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Robotic Assisted Laparoscopic Prostatectomy: Conjunctival Edema and Trendelenburg Time as Predictors for Delayed Extubation.

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Abstract

Introduction: Robotic-assisted surgeries are gaining popularity in urologic surgery. Various complications associated with robotic assisted laparoscopic prostatectomy (RALP) are due to steep Trendelenburg position, high intra-abdominal pressure (IAP), long operative time. It can give rise to upper body edema which causes delayed emergence. Conjunctival edema (CE) is easy to monitor and a reliable sign. So, we aimed to determine the incidence of CE in RALP. The secondary aim is to study whether CE along with Trendelenburg time (TT) can be use as predictors for delayed extubation.

Materials & Methods: First Fifty six patients who underwent RALP at our institute were retrospectively studied. All these cases were done in lithotomy and forty degree Trendelenburg position with IAP of 14mmHg to 20 mmHg. Extubation done as per safe extubation criteria, others were labeled as delayed extubation. CE and TT were noted down at the end of surgery which were statistically analysed.

Results: The incidence of CE in our study was 23.21%. 61.54% patients of conjunctival edema had delayed extubation which was statistically significant (p-0.0008). The percentage of delayed extubation increases with the duration of Trendelenburg position, though it has not found to be statistically significant (p-0.0842).

Conclusion: Conjunctival edema and prolonged Trendelenburg position alert anaesthesiologist for underlying airway edema, so extubation should be done cautiously to prevent airway related complications.

Keywords: Steep Trendelenburg, conjunctival edema, robotic assisted laparoscopic prostatectomy.

Introduction

Prostate cancer (Pca) is the second most common cause of cancer and the sixth leading cause of cancer death among men worldwide.[1] Standard options for the initial treatment of men with clinically localized Pca (without distant metastases) include radiation therapy and radical prostatectomy. The surgical option for early Pca

includes open or robotic prostatectomy along with extended pelvic lymph node dissection.[2] Robotic-assisted surgeries are gaining popularity in urologic surgery. Robotic-assisted urologic surgeries help perform complicated procedures with ease such as radical cystectomies, prostatectomies, and pelvic lymphadenectomies. Compared to the open method, the robotic-assisted laparoscopic prostatectomy (RALP) offers many advantages including better visualization and a more precise manipulation of delicate vessels and nerves, improved postoperative urinary and sexual function, less postoperative pain, diminished scarring, reduced bleeding and shorter hospital stay.[3] Although many features of RALP are similar to laparoscopic prostatectomy, the procedure is associated with some drawbacks. This include limited intravenous access, relatively long operating time, deep Trendelenburg position and high intra-abdominal pressure (IAP).[4]

Apart from hemodynamic changes, various complications associated with RALP are due to steep Trendelenburg position, high IAP, long operative time. Steep inclination, ranging from 25° to 45° for a prolonged period of time, can lead to upper airway and brain edema.[5] It can give rise to upper body edema which causes delayed emergence. Facial edema, conjunctival edema (CE), pharyngeal edema, laryngeal edema and cerebral edema is not uncommon in RALP. Though CE usually gets resolved after two hours of surgery, it may be associated with corneal abrasions and transient visual field defect. Positioning, pneumoperitoneum and fluids combine to put the patient at risk for airway edema and failed extubation.[6] Patients who do not meet strict extubation criteria should remain intubated in the Post-Anesthesia Care Unit.[7] Laryngeal edema is a major concern. There are reported cases which reflect the need for careful management of the airway during extubation, including delaying extubation untill the airway edema subsides, especially in cases of difficult intubation and prolonged steep Trendelenburg positioning.[8] Edema of the supraglottic airway structures, including the vocal cords, arytenoids, and epiglottis, may result in stridorous or no respirations after the endotracheal tube is removed. The need for emergent reintubation and swollen airway structures makes for a dangerous combination. Therefore, it is recommended to ensure that the patient can breathe around the endotracheal tube with the cuff leak test.[9,10] We aimed to determine the incidence of CE related to the steep Trendelenburg position and high IAP in RALP. The secondary aim is to study whether CE along with Trendelenburg time (TT) can be used as predictors for delayed extubation.

Materials & methods

First fifty six patients who underwent RALP at our institute were retrospectively studied. Cases which were converted into open radical prostatectomy were excluded from the study. After preoperative evaluation and optimization, all these cases were done under general anaesthesia. Patients premedicated with inj. Glycopyrollate 0.004mg/kg and inj. Midazolam 20mcg/kg.

