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Research Article

Fluid Management with Esophageal Doppler Monitoring (EDM) Versus Standard Monitoring During Perioperative Management of Patients with Pneumoperitoneum and Trendelenburg Position While Undergoing Robot -Assisted Laparoscopic Prostatectomy (RALP)

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Abstract

Background: Pneumoperitoneum and Trendelenburg position during Robot-assisted Laparoscopic Prostatectomy is associated with hemodynamic changes where standard monitoring may not be reliable.

Method: standard fluid management versus Esophageal doppler monitoring guided goal directed fluid therapy was study in sixty patients who under wend RALP.

Result: 26 patients were in EDM group, and 34 patients managed with standard monitor. There was no difference in intravenous crystalloid fluid use between two group, however there is lower odd of high-volume crystalloid and higher colloid use among EDM group. There was no difference of complications or length of stay between two group.

Conclusion: EDM was safe and reliable tool for hemodynamic monitoring and fluid management during RALP, likely beneficial role in optimization of perioperative fluid management and which has no negative impact on postoperative complications or length of stay.

Keywords: Esophageal Doppler Monitoring; Pneumoperitoneum; Laparoscopic Prostatectomy

Abbreviation: RALP: Robot assisted Laparoscopic Prostatectomy; EDM: Esophageal Doppler Monitoring; GDFT: Goal directed fluid therapy.

Introduction

Robot-assisted Laparoscopic Prostatectomy (RALP) is most commonly performed minimally invasive surgery for patient with early prostate cancer [1]. There has been technological evolution in robotics, in addition to clinical innovation which has resulted improved functional and clinical outcome of patients; RALP has become standard of surgical care for early prostate cancer in USA and worldwide [2]. RALP offers several advantages over traditional open methods, including decreased blood loss, shorter surgery time hospital stays, and decreased perioperative morbidity, hence most patients do well with standard anesthetic care. There have been advancement hemodynamic monitoring and fluid management, including non-invasive monitor including esophageal doppler However, there remain unresolved questions regarding role of anesthetics management contributing to overall improvement in patient outcome, in particular there are not enough literature on hemodynamic and fluid management in patient with pneumoperitoneum (PnP) and steep Trendelenburg position maintained during RALP. In addition, patient specific factors e.g., coexisting high- risk diseases may pose additional hemodynamic challenges. Perioperative fluid therapy has a direct impact on patient outcome, and it is imperative that fluid management is guided by individual patient's need [3]. Esophageal doppler monitoring (EDM) is a noninvasive tool for hemodynamic and fluid management, and been reliable in pneumoperitoneum, as such fluid management by EDM vs traditional monitor was studied in patient undergoing RALP.

Method

With Institutional Review Board Approval, total 60 patients who underwent RALP were included in a retrospective observational design; 26 (43%) patients had EDM as per institutional protocol remaining 34 (57%) were managed by standard ASA monitors. Routine preoperative evaluation includes electrocardiography, chest X-ray, hematocrit, and electrolyte screening which is used to aid identification of underlying myocardial ischemia, chronic obstructive pulmonary disease, anemia, and hyperglycemia. During RALP, the pre and intraoperative fluids administrations are managed to avoid excessive urinary flow that may obscure the operative field during bladder neck transection and urethrovesical anastomosis. Once the procedure is completed and patient returned to supine position, adequate hydration is restored.

Perioperative data including intravenous fluids, morbidities, mortality and length of stay were collected for statistical analysis.

Esophageal doppler Monitor Group

Principal investigator was directly responsible for esophageal Doppler monitoring and goal directed fluid therapy in course of usual anesthesia care of patients. Satisfactory doppler waveform was obtained and doppler parameter correlated with clinical picture, EDM parameters are described in Appendix. Clinical decision of fluid management was guided by the algorithm (Figure 1). Fluid bolus can be crystalloid or colloid as per discretion of anesthesiologist.

