

Pre-peritoneal Pelvic Pack with External Fixator versus Pelvic Pack Alone for Hemodynamically Unstable Patients with Pelvic Fracture; a Historical Cohort Study

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Abstract

Background

Pelvic fracture is one of the most common cause of death in traumatic patients. This study was designed to compare the outcome, morbidity and complications of treatment with pre-peritoneal pelvic pack with external fixator against pelvic pack alone in traumatic pelvic fracture and unstable hemodynamic patients.

Methods

In a retrospective case control study, patients with pelvic fracture and unstable hemodynamic state who referred to emergency and surgery department from August 2018 to August 2019 were enrolled by census manner. In the control group, 25 patients treated just by a pre-peritoneal pack (PPP group), while in the case group, pre-peritoneal pack and external fixator was done as the procedure to control bleeding (PPP Plus fixator group) in 22 individuals. Two groups were compared for presence of thromboembolism, hospital stay, infection, BUN, creatinine, rate of blood transfusion and mortality.

Results

Mean age of participants were 34.48 ± 13.79 in pelvic pack group, while it was 32.36 ± 16.29 in PPP plus external fixator ones. The mean Injury Severity Score (ISS) was 23.12 ± 9.85 in Pelvic Pack group, and 19.22 ± 8.09 in PPP plus external fixator group. Acute kidney injury was reported in 6 (24%) individuals of PPP group, while its rate in PPP plus fixator group was 40.9%. Mortality rate was reported 32% and 4.5% in control and case groups, respectively. There was a significant difference between groups ($p=0.017$, $LR=6.42$). VTE was reported 12% and 4.5% in PPP group and PPP plus fixator ones, respectively.

Conclusion

It was concluded that using external fixator with PPP can be a useful method for treatment of pelvic fracture that is unstable in hemodynamic situation. It is recommended to use biomarkers like lactate or others to determine the situation of patients as precise as possible.

Introduction

Pelvic fracture is one of the most common cause of death in traumatic patients and estimating for at least 5% of fractures. It is also reported in a large number of patients with multiple trauma (1). It is due to high-energy trauma, which is associated with damage to other organs, like chest and abdomen (2). Approximately 80% of patients who develop severe hemorrhagic shock after a high-energy trauma die in the early stages, even before hospitalization (3). Unstable hemodynamic state due to pelvic fracture needs early fixation which supposed as a part of the resuscitation (4).

Young classification was established according to risk of bleeding, enabling the surgeon to detect associated injuries. Type-1 representing Antero-posterior compression, which is likely to damage the internal iliac artery. Type-2 indicating Lateral compression, which is likely to be retro pubic. Type-3 which is about vertical shearing. The risk of bleeding depends on the type and severity of the lesion (2, 5). Pelvic fracture and unstable hemodynamic condition is one of the most important problems in the management of trauma. It can cause extensive bleeding, renal failure, thromboembolism and other fatal complications. So, early detection and fixation are two important parts of management (6).

The most common site of bleeding is the venous plexus and cancellous bone surfaces and arterial rupture is less common (2). The beginning treatment of these patients must emphasize on controlling hematoma rapidly. Fast fixation of fracture and configuration of accompanying trauma is critical. Individuals with unstable pelvic fracture can be treated by an anterior pelvic fixator or posterior pelvic C-clamp (7). Another way in this situation is Pelvic Peritoneal Packing (PPP). Packing is done by anterior approach and depletion of hematoma. Three packs are pushed gradually to the pelvic brim. The first pack should be put in the inferior part of Sacro-iliac joint, the second one should be placed in the anterior part of Pelvic edge and the last band should be in the retro pubic situation (8). Emergent arteriography and embolization would be mentioned, if hemorrhage is continuous (9).

A recent guideline was reported the stepwise approach of unstable pelvic fracture. The experts believed that embolization should be mentioned when the hematoma was not due to pelvic origin. If the evidence of arterial disturbance in the intravenous contrast CT scan was proved, embolization is needed without mentioning hemodynamic situation (10). In some studies, pelvic peritoneal packing (PPP) with external fixator was established as the mainstay in treatment, while some others used PPP with C-Clamp in accordance with external fixator (11, 12). There is no evidence about comparing different types of surgeries. This study was designed to compare the outcome, morbidity and complications of treatment with pre-peritoneal pelvic plexus with external fixator against pelvic packing alone treatment in traumatic pelvic fracture and unstable hemodynamic patients.