After anaesthesia induction with Inj. Fentanyl 2mcg/kg, Inj. Propofol 2-2.5 mg/kg and Inj. Atracuronium Besylate 0.4-0.5 mg/kg, endotracheal intubation was performed. Endotracheal cuff pressure was kept below 30 cmH2O and connected to ventilator with volume control mode, to maintain normocapnia. Throughout the surgery they were maintained on Oxygen, Nitrous oxide, Desflurane, Atracuronium infusion and boluses of Fentanyl as and when required. Non- invasive monitoring (Electrocardiogram, pulse oximetry, non-invasive blood pressure, nasopharyngeal temperature,

end tidal carbon dioxide, MAC & gas monitoring, Bispectral index) and invasive monitoring (ventilatory parameters) and central venous pressure (in patients with ischemic heart disease) were monitored. Large bore 16 G or 18 G intravenous canula or central venous catheterization was done through right internal jugular vein. 14 G nasogastric tube was inserted. They were placed in lithotomy position with proper padding to prevent position related nerve injury. Both eyes were lubricated with opthalmic ointment and taped. Pneumoperitoneum was created after proper port placement. Intraperitoneal pressure from 14mmHg to 20 mmHg was maintained, depending on the stage of surgery. Trendelenburg position was given gradually upto forty degree with respiratory and hemodynamic parameters monitoring. Cerebral protection was assured with Dexamethasone sodium phosphate 8mg. Palonosetron hydrochloride 75mg was administered intravenously. Intraoperative fluid management was considered in two phases, before and after ureteral anastomosis. Fluid was restricted to one litre before ureteral anastomosis. The second interval included a higher infusion rate which was titrated as per the volume status and urine output.

During extubation, the patients were taken gradually into a reverse Trendelenburg position. Extubation was performed after fulfillment of clinical safe extubation criteria; like adequate spontaneous breathing, normocapnia, reversal of neuromuscular block and normothermia. In this case study, we added additional criteria for safe extubation; like visible upper body edema, conjunctival edema , tongue edema, subcutaneous emphysema and endotracheal cuff leak test as shown in Table 1. These criteria were always co-related with other routine clinical criteria. After extubation they were observed for snoring, inspiratory difficulty and cognition. Those who fullfilled safe discharge criteria, were shifted to ward after one hour. Others who did not meet safe extubation criteria, were shifted to Intensive care unit (ICU) on ventilator with thirty degree head up and extubated later once they fullfilled the same safe extubation criteria. These patients were labelled as delayed extubation in our study.

Two major outcomes, 1) CE and 2) TT which were noted down at the end of surgery are taken into consideration. CE was assessed as clinically present or not. TT was noted in minutes. These two outcomes were statistically analysed.

Results

Fifty six RALP patients were included in the study. Data was analysed using the software Epi info version 7.2.1.0. And Microsoft word and Excel were used to generate graphs and tables. The mean age was 68.17 $\pm$ 7.76, body mass index was 26.19 $\pm$ 4.70, TT was 194.45 $\pm$ 43.07 min. Blood loss was 303.57 $\pm$ 193.47.

Major outcomes of this study i.e. CE and TT were statistically analysed.

CE - The incidence of CE in our study was 23.21%. Table 2 and graph 1, shows thirteen patients developed CE. Eight patients had delayed extubation. Thus 61.54% patients of CE had delayed extubation which was statistically significant (p-0.0008). And 93.02% patients were safely extubated, those who did not develop CE. There are 6.98% patients of delayed extubation without CE.

TT - Patients were divided on the basis of duration of TT. Table 3 and graph 2 shows, the percentage of delayed extubation increases with the duration of TT. It has not found to be statistically significant (p-0.0842).

In this study we encountered few complications like,

a) One patient had acute renal failure on second postoperative day.

b) One patient had cerebral infarct on seventh post operative day.

c) Two patients had laryngeal edema.

d) One patient developed subcutaneous emphysema.