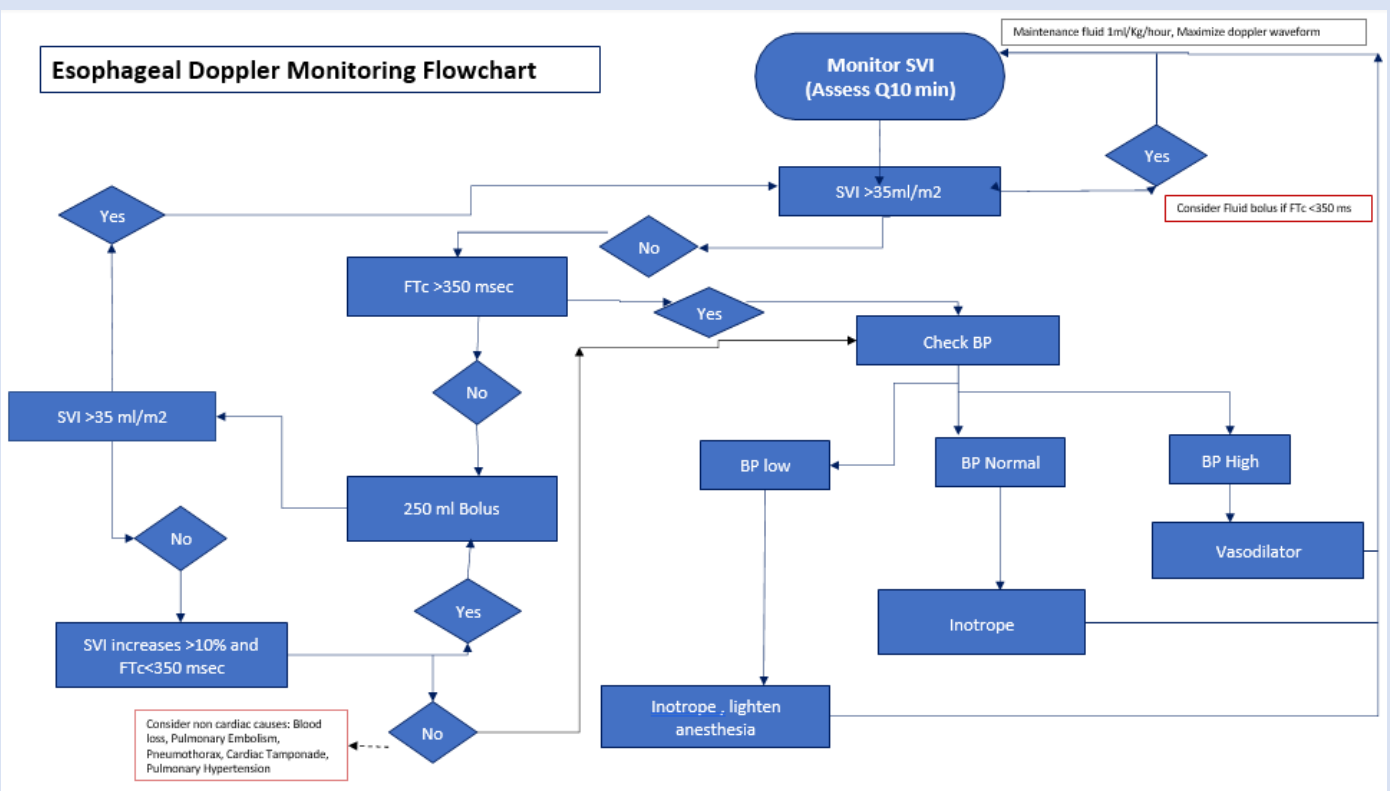

Figure 1: Flowchart for Goal directed fluid therapy using Esophageal Doppler Monitor.
1. Baseline intravenous fluid is maintained at 1ml/kg/hour; doppler waveforms are maximized and monitor every 10 minutes.
2. If stroke volume index (SVI) low (eg., < 35 ml/m^2) and Flow time corrected (FTc) not prolonged (e.g., NOT >350 ms):
a) Fluid bolus 250 ml (crystalloid or colloid) is administered, and response noted.
b) If SVI response not satisfactory but increases >10% of baseline, Fluid bolus 250 ml repeated to obtain satisfactory SVI response.
3. If stroke volume index (SVI) is low and FTc is prolonged >350 ms, non-cardiac causes are considered e.g., Blood loss Pulmonary Embolism, Pneumothorax, Tamponade, Pulmonary hypertension and treated according to existing standard of care.

Result

Patients mean age in EDM vs standard group were 61 vs 62 years (no statistical difference). Mean crystalloids volume in EDM group was 1998 ml (versus 1940 ml in standard group.) The odd of large crystalloid volume (more than 3 liter) was low in EDM [OR 0.69, p =0.76]. There was significantly higher odd of colloids in patients with EDM [OR 8.59, p 0.0004]. One patient (4%) in EDM group had fever, versus one patient (3%) in standard group had fever and pulmonary atelectasis [OR 1.52, p 0.78]. None of patient in either group had serious abdominal complications; none required postoperative surgical intervention or blood transfusion. There was no report of corneal abrasion in either group. There were no in-hospital mortality or major cardiopulmonary complications in either group. Mean length of stay (LOS) in EDM was 2.04 days versus 2.09 days in standard group. LOS in EDM group trended lower [OR 0.44, p 0.49].

