*Med. J. Cairo Univ., Vol. 93, No. 2, Accepted 3/2/2025*
*DOI: 10.22608/MJCU. 689-698, June 2025*
*www.medicaljournalofcairouniversity.net*

# Traumatic Hypovolemia and Emergency Surgery: Comparing Liberal Fluid Resuscitation versus Restricted Fluid Resuscitation with Vasopressors Regarding Clinical and Laboratory Outcomes

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## Abstract

*Background:* Trauma is a leading cause of death worldwide, it is one of the major causes of hypovolemic shock, Concerns have been raised regarding the suitability of conventional aggressive crystalloid resuscitation methods in instances of traumatic hemorrhagic shock, as these methods are associated with significant complications. Therefore, it is imperative to explore safer alternatives that may reduce the associated complications, morbidity, and mortality.

*Aim of Study:* To investigate the efficacy of restricted fluid resuscitation with early vasopressors use in trauma and emergency surgeries and whether it decrease the mortality and complication in those patients.

*Patients and Methods:* The study was conducted at Operation Theater at Souad Kafafi University Hospital-Misr University of science and Technology (MUST). 50 Patients aged 18-50 years, scheduled for urgent damage control surgeries, 25 patients in each group equally.

*Results:* Resuscitation with restricted fluid volume along with early use of vasopressor resulted in a better control over the mean arterial pressure (MAP) mainly around 72.00 to 74.00 range than the conventional liberal fluid method, and a significant concentration of central venous pressure values (CVP) around 7.3. In contrary to liberal method with a significant concentration around 9.6.

Restricted fluid with early vasopressors group throughout follow-up time points showed lower levels of serum lactate indicating better tissue perfusion and better pH state of the body, and a better recovery in the Troponin levels as well, there were statistically significant differences in troponin levels between the two groups at Time 4 and Time 5, as indicated by the *p*-values (0.043 and 0.002, respectively).

As for CRP levels measured post-operative, the F-tests for CRP levels at Times 4, 5, and 6 all indicate statistically significant differences between the groups at each time point. The significance levels (all ≤0.001).

Hemoglobin and Albumin levels post-operative, were significantly higher in the restricted fluid group in all time points compared to the liberal fluid group.

*Conclusion:* The use of restricted fluid resuscitation with early use of vasopressors along with blood products has shown better outcome than the conventional liberal fluid method in resuscitation regarding the mortality and post-operative complications after damage control surgeries, based on a better control over blood pressure and avoiding volume overload with its risks like hemo-delusion or decrease in albumin levels, and better tissue perfusion markers indicating less chance of AKI or multi-organ failure or blood acidosis.

***Key Words:*** *Restricted fluid – Early vasopressors – Liberal fluid – Resuscitation.*

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## Introduction

**TRAUMA** is the leading cause of death worldwide, and almost 30% of trauma deaths are due to blood loss. A number of concerns have been raised regarding the advisability of the classic principles of aggressive crystalloid resuscitation in traumatic hemorrhagic shock. Some recent studies have shown that early volume restoration in certain types of trauma before definite hemostasis may result in accelerated blood loss, hypothermia, and delusional coagulopathy. This study discusses the advances and changes in protocols in fluid resuscitation and blood transfusion for treatment of traumatic hemorrhage shock. The concept of low volume fluid resuscitation also known as restrictive fluid resuscitation avoids the adverse effects of early aggressive resuscitation

while maintaining a level of tissue perfusion that although lower than normal, is adequate for short periods. Restrictive fluid resuscitation is part of the damage control resuscitation strategy, which targets the conditions that exacerbate hemorrhage. The elements of this strategy are permissive hypotension, minimization of crystalloid resuscitation, control of hypothermia, prevention of acidosis, and early use of blood products to minimize coagulopathy **[1].**

For the past four decades, the standard approach to the trauma victim, who is hypotensive from presumed hemorrhage has been to transfuse large volumes of fluid as early and as rapidly as possible **[2].** The goals of this treatment strategy are rapid restoration of intravascular volume and vital signs toward normal and maintenance of vital organ perfusion. High volume IV fluid for hemodynamic instability has been the accepted standard in most prehospital care systems like advanced trauma life support system (ATLS). The most recent laboratory studies and clinical trials evaluating the efficacy of these guidelines however suggest that in the setting of uncontrolled hemorrhage, aggressive fluid resuscitation may be harmful, resulting in increased hemorrhagic volume and subsequently greater mortality **[3].** The aim is to allow a subnormal blood pressure to minimize hemorrhagic blood loss. For uncontrolled hemorrhage in the absence of TBI, target resuscitation to MAP above 65 mmHg, normal mentation and palpable peripheral pulses **[4]**. Blood should allow sufficient oxygen delivery to tissues that is ensured by monitoring serum lactate levels and central venous oxygen saturation.