Discussion

In the present study, we aimed to describe the co-relation of CE and delayed extubation in RALP, which in turn, occurs because of high IAP, steep Trendelenburg position and long operating time. Causes of delayed extubation is multifactorial. In our case study, 6.98% patients had delayed extubation without CE. But in RALP commonest cause of delayed extubation is upper body edema; especially airway edema, which is statistically proven in our study (p - 0.0008). CE is easy to monitor and a reliable sign which may occur from increased central venous pressure[11] and raised intra-ocular pressure (IOP).[12] Reduced veinous outflow from head due to steep Trendelenburg position also contributes to CE. CE causes the upper and lower eyelids to separate and can result in corneal dessication and abrasion even when the eyes are taped closed.[13] The use of opthalmic ointment acts as a shield protecting the cornea and should be considered for use in addition to securing the lids.[10] None of the patients in our study suffered from corneal abrasions or visual field defect. Our interest in this topic was raised by a case report by SVN Phong et al. They reported post-extubation respiratory distress requiring reintubation in a patient of RALP. This was attributed to laryngeal edema, which was most likely due to the reduction in venous outflow from the head, caused by the pneumoperitoneum and prolonged, extreme Trendelenburg position.[14] In our study too, two patients developed inspiratory stridor after extubation. They were reintubated and it was found to be laryngeal edema on laryngoscopy. In 2006, Chiu and colleagues demonstrated that during recumbency, fluid shifts from the lower body increases pharyngeal resistance in healthy subjects.[15] Increased upper airway resistance compromises inspiration more than expiration and can clinically be diagnosed by inspiratory stridor.[16]

Airway should be carefully managed during extubation. Although facial and CE is an important physical sign, that can alert clinicians to the presence of airway edema, significant edema of pharyngeal tissue may not be accompanied by visible external signs. Laryngeal soft tissue edema may be assessed by performing a cuff leak test.[17] If the cuff leak test fails, patients should remain intubated untill the edema has subsided.[17] Endotracheal cuff pressure on the tongue base can cause and enhance tongue edema by preventing the lymphatic and venous drainage of the tongue. The use of the head upright position prior to extubation, diuretic use when necessary and extubation itself improves “upper airway obstruction-like” symptoms.[4] So it is always important to co-relate this upper airway checklist points with other routine clinical criteria of extubation. Postoperative agitation has been observed which is multifactorial and may be attributed to cerebral edema, bladder spasm and pain due to peritoneal stretching.

The raised intra cranial pressure (ICP) during RALP for prolonged period have serious impact on the recovery characteristics and can cause reduced cerebral perfussion pressure, delayed awakening, need of post operative ventilatory support. Shagun Shah et al have frequently noticed conjunctival chemosis and edema, postoperative delirium, cognitive dysfunction and delayed awakening in their study of robotic surgery in steep Trendelenburg position and attributed these to the

raised ICP.[18] Though the evidence supports that no special measures are needed in the belief that cerebral edema is developing during procedures in this position, any condition that may disturb the blood-brain barrier carries unknown risk.[17] In this study, none of our patients had intracranial patholgy.

CE is easy to monitor physical sign so we included it in our study as a major outcome. Our study has shown, association of CE with delayed extubation. Similar study by O.F. Kilic et al have shown that chemosis after surgery is associated with upper airway edema.[16] They have found that airway resistance and nasal flow decreased at two hours after robotic prostatectomy. Badawy M. et al have shown that 5 % of the patients had delayed extubation in robot-assisted gyenecologic surgery with a pneumoperitoneum and prolonged maximum Trendelenburg position.[6] In our study, 19.64% patients had delayed extubation. But there is no other study, which quantifies the co-relation of upper body edema with delayed extubation. The patients with delayed extubation were extubated two hours after surgery in ICU uneventfully.

For the safe extubation and safe discharge of this patients, prevention of airway and cerebral edema is very important. Prevention of airway edema can be done with various modifications. Minimizing the Trendelenburg position to twenty five to thirty degree, according to the physical constitution of the patient.[19] IAP reduction will help in improving venous outflow from upper body. The steep Trendelenburg position for RALP under pneumoperitoneum improves visualization, and thus bleeding from the dorsal vein complex during surgery can be more easily controlled.[20] Furthermore, the tamponade effect by pneumoperitoneum also contributes to reduced blood loss.[21] This can be achieved with IAP of 14 - 16 mmHg.