Materials And Methods

In a retrospective case control study, patients with pelvic fracture and unstable hemodynamic state who referred to emergency and surgery department of a level I trauma center from August 2018 to August 2019 were enrolled by census manner. Sample selection was done by random allocation and all data from patients' recordings were evaluated. In the control group, 25 patients treated just by a pre-peritoneal pack (PPP group), while in the case group, pre-peritoneal pack and external fixator was done as the procedure to control bleeding (PPP Plus fixator group) in 22 individuals. Patients who had damage to anterior part of pelvic managed by external fixator in the iliac crest and supra acetabulum. After confirming good union in the site of fracture the external fixator was removed which may last approximately one month and weight bearing according to type of fracture was permitted.

All study procedures and data gathering was approved by the committee of ethics in authors' affiliated hospital; two groups were compared for presence of thromboembolism, hospital stay, infection, BUN, creatinine, rate of blood transfusion and mortality. All data gathered by blinded examiners in the course of hospitalization from three to 7 days of admission. Acute kidney injury (AKI) was mentioned as one of these two criteria; increasing creatinine up to 50% from the baseline within 48-hour, decreasing urine output less than 300 cc/kg which lasts at least 6 hours. BUN and creatinine was measured every day or every other days in the length of hospitalization.

Infection was determined as obvious pus from site of surgery, systemic sepsis which defined by high grade fever and a site of infection in pelvis. All the patients evaluated by the same blinded senior resident for evidences of infections. The patients were evaluated 12 weeks after admission for evidences of venous thrombo-embolic events (VTE) either DVT (Deep vein thrombosis) or PTE (Pulmonary thromboembolism) during the treatment period.

Results

Mean age of participants were 34.48 ± 13.79 in pelvic pack group, while it was reported 32.36 ± 16.29 in PPP plus external fixator ones (Table 1). There were no significant difference between two groups ($p = 0.481$) and fortunately two groups were similar in age groups. In another demographic data, most of the patients were men in both groups; 76% in control groups and 77.3% in PPP plus external fixator patients (Fig. 1). Analytic tests did not show any difference between two groups. This means both groups were similar according to gender frequency and males were significantly more than females ($p = 0.01$).

Table 1
The baseline characteristics of the patients in two study groups.

	PPP Alone	PPP plus external fixator	p-value
Age (year)	34.48 ± 13.79	32.36 ± 16.29	0.481
ISS	23.12 ± 9.85	19.22 ± 8.09	0.163
ISS: Injury Severity Score; PPP: Per-Peritoneal Pelvic Pack			

Mean of Injury Severity Score (ISS) (13) was measured 23.12 ± 9.85 in Pelvic Pack group, while it was calculated 19.22 ± 8.09 in PPP plus external fixator group. The severity was not different significantly between two groups of our study. Mean of hospital stay was reported 20.72 ± 15.66 and 19.68 ± 12.21 days in control and case group, respectively. There was no significant difference between two groups according to length of hospital stay ($p = 0.806$). Creatinine in case group was reported 1.18 ± 0.09 , while it was measured 1.50 ± 0.23 in control participants. BUN was also calculated 17.72 ± 1.39 in PPP plus fixator ones and 24.12 ± 3.92 in control patients. There was no significance between type of surgery and changing in values of BUN and creatinine. Acute kidney injury was reported in 6 (24%) individuals of PPP group, while its rate in PPP plus fixator group was 40.9%. P-value was reported 0.215 in the Chi-Square test and both groups did not have significant difference in AKI complications. Infection was reported in

6(27.3%) case groups, while it was declared in 3 (12%) PPP group. There was no significant difference between two groups according to infectious events ($p = 0.184$) (Table 2).

Table 2
Comparison of complications between two groups of study.

	Hospital stay (Mean \pm SD)	Creatinine (Mean \pm SD)	BUN (Mean \pm SD)	VTE (%)	Mortality rate
PPP alone	20.72 \pm 15.66	1.18 \pm 0.09	24.12 \pm 3.92	12%	32%
PPP plus external fixator	19.68 \pm 12.21	1.50 \pm 0.23	17.72 \pm 1.39	4.5%	4.5%
p-value	0.806	0.549	0.507	0.361	0.017

Mortality rate was reported 32% and 4.5% in control and case groups, respectively. There was a significant difference between groups ($p = 0.017$, LR = 6.42). This result shows that using Pre-peritoneal packing with external fixator is more effective to decrease mortality rate in comparison with pre-peritoneal packing alone. In case group, the patients divided into two groups according to the time of external fixator replacement. In 6 (27.2%) patients the external fixator was placed within 2 days and in 16 (72.7%) ones the surgery was done after 2nd day of admission. One Mortality was reported in patients who were treated by external fixator within first 48 hours of admission, while it was not reported in cases who treated after 48 hours of admission ($p = 0.095$). VTE was reported 12% and 4.5% in PPP group and PPP plus fixator ones, respectively. There was not significant in VTE reports, too ($p = 0.361$).

