Evaluating effects of pre-operative hydration on clinical outcome of patients undergoing orthopedic surgery

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Introduction
Although fluid therapy is necessary in invasive measures and anesthesia process, its type, quantity, and exact time of prescription are still a question. Almost all patients undergoing general anesthesia will receive some intravenous fluid. There are ever-increasing evidence indicating that pre-operative fluid therapy affects long-term post-operative outcomes. Routine treatment process, i.e., intravenous injection of higher crystalloid volumes for all patients, was investigated through recent trial and evidence-based studies.¹⁻⁵ The operated patients are exposed to decrease of tissue perfusion or increase of body fluids.
Speaking about fluid therapy in surgery, three points should be taken into account: hypovolemia, hypervolemia, and tissue perfusion.\textsuperscript{6-10}

In hypovolemia, the patients encounter decreases of tissue perfusion, and their different organs are damaged during or after surgery.\textsuperscript{6-9} The increase of body fluids and retention of fluids after surgery results in hypervolemia and it leads to the longer intensive care unit (ICU) admission and more post-operative mortality rate.\textsuperscript{10} There are more contradictions about pre-operative hydration, its quality, and clinical outcome of the patients. Cardiac and pulmonary function, tissue oxygenation, healing of wounds, post-operative ileus, renal function, and coagulation conditions may be affected by pre-operative fluid therapy.\textsuperscript{11} According to recent studies, pre-operative hydration does not affect osmolality of the fasting operated patients, and the prescribed crystalloid fluids are not successful in preventing from hypotension during anesthesia.\textsuperscript{12} However, other studies believe that prescribing appropriate volume of pre-operative intravenous fluids may be helpful in improving post-operative outcome.\textsuperscript{13}

This study assumes that pre-operative crystalloid fluids may improve recovery process of the patients and decrease the need to use blood products during surgery. Therefore, the present study evaluates effects of pre-operative hydration on clinical outcome of patients undergoing orthopedic surgery.

**Methods**

This case-control study was conducted on 100 patients underwent orthopedic surgeries in Shohada Hospital, affiliated by Tabriz University of Medical Sciences, Iran. Patients with lower limb fractures (hip and femur shaft) where there is not necessary to use a tourniquet as well as patients without any records of systemic disease such as diabetes, cardiac, and renal diseases were qualified to enter the study. Patients were included with long bone lower fractures need to surgical fixation, who were not need to blood transfusion before the operation, without systemic and metabolic disease, no solid organ damage or multilevel fractures.

The patients were randomly classified as case and control groups (n = 50) and compared. Patients of both groups were matched considering age, gender, and kind of surgery. According to surgery protocol of the hospital, both groups were fasting for 12 hours before surgery. The case group received 1.5 ml/kg crystalloid fluids (ringer) while they were fasting. If patients had cardiac heart failure or end-stage renal disease were excluded from the study.

The patients of the control group were fasting for 8 hours before surgery, according to the protocol of the hospital, and did not receive any intravenous fluid before surgery. Finally, the patients of both groups were followed up during and after surgery and compared considering intraoperative and post-operative complications.

All patients were completely justified about the study, and they submitted a letter of satisfaction for participating in the study. They were assured that their information will be kept confidentially, and their name and address will not be disclosed. There was not any extra intervention in this study, and the patients did not pay any extra costs.

All understudy data were analyzed using SPSS software (version 17, SPSS Inc., Chicago, IL, USA) and descriptive statistical methods [frequency, percentage, mean, and standard deviation (SD)]. Chi-square and Fischer’s exact (if required) statistical tests were used to compare qualitative findings, and quantitative variables were compared using independent t-test. In this study, $P < 0.050$ was considered meaningful.

**Results**

In this study, 100 patients underwent lower limbs orthopedic surgery was classified in two groups. Age average of the patients of the intervention and control groups was 59.86 ± 18.46 and 63.00 ± 15.92 years, respectively. Statistically, there was not any significant difference between two groups.
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(P = 0.360). The intervention group was consisted of 33 male (66%) and 17 female (34%) patients. There were 35 (70%) male and 15 (30%) female patients in the control group. There was not any significant difference between two groups considering gender (P = 0.660). Table 1 compares intraoperative and other complications after surgery. According to table 1, mortality rate and needs to ICU care were compared. Hemodynamic disorders and hypotension in the intervention group were significantly less than that of the control one and 6 patients (12%) of the intervention, and 30 patients (60%) of the control group required blood transfusion (cell pack). As observed, need to blood transfusion in the intervention group was significantly less than the control one (P < 0.001). In addition, mean transfused blood was not statistically meaningful in the groups. There was higher mean urine volume in the pre-operative fluid therapy group. Furthermore, ICU admission in the intervention group was significantly less than that of the control group. There was no significant difference between the groups considering mortality rate.