*Aim of the work:*

The aim of this study is to investigate the efficacy of restricted fluid resuscitation with vasopressors use in trauma and emergency surgeries and whether it decrease the mortality and complication in those patients.

## Patients and Methods

*Ethical considerations:* After the approval of research ethical committee. Informed written consent was obtained from study participants or their legally authorized representative.

*Study design:* Randomized comparative study.

*Study setting and location:* The study was conducted at Souad Kafafi University Hospital-Misr University of science and Technology (MUST) during 2024.

*Study population:* Patients aged from 18 to 50 years old presented to operative theatre for damage control surgeries after suffering trauma with hemodynamic instability.

Both Groups received volume resuscitation with the following difference: Group A: Received a resuscitation method of restricted fluid hydration related to body weight with vasopressors as noradrenaline. Group B: Received a resuscitation method of liberal fluid hydration.

*Eligibility criteria:*

*Inclusion criteria:* Patient's age 18-50 years, ability to sign the consent, patients presented to operative theatre for damage control surgeries after suffering trauma with hemodynamic instability, ASA classification I, II: ASA I: Normal Healthy Patient, ASA II: Patient with mild systemic controlled disease; Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease.

*Exclusion criteria:* Coagulopathies, hepatic dysfunction (prothrombin ratio <50%), renal dysfunction, congestive heart failure (New York Heart Association scores ≥ 3), peripheral vascular disease, ASA III, IV: ASA III: A patient with severe systemic disease; Poorly controlled DM or HTN, Chronic Obstructive Lung Disease (COPD), morbid obesity (BMI ≥ 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, End Stage Renal Disease (ESRD) undergoing regularly scheduled dialysis, ASA IV: A patient with severe systemic disease that is a constant threat to life; Recent (<3 months) myocardial infarction (MI), Cerebrovascular accident (CVA), Transient Ischemic Attack (TIA) or coronary artery disease (CAD/stents), ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, shock, sepsis, Disseminated Intravascular Coagulation (DIC), acute respiratory distress syndrome (ARDS) or ESRD not undergoing regularly scheduled dialysis.

*Study procedures:*

*Randomization:* Patients were randomly allocated by a block randomization pattern of 4 blocks containing the two groups A and B, with a fixed sequence of (ABAB) respectively.

*Study protocol:*

All Patients have had a pre-operative assessment visit, which included history taking, complete physical examination and review of all the results of the routine investigations. After applying standard monitoring including continuous electrocardiographic data, heart rate, pulse oximetry, Anesthesia induction will include Ketamine (1mg/kg), fentanyl (2mg/kg), atracurium (0.5mg/kg) and maintenance with sevoflurane at minimum alveolar concentration of 2 **[5]**. Also mechanically controlled ventilation with an inspired oxygen fraction of 50% of air-oxygen mixture to maintain $PaCO_2$ between 35 and 40mmHg, plus a positive end-expiratory pressure of 5cm$H_2O$ and the lowest allowable tidal volume to keep the $PCO_2$ within the desired range Invasive mean arterial pressure (MAP) and central venous

pressure were monitored. Normothermia was maintained with a convective air warming system.

Data were collected and measured at fixed time points namely: T0 at induction, T1 at 10mins after induction, T2 at one hour from start of surgery, T3 at the end of surgery, T4 at 1st day post-operative, T5 at 2nd day post-operative, T6 at 5th day post-operative.

The following was measured at all time points: Mean arterial pressure (MAP), Central venous pressure (CVP), Urinary output (UOP), Serum lactate.

And the following at only T4, T5 and T6: Body weight, The cardiac biomarkers high sensitive troponin I, C-reactive protein (CRP), Hemoglobin (Hb), Albumin, Creatinine.

Postoperative hydration was identical in both groups and consisted primarily of 1,000ml of balanced Ringer's solution and 1000ml of glucose 5% per 24h until resumption of normal food intake. If the mean arterial pressure (MAP) drops below 70mmHg, first, a bolus of 500ml of balanced Ringer's solution was administrated, if mean arterial pressure (MAP) was persistent less than 70mmHg, norepinephrine was infused up to a rate of 0.05-0.15ug/kg/min targeting mean arterial pressure (MAP) above 70mmHg. Packed erythrocytes units was transfused according to the American Society of Anesthesiologists guidelines and fresh frozen plasma transfusion was given if the prothrombin time is greater than 1.5 times the normal value.