In our study, we found that IAP upto 20mmHg is required at the start of CO2 insufflation and to prevent bleeding from the dorsal vein complex. Thus, IAP can be adjusted according to the stages of surgery and also respiratory & hemodynamic changes. The application of intraoperative fluid restriction is helpful in reducing the outflow of urine and provides an improved surgical field of vision during anastomosis between the bladder neck and ureter. This way, improved surgical field may contribute indirectly to less Trendelenburg duration. In addition, fluid restriction reduces the airway edema and facial edema, which occurs with the steep Trendelenburg position.[22,23] Dexamethasone sodium phosphate which is used for cerebral protection, helps to reduce airway edema too. According to some studies, it does not appear to be useful for laryngeal edema prevention after tracheal extubation, regardless of intubation duration.[24,25,26] The benefit from steroids will be greater in patients at risk for laryngeal edema, who could be identified with a positive cuff leak test.[27] Steroid use for 24 hours is considered safe, and no major adverse effects related to its use have been reported in a number of studies.[28] Restrict the endotracheal cuff pressure below 30 cmH2O as high endotracheal cuff pressure for prolonged duration is one of the risk factors for laryngeal edema.[29] Attention should be paid to the degree of limb extension, stirrup location, padding of bony prominences, and duration of immobility.[8] During extubation, the patients should be taken into a reverse Trendelenburg position, and diuretic can be administered to decrease upper airway edema might be caused by the prolonged use of the steep Trendelenburg position.[4]

Steep Trendelenburg, ranging from 25 to 40 degree for a prolonged period of time, can also lead to an increase in the intracranial pressure and the cerebral blood flow.

For the preservation of cerebrovascular homeostasis, maintainance of normocarbia is recommended.[30] Thus, prevention of cerebral edema can be done with maintaining of normocarbia. Avoid excessive rotation of the head to prevent venous outflow from the head and neck. Dexamethasone sodium phosphate can be used for cerebral protection.[4]

We faced few complications in our study. One patient developed acute renal failure and anastomotic leak on second post operative day. He was conservatively managed with fluids and pig tail catheter. Direct compression of the intra-abdominal vessels and renal parenchyma by pneumoperitoneum can decrease cardiac output, renal blood flow, the glomerular filtration rate , and urine output.[31,32,33] These physiologic changes consequently stimulate the renin-angiotensin system and further decreases renal blood flow.[34,35] All of these can contribute to the impairment of renal function. Two patients developed post extubation inspiratory stridor. They were reintubated and ventilated postoperatively. Laryngoscopy confirmed laryngeal edema and extubated after two hours uneventfully in I.C.U. One patient had cerebral infarct on seventh postoperative day. It could be attributed to steep Trendelenburg position for prolonged time. This was treated with stenting at other centre. One patient was electively ventilated, six hours after surgery for subcutaneous emphysema and later extubated uneventfully.

The inevitable limitations of our current study comes from its retrospective design. Many confounders such as age, body mass index, comorbidities may affect the extubation. Also, cerebral parameters were not monitored in our study. This was the data of first fifty six patients underwent RALP at our institute, so learning curve of the operating surgeon is one of the important factors.

Conclusion

The majority of patients generally tolerate RALP well and appreciate the benefits; however, anaesthesiologist must have knowledge of physiological changes associated with high IAP and steep Trendelenburg position for prolonged time. CE and prolonged Trendelenburg position alert anaesthesiologist for underlying airway edema, so extubation should be done cautiously to prevent airway related complications in postoperative period.

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Legends Tables and Graph

Table 1: Checklist for the safe extubation and discharge of robotic-assisted laparoscopic prostatectomy patients from operating room / recovery room.
Safe extubation
Adequate breathing.
Reversal of neuromuscular block.
Normocapnia.
Normothermia.
Leak test.
No or improved upper body edema.
No or improved conjunctival edema.
No or improved subcutaneous emphysema.
Safe discharge from recovery room.
No snoring
No inspiratory difficulty or distress.
No postoperative agitation.

Table 2 Co-relation of conjunctival edema and delayed extubation.

Conjunctival edema	Delayed extubation	Extubation	Total
No	3 (6.98%)	40 (93.02%)	43
Yes	8 (61.54%)	5 (38.46%)	13
	11	45	56

Chi-square - 15.5285 Probability(p) - 0.0008

Graph 1 : Co-relation of conjunctival edema and delayed extubation.