Discussion

This clinical trial was done on 47 patients with pelvic fracture who were unstable according to their hemodynamic evaluations. Among them 25 patients were managed by packing in pre-peritoneal portion, while 22 ones were treated by preperitoneal pack and external fixator. The patients were similar in demographic data including age and gender. This similarity can increase the internal validity of our study, because mortality and complications can rise in older patients. In both groups the main gender were males and this significant data also helped us to generalize our data because of most of the people who were evaluated due to pelvic fracture are males. In a new survey which was done to evaluate the unstable pelvic fractures in Taiwan the majority of patients were males and the most age specific group in this investigation was reported between 46–65 years old (14). Our data was similar to this and other appropriate studies in according to the mean age and gender of participants.

Mean of Injury Severity Score (ISS) was measured 23.12 \pm 9.85 and 19.22 \pm 8.09 in Pelvic Pack group and PPP plus external fixator group, respectively. This score was approximately similar to Schweigkofler et al. (15). Mean of hospital stay was not significant between two different types of operations. Malik et al reported the hospital stay more than 9 days for their cases. This study estimated the length of hospital stay less than our study (16). The patients in Malik study were managed by fixator and it may be the cause of difference between its hospital stay and ours. There was no significance between types of

surgery and changing in values of BUN and creatinine. Some studies (17, 18) reported the acute kidney injury as an important complication in pelvic fracture who are unstable, but because of operation in all of patients in our study the prevalence of AKI was rare.

There was a significant difference between groups (P-Value = 0.017, LR = 6.42) in according to mortality rate. This result shows that using Pre-peritoneal packing with external fixator is more effective to decrease mortality rate in comparison with pre-peritoneal packing alone. In case group, the patients divided into two groups according to the time of external fixator replacement. In 6 patients the external fixator was placed within 2 days and in 16 ones the surgery was done after 2nd day of admission. One Mortality was reported in patients who were treated by external fixator within first 48 hours of admission, while it was not reported in cases who treated after 48 hours of admission.

Cothren and et al. declared that PPP is a fast manner for preventing hemorrhagic shock due to pelvic fracture and this treatment can be completed by angiography. Need of blood and its production transfusion and mortality rate was dramatically decreased after this type of surgery (4). Guthrie et al. mentioned that embolization via angiography was not a rapid way to control homeostasis in some medical centers and pelvic packing is able to decrease blood loss. Packing may be placed either retroperitoneal or pre-peritoneal. They believed that using external fixator can magnify the effects of packing in bleeding control (19).

Ertel et al. reported 20 patients with unstable situation due to pelvic fracture because of multiple trauma in a prospective investigation. They used hemoglobin, hematocrit and lactate to compare hemorrhagic shock in these patients. They found that pelvic packing with external fixator placement can be a more useful method to control bleeding (20). Roman Pavic and et al. concluded that the most effective therapeutic method for treatment of pelvic fracture is using external fixator or C-Clamps for immobilization. They declared that embolization can be used if these methods do not work (21). Artoni et al reported that Pelvic fractures due to multiple trauma which was managed by early surgical operation can be more effective and has less reduction in quality of life (22). This study was different about our study; they believed that early surgery as soon as possible can affect outcomes, while mortality was not reported in patients who were operated after 48 hours. This maybe because of using pack cell and hydration in our management which may better the outcome and decrease the mortality rate.

VTE was reported 12% and 4.5% in PPP group and PPP plus fixator ones, respectively. There was not significant in VTE reports, too. Many studies mentioned that VTE is a prevalent complication among individuals who had hemodynamic instability due to pelvic fracture (23, 24). In this study common morbidity and mortality rate of two different therapeutic approaches were investigated in patients with pelvic fracture and unstable hemodynamic state. AKI, infection and VTE were not significantly different between two types of treatment. Our study declared that pre-peritoneal pelvic pack with external fixator was more effective in decreasing mortality rate in comparison to pre-peritoneal pelvic pack without any fixator. The investigation did not mention the best time for place external fixator. According to data from our study and similar investigations which were discussed above, using external fixator along with pre-

peritoneal packing can be more useful in controlling blood loss and decreasing mortality rate. One of our unique methodology was dividing placement of external fixator into two groups; within 48 hours and after 48 hours. Results did not show any relation between time of fixation and mortality rate.

Conclusion

It was concluded that using external fixator with PPP can be a useful method for treatment of pelvic fracture that is unstable in hemodynamic situation. It is recommended to use biomarkers like lactate or others to determine the situation of patients as precise as possible.