*Study outcomes:*

*Primary outcome:* Hemodynamic stability regarding vital signs and urinary output intraoperative and postoperative.

*Secondary outcome(s):* Laboratory values regarding serum lactate level, hemoglobin (Hb), Albumin, creatinine, C reactive protein (CRP) and troponin levels. Postoperative morbidity and mortality. The average length of stay in the intensive care unit (ICU).

*Statistical methods:*

The sample size calculation was done by G*Power 3.1.9.2 (Universitat Kiel, Germany).

According to previous studies, the mean ± SD of CRP postoperatively D2 (the primary outcome) was 114±23.14mg/l with Restrictive group and 93.26±27.55mg/l with Liberal group. The sample size was based on the following considerations: 0.815 effect size, 95% confidence limit, 80% power of the study, group ratio 1:1. Therefore, we will recruit 25 patients in each group.

## Results

Table (1) presented that The Study Group (Restricted Fluid) shows a steady increase in mean MAP over time, with a notable rise from Time 0 to Time 2, after which the increase slows down.

The Control Group (Liberal Fluid) shows a more gradual increase in mean MAP initially but then exhibits a significant rise from Time 3 onwards, surpassing the Study Group's MAP by Time 4.

This suggests that the liberal fluid approach may lead to a more pronounced increase in MAP over time compared to the restricted fluid approach, and more control over MAP in study group.

Table (1): Descriptive statistics and comparing the mean values of MAP.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| Mean Arterial Pressure at Time 0 | Restricted Fluid (study) | 25 | 59.7600 | 6.09152 |
| | Liberal Fluid (control) | 25 | 56.0800 | 4.00957 |
| Mean Arterial Pressure at Time 1 | Restricted Fluid | 25 | 68.1600 | 4.71416 |
| | Liberal Fluid | 25 | 56.1600 | 3.91237 |
| Mean Arterial Pressure at Time 2 | Restricted Fluid | 25 | 73.1600 | 4.79305 |
| | Liberal Fluid | 25 | 65.3600 | 3.81750 |
| Mean Arterial Pressure at Time 3 | Restricted Fluid | 25 | 74.8000 | 4.96655 |
| | Liberal Fluid | 25 | 75.1200 | 4.56727 |
| Mean Arterial Pressure at Time 4 | Restricted Fluid | 25 | 77.5600 | 6.19193 |
| | Liberal Fluid | 25 | 82.9200 | 5.08199 |
| Mean Arterial Pressure at Time 5 | Restricted Fluid | 25 | 79.8000 | 5.97913 |
| | Liberal Fluid | 25 | 89.0000 | 5.43906 |
| Mean Arterial Pressure at Time 6 | Restricted Fluid | 25 | 81.8400 | 7.84581 |
| | Liberal Fluid | 25 | 103.8800 | 5.59255 |

Fig. (1) the bar chart suggested that the Study Group has a more concentrated distribution of MAP values around the 72.00 to 74.00 range, while the Control Group has a more evenly distributed range of MAP values. This could imply that the study intervention has an effect on stabilizing or concentrating MAP values within a specific range.

