Retroperitoneoscopic approach of nephrectomy in pediatric patients is a debatable issue from surgical point of view. Experience of anesthetic management of 15 such patients from a tertiary care teaching hospital has been described here. We found that capno-retroperitoneum increases end-tidal carbon-di-oxide, but normocapnea was achieved in the most of the patients. No significant hemodynamic changes were noted in any patients. However, subcutaneous emphysema was common, but self-limiting without any serious consequence. Postoperative pain after this procedure is usually manageable by nonopioid analgesics.

**Key words:** Capno-retroperitoneum, pediatrics, retroperitoneoscopy

## Introduction

Minimally invasive nephrectomy can be performed by either a trans-peritoneal or retroperitoneal approach. Though reported long ago,[1] the benefits and risks of nephrectomy in pediatric patients through a retroperitoneoscopic approach is still controversial. Classically retroperitoneal approach is believed to be associated with less postoperative ileus and early return of bowel function. Capno-retroperitoneum has been associated with more carbon-di-oxide absorption with consequent hypercarbia. However, recently retroperitoneoscopic approach has been found to be at least as safe as open approaches for pediatric nephrectomies and associated with much less postoperative pain.[2] Clinical data from an anesthesiologist’s point of view on the management of capno-retroperitoneum and management of these patients is sparse. However, both animal[3] and human[4] studies have observed significantly differing hemodynamic and respiratory effects of carbon-di-oxide insufflation in peritoneum and retroperitoneum. Practicing anesthesiologists must be aware about the respiratory and hemodynamic changes of capno-retroperitoneum for safe management of such patients.

We hereby report our initial experience on anesthetic management and perioperative course of consecutive 15 children posted for retroperitoneoscopic nephrectomy in a tertiary care teaching hospital in India.

## Materials and Methods

After obtaining written informed consent, we prospectively collected anesthesia data of consecutive fifteen retroperitoneoscopic nephrectomies performed during the period of July 2012 to June 2013. The following parameters were noted from the records: Demographics, indication of surgery, preoperative clinical and investigation data, intraoperative anesthesia management, hemodynamic and ventilation parameters, surgical notes, postoperative analgesia, and any intraoperative or postoperative complications.

## Demographic parameters

There were nine males and six females with median age of 7 years range (4.5-9 years). In 7 cases, nephroureterectomy was done in left side and in right side in 8 cases. Indication of surgery was nonfunctioning kidney in all cases. Preoperative physical examination and laboratory investigations were within
normal limit in all patients. Mean operating time was 80 min (range 50-120 min). One was converted to open because of pyonephrotic kidney with severe adhesions due to previous surgery. Demographic profile of patients has been provided in Table 1.

**Anesthesia protocol**
All patients had intravenous cannula in situ in the preoperative period. Anesthesia was induced with injection fentanyl 2 mcg/kg, propofol 2-3 mg/kg and muscle relaxation was achieved by injection atracurium at a dose of 0.5 mg/kg. Endotracheal (ET) intubation was done in all cases by appropriate sized cuffed ET tube by McIntosh laryngoscope blade. Patients were placed in the lateral decubitus position with the side to be operated kept up. All cases were carried out by a single surgeon and he used three 5 mm port including one for camera. Maintenance of anesthesia was done by an air-oxygen-isoflurane technique targeting an end tidal concentration of isoflurane about 0.8-1.0 MAC and intermittent boluses of atracurium at 0.1 mg/kg. Intravenous morphine was given to all patients at a dose of 100 mcg/kg and intravenous paracetamol was given at a dose of 15 mg/kg before extubation. At the end of surgery, residual neuromuscular block was reversed by neostigmine-glycopyrolate and trachea were extubated when patients were fully awake.

**Formation of capno-retroperitoneum**
The initial rate of carbon-di-oxide insufflation was 2l/min in all cases and a pressure of 8-10 mm Hg was kept. CO2 insufflation was done by a Karl Storz™ Endo-inflator (KARL STORZ GmbH & Co. KG, Tuttingen, Germany).

**Intraoperative ventilation protocol**
All patients were ventilated by pressure limited volume control ventilation through a circle absorber system. Initially, a minute ventilation of 100 ml/kg was instituted. A limiting pressure was set at 30 cm H2O targeting an end-tidal carbon-di-oxide (EtCO2) tension of 35-45 mm Hg. After institution of capno-retroperitoneum, initially minute ventilation was increased 15% and subsequently adjusted to maintain an EtCO2 below 50 mm Hg.

In 11 of 15 patients, we were able to maintain an EtCO2 below 50 mm Hg within the predefined peak pressure limit.

**Intraoperative hemodynamic parameters**
Tachycardia (increase in heart rate >20% from baseline) and hypertension (increase in mean arterial pressure >20% from baseline) were noticed in 14 of 15 patients during institution of capno-retroperitoneum. However, both heart rate and blood pressure reached baseline within 10-15 min. In 1 patient, we noticed bradycardia up to 74/min which responded to temporary cessation of CO2 insufflation. No other significant hemodynamic changes of any form in the intraoperative period that required intervention were noticed. A snap shot of intraoperative hemodynamic data have been provided in Figure 1.

**Intraoperative complications**
We noticed subcutaneous emphysema in 5 patients during surgery. Interestingly, in three of them, we found difficulty in maintaining normocarbia with a safe peak airway pressure limit. However, it was self-limiting in all patients and resolved completely within 8 h after surgery. We did not notice any pneumothorax or gas embolism in any of our patients.