Discussion
The pre-operative fluid prescription is required for surgical care. Severity of disease, extent and duration of surgery, accompanying diseases, quality of patients’ body response to pain all affect the need to intraoperative and pre-operative hydration.12-15 However, high and low fluid therapy is associated with some complications. Low fluid therapy may lead to organ insufficiency due to decrease of intravenous fluid and adversely affect the performance of the heart, lungs, digestive system, and kidneys. It even affects tissue oxygenation and wound healing.9-11

However, high fluid therapy leads to some complications such as pulmonary edema, post-operative coagulopathy, and even compartment abdominal syndrome.14-16 In spite of emphasize on pre-operative fluid therapy, there are still challenges about the volume of the prescribed fluids.17,18 In orthopedic surgeries, as one of the major surgeries, appropriate fluid therapy may be useful in achieving better post-operative results. According to recent observations and studies, it was assumed that restrictive pre-operative fluid therapy may be associated with satisfaction results. Therefore, the present study classified the patients underwent lower limbs orthopedic surgery in two intervention group (pre-operative fluid therapy, n = 50) and control group (no pre-operative fluid therapy, n = 50). According to this study, pre-operative fluid therapy is associated with better results during and after surgery. According to previous studies, pre-operative hydration with appropriate volume of fluids may lead to better results and less post-operative complications.19,20

The present study suggested that pre-operative hydration is associated with less hemodynamic disorder and hypotension as well as less pack cell during surgery. Contrary to findings of the above study, Abraham-Nordling et al.21 observed that more vasopressors are used in the restrictive fluid therapy group due to hypotension.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control group (n = 50)</th>
<th>Case group (n = 50)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotension [n (%)]</td>
<td>5 (10)</td>
<td>19 (38)</td>
<td>0.010</td>
</tr>
<tr>
<td>Hemodynamic disorder [n (%)]</td>
<td>4 (8)</td>
<td>15 (30)</td>
<td>0.020</td>
</tr>
<tr>
<td>Need to blood transfusion after operation [n (%)]</td>
<td>6 (12)</td>
<td>30 (60)</td>
<td>0.001*</td>
</tr>
<tr>
<td>Volume of transfused blood (unit) (mean ± SD)</td>
<td>1.70 ± 0.73</td>
<td>1.50 ± 0.54</td>
<td>0.510</td>
</tr>
<tr>
<td>Urine volume (cc) (mean ± SD)</td>
<td>1047.68 ± 586.78</td>
<td>750.36 ± 437.25</td>
<td>0.005*</td>
</tr>
<tr>
<td>Need to ICU [n (%)]</td>
<td>6 (12)</td>
<td>15 (30)</td>
<td>0.020</td>
</tr>
<tr>
<td>Duration of ICU admission (day) (mean ± SD)</td>
<td>3.50 ± 1.87</td>
<td>5.00 ± 2.07</td>
<td>0.140</td>
</tr>
<tr>
<td>Duration of hospitalization (day) (mean ± SD)</td>
<td>6.96 ± 1.78</td>
<td>8.96 ± 3.10</td>
<td>0.040*</td>
</tr>
<tr>
<td>Mortality [n (%)]</td>
<td>2 (4)</td>
<td>3 (6)</td>
<td>0.200</td>
</tr>
</tbody>
</table>

Significant difference
ICU: Intensive care unit; SD: Standard deviation
Similarly, Osugi et al.\textsuperscript{12} suggested that pre-operative fluid therapy and hydration did not affect hypotension during surgery. The difference may be attributed to the type of surgery and the operated organ affecting need to hydration and its treatment outcomes. In addition, according to this study, there was not any difference in the mortality rate of the intervention group. However, the groups were different considering morbidity, intensive care costs, and hospitalization duration. There was not observed any major post-operative complication in this study. Furthermore, intraoperative complications were significantly less in the restrictive pre-operative fluid therapy group.

In a meta-analysis study, Boland et al.\textsuperscript{22} reported that restrictive fluid therapy does not affect post-operative complications. Contrary to the above findings, however, they observed that restrictive fluid therapy does not affect post-operative complications.\textsuperscript{23} Several studies reported different results considering the mentioned complications. According to Brandstrup et al.,\textsuperscript{24} there was significantly fewer complications in the patients received restrictive fluids in comparison with the group with the standard regime of intravenous fluids. Similar results were reported in the studies conducted by Abraham-Nordling et al.,\textsuperscript{21} de Aguilar-Nascimento et al.,\textsuperscript{25} Kocian et al.,\textsuperscript{26} and Weinberg et al.\textsuperscript{27} However, Warrillow et al.\textsuperscript{28} stated that pre-operative fluid therapy is associated with more complications (about 57\%) in major surgeries of digestive system. Of course, it should be noted that accompanying background diseases, as well as type and location of surgery, may be involved in emerging of complications independent from fluid therapy.\textsuperscript{28} According to the present study, patients with pre-operative hydration significantly required less ICU admission as well as shorter hospitalization duration.

Contradictory findings were reported by the previous studies in this regard. Similar to this study, de Aguilar-Nascimento et al.\textsuperscript{25} suggested that restrictive fluid therapy protocol leads to shorter hospitalization period. According to Weinberg et al.,\textsuperscript{27} restrictive fluid therapy is associated with shorter hospitalization period. Contrary to the above-mentioned findings, Abraham-Nordling et al.\textsuperscript{21} stated that restrictive pre-operative fluid therapy does not affect shorter hospitalization period. According to the meta-analysis study conducted by Boland et al.,\textsuperscript{22} restrictive fluid therapy does not lead to shorter hospitalization period. Furthermore, Kocian et al.\textsuperscript{26} believe that restrictive fluid therapy does not affect hospitalization duration. In general, as mentioned above, type, extension, and duration of surgery, as well as the accompanying background diseases may lead to more need to fluids and affect the type of fluid therapy. Therefore, the differences found in results of several studies may be attributed to above reasons. Interestingly, pre-operative fluid therapy significantly affects lower limbs orthopedic surgery.

Conclusion
According to results of the present study, it can be concluded that pre-operative fluid therapy leads to better intraoperative conditions, less hypotension, and shorter hospitalization period.

Conflict of Interests
Authors have no conflict of interest.

Acknowledgments
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References
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