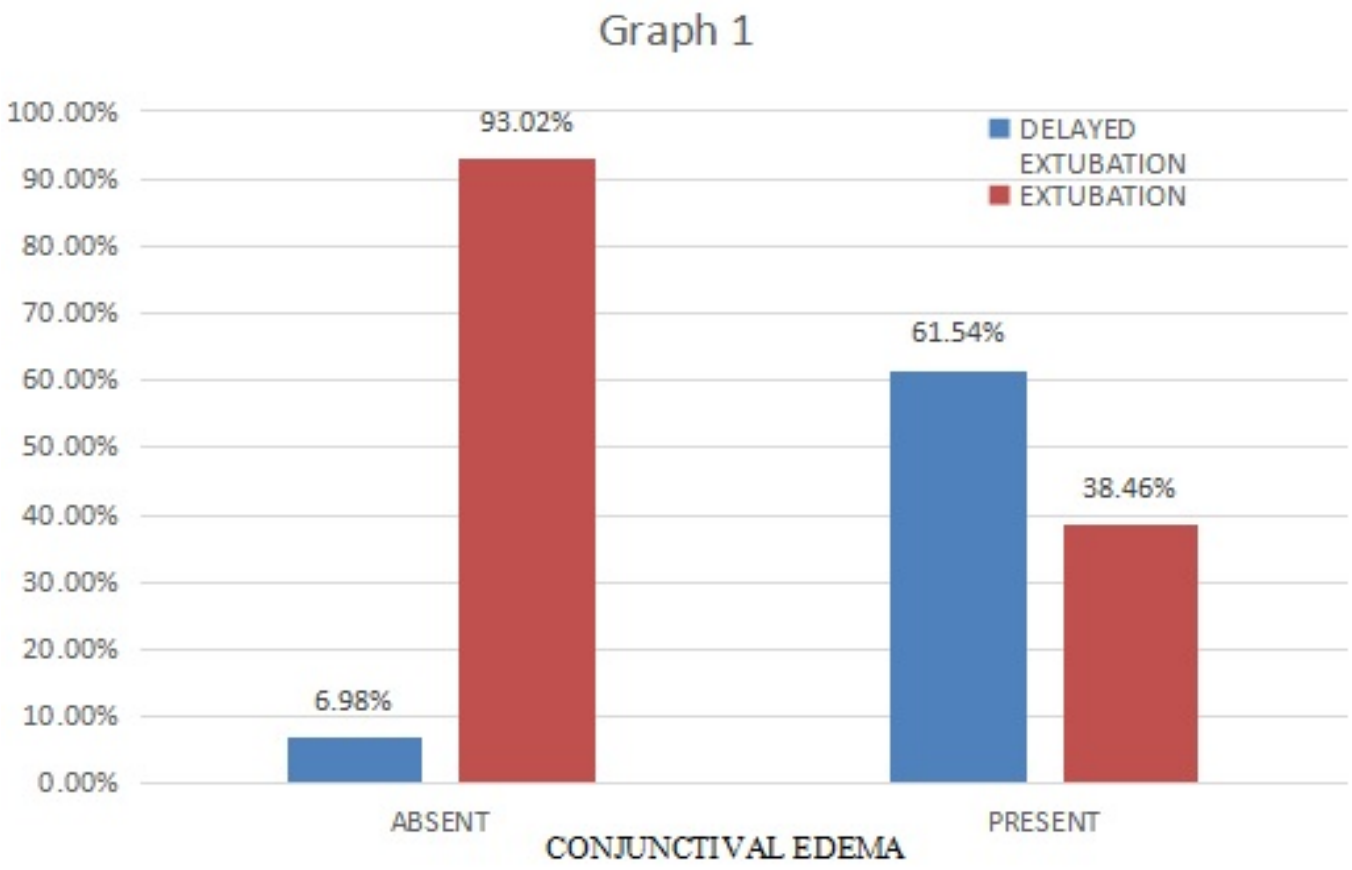

Table 3: Co-relation of Trendelenburg time and delayed extubation.		
Trendelenburg time (Hours)	Delayed extubation	Extubation
2 ≤ 3	2 (11.11%)	16 (88.89%)
3 ≤ 4	5 (17.24%)	24 (82.76%)
4 ≤ 5	3 (37.50)	05 (62.50%)
5 and above	1 (100%)	00 (00.00%)
Total	11	45

Chi-square - 6.6431. Probability(p) - 0.0842.

Graph 2 : Co-relation of Trendelenburg time and delayed extubation.