**Postoperative period**
Residual neuromuscular blockade were reversed by standard dosage of neostigmine and glycopyrolate and extubated when patients were fully awake. Tracheas of all patients were extubated in the operating room. No postoperative respiratory complications were noted in any patient. Port site local anesthetic infiltration with 0.2% ropivacaine was used in all patients at the end of surgery and all of them received intravenous paracetamol

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**Table 1: Demographic details of the patients; data expressed as mean (SD), median (range) or proportions**

| Age (in years) | 7 (4.5-9) |
| Sex (male/female) | 9/6 |
| Body weight (in kg) | 18.8 (5.4) |
| Duration of surgery (in min) | 80 (50-120) |

SD = Standard deviation

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**Figure 1:** Mean heart rate, mean arterial pressure and end-tidal carbon-di-oxide in the Intraoperative period (T_baseline: Baseline, T1: At the time of induction of anesthesia, T10: 10 min after induction of anesthesia, T_pneumo: After creation of pneumo-peritoneum, T15, 30, 45, 60, 75 and 90: 15, 30, 45, 60 and 90 min after creation of pneumo-peritoneum)
at a dose of 15 mg/kg QID for 48 h. Intravenous morphine 50 mcg/kg bolus was used as rescue analgesic. Six patients required at least one rescue morphine bolus in the initial 6 h of the postoperative period. Two patients required two boluses each. We performed a caudal block with 0.2% ropivacaine in cases which were converted to an open approach. In the postoperative period bowel sound returned in all patients by next day and oral feeding were started in all patients by 24 h.

All patients were followed until they were discharged from the hospital, and we did not notice any surgical complication in any patients.

**Discussion**

Urological surgeries in pediatric patients through retroperitoneal route are at least as favorable as trans-peritoneal approach from surgical point of view. Previous animal studies are not unanimous about CO2 absorption through intra-peritoneal and retroperitoneal approach. Increased absorption through intra-peritoneal space[13] and similar absorption[15] through either route has been reported. Human studies have been conducted in adult patients and reported conflicting results. Kadam et al.[6] and Ng et al.[7] have reported a similar absorption of carbon-di-oxide in either route. However, Streich et al. in[8] 2003 reported that retroperitoneal carbon dioxide insufflation causes more carbon dioxide absorption than intra-peritoneal insufflation. Previously Wolf et al.[9] in 2005 reported in a retrospective analysis that, extra-peritoneal CO2 insufflation and subcutaneous emphysema were significantly associated with hypercarbia. Karsli et al.[10] found that EtCO2 seem to increase progressively and gradually during retroperitoneal laparoscopy, in contrast to the plateau effect during trans-peritoneal laparoscopy. Similarly Lorenzo et al.[11] and Halachmi et al.[12] also found significant hemodynamic changes after capno-retroperitoneum. However, Nadu et al.[13] found that retroperitoneoscopy is associated with less hemodynamic changes that trans-peritoneal approach. They also found that increase in peak airway pressure is also less in retroperitoneal approach. In our series, we found that despite initial increase of EtCO2, normocarbia could be maintained with a safe peak airway pressure in most of the patients. It is most probably due to a less decrease in respiratory compliance by capno-retroperitoneum than capno-peritoneum as mentioned by Nadu et al.[13] However, where normocarbia was difficult to maintain, hypercarbia regressed after deflation of the capno-retroperitoneum and no other complications occurred. It is worth mentioning in this context, that no other clinical data on the effects of capno-retroperitoneum in pediatric patients exists in anesthesia literature. Giebler et al.[14] in 1996 found that CO2 insufflation in retroperitoneum does not cause any significant hemodynamic change other than an increase in central venous pressure. They also found that the procedure is safe and although there is significant increase in PaCO2, it was below 45 mm Hg. Incidence of subcutaneous emphysema in their series was 12.5%.

We also found that subcutaneous emphysema was the cause of hypercarbia in three of the 4 patients in whom normocarbia was difficult to maintain. It is also worth mentioning that subcutaneous emphysema is common in this procedure and it can happen any time after formation of capno-retroperitoneum. A high index of suspicion and vigilance is required to detect it early. We did not find any serious complications like pneumothorax or gas embolism in any patients.

**Conclusion**

Though significant hypercarbia may occur in pediatric patients during capno-retroperitoneum, it is usually safely manageable and associated with no serious complications at least in our small series. A randomized control trial is required in these patients to accurately delineate the effects of intra-peritoneal and retroperitoneal carbon-di-oxide insufflation. However, a thorough vigilance is required from our point to detect possible complications.

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How to cite this article: Maitra S, Khanna P, Baidya DK, Pawar DK, Baipai M, Panda SS. Pediatric retroperitoneoscopic nephrectomy: An initial experience of 15 cases. J Anaesthesiol Clin Pharmacol 2015;31:115-8.

Source of Support: Nil, Conflict of Interest: None declared.

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Retrospective studies, audits, novel case series or rare cases can be reported as Forum. They should be unique, describing a great diagnostic or therapeutic challenge and providing a learning point for the readers. Studies/cases with clinical significance or implications will be given priority. These communications could be of up to 1000 words (excluding Abstract and references) and should have the following headings: Abstract, Key-words, Introduction, Materials and Methods/Case report, Results, Discussion, Reference, Tables and Legends in that order. The manuscript could be of up to 1000 words (excluding references and abstract) and could be supported with up to 10 references. Forum articles could be authored by up to four authors. Henceforth case reports will be accepted as Correspondence/Letters to Editor. Case reports that do not require extensive patient detail should be submitted as correspondence or Letter to Editor. Please visit our website http://www.joacp.org/contributors.asp to view the detailed revised instructions for Authors.