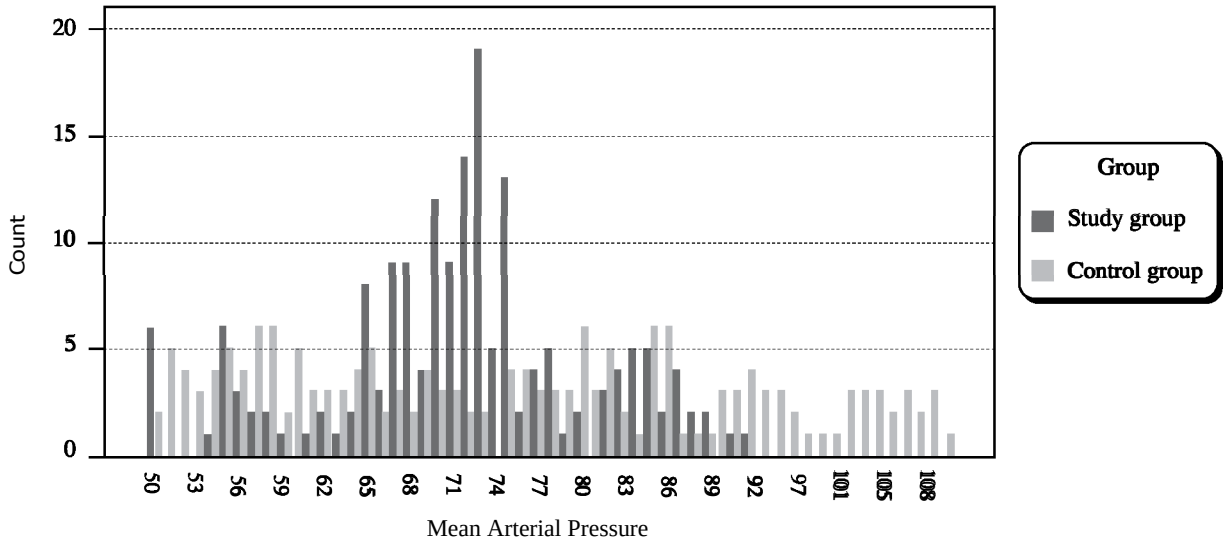


Fig. (1): Frequency of the Studied Groups MAP Values.

Table (2) presented that the analysis of mean arterial pressure (MAP) at different time points reveals significant differences between the two groups at most time points, except for Time 3. Levene's Test indicates unequal variances at Time 0 and Time 6, suggesting that the t-test results for these time points should be interpreted with caution. The significant t-values at other time points indicate notable differences in MAP between the groups, which could have important clinical implications.

Table (2): Levene's Test for Equality of Variances for mean arterial pressure.

| | F | Sig. | t |
|---|---|---|---|
| Mean Arterial Pressure at Time 0 | 4.327 | .043 | 2.523<br>2.523 |
| Mean Arterial Pressure at Time 1 | .434 | .513 | 9.794<br>9.794 |
| Mean Arterial Pressure at Time 2 | .830 | .367 | 6.365<br>6.365 |
| Mean Arterial Pressure at Time 3 | .017 | .898 | -.237-<br>-.237- |
| Mean Arterial Pressure at Time 4 | 1.171 | .285 | -3.346-<br>-3.346- |
| Mean Arterial Pressure at Time 5 | .693 | .409 | -5.691-<br>-5.691- |
| Mean Arterial Pressure at Time 6 | 5.538 | .023 | -11.437-<br>-11.437- |

Table (3) indicated that The Control Group (Liberal Fluid) consistently shows higher mean CVP values compared to the Study Group (Restricted Fluid) from Time 2 onwards. The restricted fluid administration in the Study Group results in lower CVP values, which may be beneficial in certain clinical scenarios to avoid fluid overload.

Table (4) presented Mean Urine Output: The Restricted Fluid Group generally has a higher mean urine output compared to the Liberal Fluid Group at most time points, especially from Time 3 onwards. This could have implications for fluid management strategies in clinical practice, particularly in settings where urine output is a critical indicator of patient status.

Table (5) indicated that the Control Group (Liberal Fluid) consistently has higher mean serum lactate levels compared to the Study Group (Restricted Fluid) at all time points. The differences in means and standard deviations suggest that the type of fluid administration may have a significant impact on serum lactate levels, tissue perfusion and blood PH.

Table (6) indicated that restrictive fluid management (Study Group) is associated with higher initial troponin levels, at Time 4. However, over time, the Study Group shows lower troponin levels compared to the Control Group (Liberal Fluid), indicating better recovery. These findings highlight the complex interplay between fluid management strategies and tissue injury, with potential implications for clinical practice and patient outcomes.

Table (7) presented that Mean CRP Levels: At Time 4, 5 and 6, the mean CRP level is slightly higher in the liberal fluid Group compared to the restricted fluid Group. The differences in mean CRP levels between the two groups shows more rapid recovery in CRP levels in restricted fluid group.

Table (8) presented that the study group (restricted fluid) consistently has higher mean hemoglobin levels compared to the control group (liberal fluid) at all three time points. This suggests that the restricted fluid approach may be associated with higher hemoglobin levels, which could be due to less dilution of blood compared to the liberal fluid approach, which gives better oxygen-carrying capacity and potentially improved patient outcomes.

Table (9) presented that the restricted fluid regimen is associated with higher mean albumin levels compared to the liberal fluid regimen at all three time points.

Table (3): Comparing the mean values of CVP.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| Mean Venous Pressure at Time 0 | Restricted Fluid (study) | 25 | 6.1400 | .73993 |
| | Liberal Fluid (control) | 25 | 6.0120 | .29484 |
| Mean Venous Pressure at Time 1 | Restricted Fluid | 25 | 6.3960 | .47124 |
| | Liberal Fluid | 25 | 6.2120 | .28036 |
| Mean Venous Pressure at Time 2 | Restricted Fluid | 25 | 7.0920 | .39149 |
| | Liberal Fluid | 25 | 7.5480 | .25351 |
| Mean Venous Pressure at Time 3 | Restricted Fluid | 25 | 7.3240 | .22598 |
| | Liberal Fluid | 25 | 9.4560 | .23466 |
| Mean Venous Pressure at Time 4 | Restricted Fluid | 25 | 7.5400 | .35590 |
| | Liberal Fluid | 25 | 9.8320 | .23402 |
| Mean Venous Pressure at Time 5 | Restricted Fluid | 25 | 7.6480 | .48659 |
| | Liberal Fluid | 25 | 10.0480 | .26944 |
| Mean Venous Pressure at Time 6 | Restricted Fluid | 25 | 7.8920 | .45909 |
| | Liberal Fluid | 25 | 9.5400 | .25000 |