Declarations

- **Ethics approval and consent to participate**

The study protocol was approved by the institutional review board and medical ethics committee of the Baqiyatallah University of Medical Sciences (IR.BMSU.REC.1397.196).

- **Consent for publication**

Not applicable

- **Availability of data and material**

The data material of the study is available in SPSS file and would be available on request.

- **Competing interests**

None of the authors have any conflict of interest to declare regarding the study.

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- **Authors' contributions**

HK: Concept and design; supervision; data interpretation; critically revising the manuscript

SP: Concept and design; data interpretation; approving the final draft

MA: Data gathering; analysis of the data; drafting the manuscript

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Figures

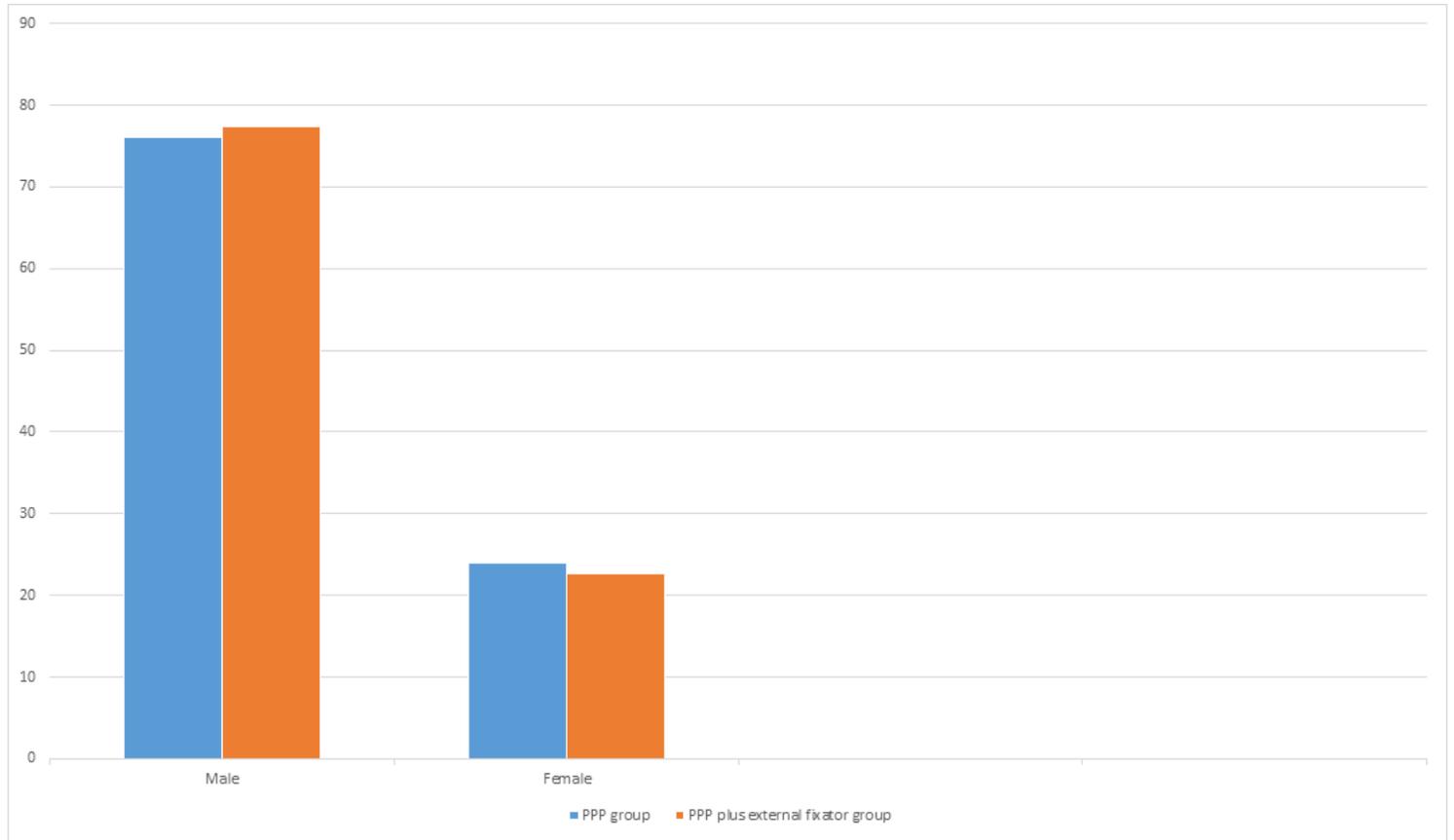


Figure 1

Gender frequency among patients participating in study.