of further bleeding and transfusion-related adverse events. Second, two randomized controlled trials were included in our meta-analysis and unanimously supported the effectiveness of restrictive transfusion in decreasing the incidence of rebleeding. Our meta-analysis demonstrated a trend in decreasing the incidence of rebleeding in patients treated with restrictive transfusion, but it did not reach any statistical significance. This unexpected finding could be explained by the fact that a random-effect model was employed due to a significant heterogeneity among studies, and the number of patients included in the two randomized controlled trials was substantially different. Third, patients treated with restrictive transfusion had a significantly shorter length of hospitalization and a smaller amount of blood transfused, although the value of hematocrit and hemoglobin at discharge or after expansion was lower in patients treated with restrictive transfusion than in those with liberal transfusion. Generally, these findings accorded with the current international consensus recommendation in which restrictive transfusion should be employed in patients with upper gastrointestinal bleeding. However, we should acknowledge that the threshold of restrictive transfusion strategy was various among these included studies. Accordingly, further studies should be warranted to elucidate the accurate threshold of transfusion in these patients.

The strengths of our study were as follows. First, only randomized controlled trials were included into our meta-analysis. Second, a comprehensive literature search was performed by searching three databases. Third, no publication language was restricted. One Spanish-language full text paper was retrieved by contacting the journal secretary and was translated by Google^[23]. Fourth, a random-effect model was employed to produce a conservative result with wider confidence intervals, as the heterogeneity among studies was significant^[19].

Several limitations of our study should be fully emphasized. First, the publication date of the four studies spanned from 1986 to 2013. This was a relatively long time during which many diagnostic techniques and treatment modalities had been improved. But it should be noted that heterogeneity among studies was not significant for death. Second, three earlier randomized controlled trials had a relatively small sample size^[23-25]. By comparison, the latest randomized controlled trial had a

larger number of participants included^[14]. Therefore, the weight of this trial was larger than that of other studies in meta-analyses. In future, more randomized controlled trials are needed to perform a further meta-analysis regarding this topic. Third, one randomized controlled trial had a relatively high proportion of loss to follow-up, thereby increasing the possibility of selection bias^[23]. Fourth, one randomized controlled trial primarily aimed to observe the hemodynamic effects of an acute increase in blood hemoglobin levels^[24]. Thus, the data regarding the survival and rebleeding could not be extracted. Fifth, results of one large randomized controlled trial were partially published in two previously published abstracts^[21,22]. A total of 277 patients with cirrhosis with acute variceal bleeding were enrolled in this study^[14]. By contrast, the outcome of 147 participants with cirrhosis with acute variceal bleeding was described in one abstract, and the outcome of 214 participants was reported in another abstract^[21,22]. Importantly, no interim analysis or so called “early stopping rule” was planned in the study. Accordingly, the misbehavior that the authors looked at the data and reported the partial results before the study was completed would introduce the chance of falsely rejecting the null hypothesis (*i.e.*, type I error). Finally, we could not do a meta-analysis according to the different source of bleeding due to a small number of studies included.

In conclusions, this meta-analysis provides preliminary evidence to support that the restrictive transfusion should be employed in patients with upper gastrointestinal bleeding, although the limitation of our study is obvious. Further well designed and conducted randomized controlled trials should be warranted to confirm whether or not restrictive transfusion should be beneficial in different sources of upper gastrointestinal bleeding.

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COMMENTS

Background

Acute upper gastrointestinal bleeding is a common cause for emergency hospitalization with a relatively high morbidity and mortality. Red blood cell transfusion is often required in such patients due to the reduction of tissue perfusion after acute blood loss. Current international consensus recommends restrictive transfusion for upper gastrointestinal bleeding. However, this recommendation is largely based on expert opinions.

Research frontiers

Recently, several large-scale observational studies demonstrated that blood transfusion after nonvariceal upper gastrointestinal bleeding might increase the rate of mortality and rebleeding. More recently, a large and well-organized randomized controlled trial showed a significant benefit of restrictive transfusion strategy in improvement of outcome in patients with upper gastrointestinal bleeding.

Innovations and breakthroughs

A previous Cochrane Collaboration systematic review of three randomized

controlled trials has shown a tendency in decreasing the mortality of patients with upper gastrointestinal bleeding after restrictive transfusion. But a small number of participants and a high proportion of missing data limit the significance of these findings. These authors concluded that their review might not provide useful data regarding outcomes following red blood cell transfusion for acute upper gastrointestinal bleeding. Thus, authors performed an updated meta-analysis of randomized controlled trials to compare the outcome of upper gastrointestinal bleeding between patients treated with restrictive and liberal transfusion. Results of their meta-analysis demonstrated that patients receiving restrictive transfusion had a lower incidence of death and rebleeding, a shorter length of hospitalization, and a smaller amount of blood transfused than those receiving liberal transfusion.

Applications

Evidence suggested that restrictive transfusion should be employed in patients with upper gastrointestinal bleeding.

Peer review

Restrictive transfusion for acute upper gastrointestinal bleeding will become a hot topic in recent years. This study is very interesting. It is valuable to be published.

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