Table (4): Comparing the mean values of urine output.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| Mean Output at Time 0 | Restricted Fluid (study) | 25 | 43.2458 | 26.46372 |
| | Liberal Fluid (control) | 25 | 31.1200 | 5.18266 |
| Mean Output at Time 1 | Restricted Fluid | 25 | 38.2400 | 26.65408 |
| | Liberal Fluid | 25 | 32.9600 | 5.20000 |
| Mean Output at Time 2 | Restricted Fluid | 25 | 38.5200 | 27.30555 |
| | Liberal Fluid | 25 | 38.9600 | 5.14360 |
| Mean Output at Time 3 | Restricted Fluid | 25 | 48.0800 | 24.04149 |
| | Liberal Fluid | 25 | 46.8800 | 5.42617 |
| Mean Output at Time 4 | Restricted Fluid | 25 | 76.4400 | 24.53243 |
| | Liberal Fluid | 25 | 61.4800 | 5.31601 |
| Mean Output at Time 5 | Restricted Fluid | 25 | 91.8000 | 26.87626 |
| | Liberal Fluid | 25 | 66.0800 | 5.24341 |
| Mean Output at Time 6 | Restricted Fluid | 25 | 85.8000 | 26.21386 |
| | Liberal Fluid | 25 | 87.6400 | 5.23514 |

Table (5): Mean values of serum lactate level.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| Serum Lactate Level at Time 0 | Restricted Fluid (study) | 25 | 1.9296 | .87859 |
| | Liberal Fluid (control) | 25 | 4.0004 | .28709 |
| Serum Lactate Level at Time 1 | Restricted Fluid | 25 | 1.8624 | .87120 |
| | Liberal Fluid | 25 | 4.1008 | .28697 |
| Serum Lactate Level at Time 2 | Restricted Fluid | 25 | 2.1556 | .91819 |
| | Liberal Fluid | 25 | 4.4884 | .24193 |
| Serum Lactate Level at Time 3 | Restricted Fluid | 25 | 2.0580 | .76388 |
| | Liberal Fluid | 25 | 4.4008 | .28697 |
| Serum Lactate Level at Time 4 | Restricted Fluid | 25 | 1.6600 | .67228 |
| | Liberal Fluid | 25 | 4.3124 | .26333 |
| Serum Lactate Level at Time 5 | Restricted Fluid | 25 | 1.1633 | .60170 |
| | Liberal Fluid | 25 | 4.2012 | .28686 |
| Serum Lactate Level at Time 6 | Restricted Fluid | 25 | .7652 | .46782 |
| | Liberal Fluid | 25 | 3.5016 | .28676 |

Table (6): Mean values of troponin.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| Troponin at Time 4 | Restricted Fluid (study) | 25 | 3.5380 | 16.97138 |
| | Liberal Fluid (control) | 25 | .2004 | .02226 |
| Troponin at Time 5 | Restricted Fluid | 25 | .1016 | .03902 |
| | Liberal Fluid | 25 | .1816 | .02154 |
| Troponin at Time 6 | Restricted Fluid | 25 | .0416 | .02055 |
| | Liberal Fluid | 25 | .0728 | .02092 |

Table (7): CRP mean values.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| C-Reactive Protein at Time 4 | Restricted Fluid (study) | 25 | 84.7612 | 29.85065 |
| | Liberal Fluid (control) | 25 | 85.6000 | 5.61249 |
| C-Reactive Protein at Time 5 | Restricted Fluid | 25 | 83.8400 | 24.45179 |
| | Liberal Fluid | 25 | 84.5600 | 5.67950 |
| C-Reactive Protein at Time 6 | Restricted Fluid | 25 | 73.4400 | 24.10754 |
| | Liberal Fluid | 25 | 79.6800 | 5.49788 |

Table (8): Mean values of hemoglobin.