Discussion

Hemodynamic management for majority of patients undergoing robot assisted laparoscopic prostatectomy has been achieved by conventional standard monitor because lower risk of surgery, short procedure time and minimum expected blood loss does not necessitate more invasive monitoring. However, particular attention is warranted during pneumoperitoneum and Trendelenburg position. Pneumoperitoneum is associated with multiple cardiovascular changes and may be exacerbated in patient during Trendelenburg position [4]. Special consideration including preoperative advanced invasive monitor has been recommended for patients with high-risk co-existing diseases, expected large blood loss or prolonged surgery. If a perioperative emergency arises, transesophageal echocardiography is considered most effective means of assessing cardiac function in such conditions. Recent study has shown goal-directed fluid therapy (GDFT) is safe in radical cystectomy without compromising the renal function. It is associated with less intra- and perioperative fluid infusion [5]. Esophageal doppler monitoring (EDM) is non-invasive tool for hemodynamic monitoring and is reliable in pneumoperitoneum [6] and as such fluid management by EDM vs traditional monitor was studied at our institution. It is to be noted that, goal directed fluid therapy has resulted in conflicting and often confusing outcome in various studies. A meta-analysis demonstrated GDFT is associated with a significant reduction in morbidity, length of ICU and hospital stay. Interestingly, the reduction in morbidity and length of hospital stay were lost when patients were managed in an enhanced recovery after surgery (ERAS) pathway, compared with traditional care [7].

For major surgery, there is a sizeable body of evidence that an individualized goal-directed fluid therapy (GDFT) improves outcomes [8]. However, other study shown no significant benefit and no significant difference in any clinical outcome measure studied between GDFT and conventional fluid therapy, including overall morbidity in literature [9]. A more recent study however demonstrated that, irrespectively to the amount of perioperative fluid administered, GDFT reduces postoperative complications, but not perioperative mortality [10]. GDFT may not be of benefit to all elective patients undergoing major abdominal surgery, particularly those managed in an ERAS setting. Since perioperative complications are rare for patients undergoing robotic-assisted laparoscopic prostatectomy who are managed in ERAS setting, GDFT is unlikely to show statistically significant improved outcomes following RALP. Our study demonstrated patients with EDM monitoring has lower odd of excessive crystalloids use perioperatively; which may be beneficial to patients. It has been suggested that avoiding excessive fluid perioperatively may minimize risk of facial and laryngeal edema during RALP. Higher odd of colloid use in patient with EDM is consistent with findings in literature [11]. It is relevant to mentioned that there are not clinically meaningful differences in the hemodynamic parameter in patients given goal-directed colloid and crystalloids. As might be expected from longer intravascular dwell time, the interval between boluses is expected be longer with colloids. However, Colloids do not appear to provide substantial hemodynamic benefit [12]. Major complications were rare in both group in our study and has no statistical difference. Length of stay (LOS) for patients undergoing RALP in a high-volume hospital are usually lower compared to our study. Prolonged LOS stay (+3days) trended higher is standard group in our study, however the difference was not significant. A scoping review has concluded that there are multiple variables (clinical and non-clinical) which interact in a complex adaptive hospital system influencing length of stay [13]. It is therefore not expected for a single clinical intervention to affect LOS significantly, as we have noted similar findings in our study.

Conclusion

EDM guided fluid management is safe and reliable for intraoperative monitoring of patient undergoing RALP, likely beneficial role in optimization of perioperative fluid management and which has no negative impact on postoperative complications or length of stay. More study in a larger number of patients may be needed to demonstrate role of EDM and improvement of intraoperative hemodynamic status of such patients.

Appendix

Glossary Esophageal doppler Monitoring

a) FT (Flow time): The time of systolic aortic blood flow (sec).

b) FTc (Flow time corrected): FT is divided by the square root of the cardiac cycle time; thus, adjusting the heart rate to 60 bpm. This corrects flow time to a heart rate of 60 bpm (msec) SV (Stroke Volume) Blood ejected during each systolic phase (ml).

c) SVI (Stroke Volume index): Stroke volume normalized for body surface area (ml/m^2).

d) CO (Cardiac Output): Liters of blood pumped per minute (L/min).

e) CI (Cardiac Index): Cardiac output normalized for body surface area (L/min/m^2).

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