| | Study vs. Control Group | N | Mean | Std. Deviation |
|---|---|---|---|---|
| Hemoglobin at Time 4 | Restricted Fluid (study) | 25 | 12.2160 | 15.17203 |
| | Liberal Fluid (control) | 25 | 8.0560 | .21922 |
| Hemoglobin at Time 5 | Restricted Fluid | 25 | 9.6640 | .63828 |
| | Liberal Fluid | 25 | 8.4152 | .64410 |
| Hemoglobin at Time 6 | Restricted Fluid | 25 | 10.4880 | .70788 |
| | Liberal Fluid | 25 | 9.0476 | .19049 |

Table (9): Mean values of albumin.

| | Study vs. Control Group | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Albumin at Time 4 | Restricted Fluid (study) | 25 | 4.5960 | 1.40074 | .28015 |
| | Liberal Fluid (control) | 25 | 4.2120 | .27586 | .05517 |
| Albumin at Time 5 | Restricted Fluid | 25 | 4.4200 | .51962 | .10392 |
| | Liberal Fluid | 25 | 3.8160 | .27940 | .05588 |
| Albumin at Time 6 | Restricted Fluid | 25 | 4.6720 | .47392 | .09478 |
| | Liberal Fluid | 25 | 3.2120 | .24207 | .04841 |

### *Discussion*

The key to restricted fluid resuscitation is providing sufficient fluid to prevent cardiovascular collapse and to perfuse organs, without giving excessive amounts that can cause increased bleeding and wash out clots. Restricted fluid resuscitation appears safe and is associated with a decreased mortality rate when compared to conventional resuscitation. There is less blood loss, hemodilution, ischemia, and hypoxia in tissues. Additional research is required to determine the exact parameters that are most beneficial and in which patient populations. Woodward L, Alsabri M *[1]*. Permissive hypotension resuscitation strategy serves as a better option, as it can reduce the mortality of shock patients, promote the recovery of physical function and reduce the incidence of adverse events, such as AKI, ARDS and MODS. However, there are complex questions to be answered, such as the role of lens in hemostasis and resuscitation, coagulation disorders and treatment caused by trauma, duration of permissible hypotension and specific implementation plan. All of those need further high-quality and dynamic experiments to clarify Zhang, Yang, et al. *[5]*. Fluid restriction resuscitation may have a positive impact on 30-day mortality, when compared with fluid resuscitation methods, however there is evidence to suggest that fluid restriction resuscitation may be more effective for blunt force injuries. Some studies even suggest a reduction in the treatment cost when reducing fluid volumes. Penetrating injuries are usually more likely to be a compressible source of haemorrhage within which haemorrhage control can be gained much more easily. There are recommendations for the use of fluid restriction resuscitation in both compressible and non-compressible injuries. It is difficult at this time to draw definitive conclusions for the treatment of every case related to traumatic hemorrhage given the variability and unpredictability of trauma. Clarke, Rebecca, and Enrico Dippenaar *[6]*. It was concluded that the recovery rate and effective hemoglobin concentration were significantly improved in experimental patients and also probability of complications was extensively lower in patients managed with limited fluid resuscitation than conventional fluid resuscitation.

Moreover, controlled blood pressure elevation through limited fluid resuscitation is the best intravenous fluid administration strategy to prevent fatal complications in trauma patients and reduce the chances of hypothermia and cardiogenic shock. Riaz, Muhammad Mohsin, et al. *[7]*. Earlier vasopressor requirement among hypotensive trauma patients was independently associated with increased mortality and major complications. Further research on the utility and optimal timing of vasopressors during the post-injury resuscitative period is warranted. Anand T, Hejazi O, Nelson A, et al. *[8]*. The study was conducted at Souad Kafafi University Hospital-Misr University of science and Technology (MUST). The aim of this study was to investigate the efficacy of restricted fluid resuscitation with vasopressors use in trauma and emergency surgeries and whether it decrease the mortality and complication in those patients. Our study showed that there were statistically significant differences between the study groups regarding tissue perfusion indicators, hemoglobin and albumin levels, control of MAP and CVP. Our results were consistent with Woodward L, Alsabri M. *[1]* who reported that there was significance between the studied groups regarding blood loss, hemodilution, ischemia, and hypoxia in tissues. In our study there was statistically significant difference between the two groups regarding CVP reading, where The Liberal Fluid group consistently shows higher mean CVP values compared to the restricted fluid Group from Time 2 onwards (T2, T3, T4, T5, T6). The difference in mean CVP between the two groups becomes more pronounced over time, with the Liberal Fluid Group showing a significant increase in CVP, also the difference in hemoglobin levels post-operatively, as the restricted fluid group consistently has higher mean hemoglobin levels compared to the liberal fluid group at all time points (Time 4, Time 5, Time 6). This suggests that the restricted fluid approach may be associated with higher hemoglobin levels, which could be due to less dilution of blood compared to the liberal fluid approach. Also, Woodward L, Alsabri M. *[1]* reported in his review that administration of an adequate volume of fluids to avert cardiovascular failure and ensure proper organ perfusion, while avoiding excessive quantities that may lead to heightened

bleeding and the dilution of clots can give better outcomes regarding mortality of patients. In our study, Restrictive fluid management group is associated with higher initial troponin levels, at Time 4. However, over time, at Time 5 and Time 6, the restrictive fluid group shows lower troponin levels compared to the Liberal Fluid Group, indicating better recovery. We also found in our study that, the CRP levels were significantly different between both groups, as it was higher in the restricted fluid group at Time 4 and Time 5, However it recovered rapidly showing lower levels at Time 6 than the liberal fluids group, which implies that restricted fluid has a significantly effect in improving the perfusion. In Woodward L, Alsabri M. [1] review, they also concluded that restricting fluids and avoiding fluid overload showed less tissue ischemia and better perfusion. Our study indicated that statically significant differences in serum lactate levels between the groups were noted at Time 0, Time 1, Time 2, Time 3, and Time 4. However, no significant differences were found at Time 5 and Time 6, which overall indicated that the Liberal Fluid Group consistently has higher mean serum lactate levels compared to the Restricted Fluid Group at all time points, which showed that there is lower incident of lactic acidosis with the restricted fluid with vasopressors therapy. Also, Zhang, Yang, et al. [5] who reported that Permissive hypotension resuscitation strategy reduce the mortality of shock patients, promote the recovery of physical function and reduce the incidence of adverse events, such as AKI, ARDS and MODS. In our study showed that the creatinine levels differ statistically significantly between the two groups at Time 4 and Time 5, but not at Time 6 between the two study groups, implying a more rapid recovery of the renal functions in restricted fluid regime which decrease the chance of acute kidney infarction. Zhang, Yang, et al. [5]in their meta-analysis also, provided that the risk of AKI and MODS is lesser in permissive hypotensive resuscitation than the conventional liberal in most of their searched studies. Additionally, Riaz, Muhammad Mohsin, et al. [7], in their study on a larger number of patients, stated that Hemoglobin concentration was significantly improved ($p$<0.05) in the patients of experimental groups (mean 11.12±2.39g/dl) than control group, which aligns with most of our results, including the better hemoglobin concentration at the end point of our study (at Time 6), at Time 5 and Time 6. Riaz, Muhammad Mohsin, et al. [7] also stated that hypoxia and intravascular coagulation was more statistically significant with the liberal fluid regime, which aligns with our study results, including the recovery of CRP levels which was more palpable in the restricted fluid group, shown by the less CRP level in that group at Time 6 even when it was higher at Time 4 and Time 5 than the liberal fluid group. Our study also supported with Riaz, Muhammad Mohsin, et al. [7] who reported a better perfusion in the limited fluid regime group, which appeared in our results of the Troponin levels control in the restricted fluid group along with the CRP levels as mentioned. Zhang, Yang, et al. [5] also stated that, A statistically significant reduction in mortality was observed in the permissive hypotension group (RR=0.70; 95%CI=0.58-0.84; $p$<0.05), The loss of platelet (PLT), hemoglobin (Hb) and body fluid was properly protected, the amount of resuscitation fluid was reduced, and the incidence of some adverse events was effectively reduced, However they stated that there was no significant difference in coagulation time and hospital stay between the two groups. In our study, the results showed less complications in the restricted fluid with vasopressors therapy, which was evident by the decrease in CRP levels, Troponin levels and creatinine levels, which implies a better tissue perfusion and less chance of acute kidney injury, alongside with the better haemoglobin and albumin levels. And the less chance of fluid overload in restricted fluid therapy which appeared in the less CVP measurements and the better control of MAP, which can result in less coagulopathy and less shifting of the Endothelial Glycocalyx Layer (EGL), which in result decrease the chances of complications and provide better outcome in hypovolemic shock patients after suffering poly-traumatic events. On the contrary, Anand T, Hejazi O, Nelson A, et al. [8] stated in their retrospective analysis of the 2017-2018 ACS-TQIP database that every one-hour delay in vasopressor administration beyond the first hour was independently associated with decreased odds of 24-hour mortality (aOR: 0.65, $p$<0.001), inhospital mortality (aOR: 0.65, $p$<0.001), major complications (aOR: 0.77, $p$=0.003), and increased odds of longer ICU LOS (β + 2.53, $p$=0.012), however There were no associations between the timing of early vasopressor administration and 24-hour PRBC transfusion requirements ($p$>0.05), and also concluded that The earlier need for vasopressors in hypotensive trauma patients was found to be independently linked to a higher risk of mortality and significant complications, which was against our study on some aspects. To be noted that in Anand T, Hejazi O, Nelson A, et al. [8]'s retrospective analysis, they included patients in a more wide range of age groups of 18 years and older, with a mean age of 55±20 years, while we were restricted to age from 18 to 50, maybe the inclusion of the high age caused the conflict on our results which needs further studying.

*Conclusion:*

The use of restricted fluid resuscitation with early use of vasopressors along with blood products has shown better outcome than the conventional liberal fluid method in resuscitation regarding the mortality and post-operative complications after damage control surgeries, based on a better control over blood pressure and avoiding volume overload with its risks like hemodelusion or decrease in albumin levels, and better tissue perfusion markers indicating less chance of AKI or multi-organ failure or blood acidosis.

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# مقارنة ما بين اسعاف مرضى الصدمة الوعائية بالسوائل بكميات حرة مقابل استخدام السوائل بكميات محدودة مع الأدوية القابضة للأوعية الدموية فى حالات الصدمة الوعائية الناتجة عن نقص حجم الدم المرتبطة بجراحات الطوارئ : مقارنة فيما يتعلق بالنتائج الاكلينيكية والمختبرية

يُعد الصدمة الناتجة عن الإصابات والحوادث أحد الأسباب الرئيسية للوفاة على مستوى العالم، كما أنها من الأسباب الرئيسية للصدمة النزفية. تم إثارة الشكوك مدى ملاءمة طرق الإنعاش التقليدية باستخدام المحاليل البلورية بشكل مفرط فى حالات الصدمة النزفية الناتجة عن الإصابات، حيث أن هذه الطرق مرتبطة بمضاعفات كبيرة.

لذلك، من الضرورى استكشاف بدائل أكثر أمانًا التى قد تقلل من المضاعفات المرتبطة بها، وكذلك من المرض والوفيات.

ظهرت مؤخرًا طرق للإنعاش تشمل استخدام تعويض السوائل بمعدل أقل وأكثر تقييداً مقارنة بالحجم المفقود، بالإضافة الى استخدام منتجات الدم، وذلك لتقليل خطر خثرات الدم، نقص التغذية النسيجية أو الفشل العضوى.

أظهرت هذه الأساليب نتائج نجاح أفضل مع تقليل المضاعفات والوفيات. كما أن استخدام الأدوية القابضة للأوعية مبكرًا مع تعويض السوائل المحدود أظهر فعالية عالية مع نتائج أفضل وقلة فى المضاعفات.

الهدف من البحث: الهدف من هذه الدراسة هو التحقيق فى فعالية الإنعاش باستخدام السوائل المحدودة مع استخدام الأدوية القابضة للأوعية فى حالات الإصابات المتعددة والحوادث والعمليات الطائة، وما اذا كانت هذه الطريقة تقلل من الوفيات والمضاعفات فى هؤلاء المرضى.

طريقه البحث: تم تقسيم الخمسون مريض الذين تتراوح أعمارهم بين الثمانية عشر إلى الخمسون عامًا، والذين تم ادخالهم الى غرفة العمليات لإجراء عمليات السيطرة على الأضرار بعد تعرضهم للإصابات والحوادث مع عدم استقرار الدورة الدموية والهبوط الحاد بها، الى مجموعتين يحتويان على ٢٥ مريض بكل مجموعة :المجموعة أ: تلقت طريقة انعاش محدودة للسوائل تعتمد على وزن الجسم مع الأدوية القابضة للأوعية مثل النور أدر ينالين. المجموعة ب: تلقت طريقة انعاش سوائل حرة،

الاستنتاج: أظهرت النتائج أن الإنعاش باستخدام السوائل المحدودة مع استخدام الأدوية القابضة للأوعية مبكرًا مع منتجات الدم أدى الى نتائج أفضل من الطريقة التقليدية فى الإنعاش فيما يتعلق بالوفيات والمضاعفات بعد العمليات الجراحية المتعلقة بالسيطرة على الأضرار، حيث تم تحقيق تحكم أفضل فى ضغط الدم وتجنب الحمل الزائد فى حجم الدم وما يرتبط به من مخاطر مثل التخفيف الدموى أو انخفاض مستويات الألبومين، كما أن مؤشرات التغذية النسيجية كانت أفضل مما يشير الى انخفاض فرصة الإصابة بالفشل الكلوى الحاد أو الفشل العضوى المتعدد أو الحموضة الدموية.