




Hem-o-Lok polymer clips for major vascular control in paediatric minimally invasive surgery

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Abstract

Purpose The challenge of endoscopic large vessel control has brought sweat to the brow of many a surgeon, yet the optimal method for use in a small working space remains unknown. Reports of delayed, major haemorrhage with exclusive energy device use have raised significant concerns. We, therefore, report outcomes of an alternative sealing device (Weck Hem-o-Lok polymer clips) in laparoscopic and thoracoscopic surgery.

Methods A retrospective review of all patients (< 18 years) who underwent laparoscopic splenectomy or thoracoscopic pulmonary resection between February 2018 and August 2020 (30 months) was undertaken. Data are presented as median (IQR).

Results Thirty-three patients were identified (16 female); 16 underwent laparoscopic splenectomy and 17 thoracoscopic lobectomy/excision of congenital pulmonary airway malformation (CPAM) or resection of pulmonary sequestration. Age at surgery was 7 years 7 months (6 years 2 months–9 years 9 months) and weight 23.0 kg (20.2–37.4 kg) in the splenectomy group: it was 16 months (13–19 months) and 12.0 kg (10.4–13.2 kg) in the thoracic group. Hem-o-Lok clips (medium–large) were used to individually clip: (1) the main splenic artery and vein; or (2) pulmonary arterial branches and vein; or (3) systemic sequestration vessels, using a 5 mm endoscopic applicator. In most cases, two clips were placed proximally and one distally: the vessel then divided without energy. There were no incidences of clip failure during application or migration. There was no significant intra-operative or post-operative bleeding.

Conclusion Hem-o-Lok polymer clips are a safe and reliable method for major vascular control during endoscopic surgery in small children.

Keywords Laparoscopic · Thoracoscopic · Vessel ligation · Child · Splenectomy · Lobectomy

Introduction

Secure endoscopic vascular control is an integral technique for the safe practice of many paediatric surgical procedures, such as thoracoscopic pulmonary resections and laparoscopic splenectomy. Since the early 1990s, thoracoscopic pulmonary resections and laparoscopic splenectomy have been advocated over the open approach in paediatric surgery

[1–3]. Studies have demonstrated a reduction in post-operative pain and length of stay as well as cosmetic advantages [4, 5]. However, the small working space of the paediatric patient complicates the already challenging task of dividing large vessels.

Methods of vessel sealing include suture ligation and staples/metal clips. Both these techniques are technically challenging in a small working space and using 5 mm paediatric ports and may slip/migrate. An alternative, and the preferred technique by many, is the use of advanced bipolar energy devices such as LigaSure (Medtronic), using bipolar and radiofrequency current with feedback mechanisms to allow for sealing of vessels without eschar formation. However, there have been anecdotal reports of delayed major haemorrhage after the exclusive use of energy devices for the sealing of major blood vessels such as the splenic artery and vein. The Weck Hem-o-Lok (Teleflex) polymer locking ligation system provides an alternative, cold system minimising the

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use of thermal energy, and thus the risk of thermal injury to surrounding structures. The inner edge of the clip contains small teeth to prevent slipping and the applicator supplies tactile feedback to the surgeon when the clip is secure. Endoscopic applicators are available for the use of medium/large, large and extra-large clips: the medium/large size can be used on vessels up to 10 mm diameter and can be deployed using a 5 mm applier.

The optimal method of vascular control in the paediatric population is unknown. In this study, we share our outcomes with the use Hem-o-Lok clips during paediatric thoracoscopic and laparoscopic surgery to support a safe alternative to the use of energy devices for vessel sealing.

Materials and methods

A review was performed of all patients, under 18 years of age, who underwent a thoracoscopic resection of pulmonary sequestration, thoracoscopic lobectomy/excision of congenital lung lesion or laparoscopic splenectomy over a 32-month period from February 2018 to October 2020 at Royal Manchester Children's Hospital. Preliminary data were collected prospectively for this cohort of patients and medical records were reviewed if more detailed information was required.

Within the Department of Paediatric and Neonatal surgery at Royal Manchester Children's Hospital, there is a thoracic and upper gastrointestinal surgery team of three consultant paediatric surgeons and all operations were performed by one or more of these consultants.

Demographic data including age, weight and gender were collected as well as additional data to include diagnosis, surgical procedure, and details of surgical technique. In all patients, a 5 mm auto-applicator device was used to apply medium/large Hem-o-Lok clips via a 5 mm working port.

Outcome measures included intra-operative complications, post-operative complications, and length of inpatient stay. Continuous data were analysed and are presented as median and interquartile range (IQR).

Results

A total of 33 patients were included (16 female; 17 male) over the 32-month time-period. The standard approach was to apply two Hem-o-Lok clips proximally and a further one (two clips if the vessel was branching) distally then the vessel was divided without energy. In a small number of cases, a LigaSure device was used to seal and divide the distal vessel end only when there was adequate vessel length (~5 mm) to apply the device away from the Hem-o-Lok clips remaining in the patient.

Laparoscopic splenectomy was performed in 16 patients. Age at time of surgery was 7 years and 7 months (6 years 2 months–9 years 2 months) and weight 23.0 kg (20.2–37.4 kg). Indications for laparoscopic splenectomy included hereditary spherocytosis ($n=10$), HbSS sickle cell disease ($n=5$) and transfusion dependent beta thalassaemia major ($n=1$). Hem-o-Lok clips were used to individually seal the main splenic artery and splenic vein (Fig. 1a–c). Complications included one small wound haematoma and post-operative pancreatitis in one patient. There were no incidences of clip migration or failure, and no incidences of major intra-operative or post-operative haemorrhage. Post-operative length of stay was 2 days (2–3 days). At the time of study, all 16 patients had outpatient follow-up post-surgery and all patients reported to be doing well with no surgical complications.

A total of 17 thoracoscopic resections were performed; 10 lobectomy/excision of congenital pulmonary airway malformation (CPAM) and 7 resections of pulmonary sequestrations. Age at surgery was 16 months (13–19 months) and weight 12.0 kg (10.4–13.2). Indications for surgery included intra-lobar sequestration [6], extra-lobar sequestration [1] and CPAM [10]. Hem-o-Lok clips were used to individually seal pulmonary arterial branches and the pulmonary vein or systemic sequestration vessels (Fig. 2a–c). Complications included one wound infection, one wound haematoma and one patient who required conversion to open thoracotomy due to failure to tolerate carbon dioxide insufflation. There were no incidences of clip migration or failure and no major intra-operative or post-operative bleeding. Post-operative length of stay was 2 days (2–2 days). At the time of study, 13/17 patients had outpatient follow up post-surgery. One patient was re-admitted post-operatively to their local hospital due to fever but was discharged after a 4-day course of antibiotics. All other patients reported to be doing well with no reported complications.

Discussion

This case series demonstrates a cohort of patients in whom Weck Hem-o-Lok clips were successfully used for vascular control without adverse effects. Although the literature currently contains little data on the optimal method of vascular control in the paediatric population, there are animal studies which have produced interesting data regarding 'burst pressure' with energy devices and clips. These studies demonstrate a significantly higher average burst pressure of 1200 mmHg with Hem-o-Lok clips compared to 250 mmHg with Ligasure [6]. However, we recognise these pressures are supra-physiological and suggest both techniques should provide adequate vessel sealing.

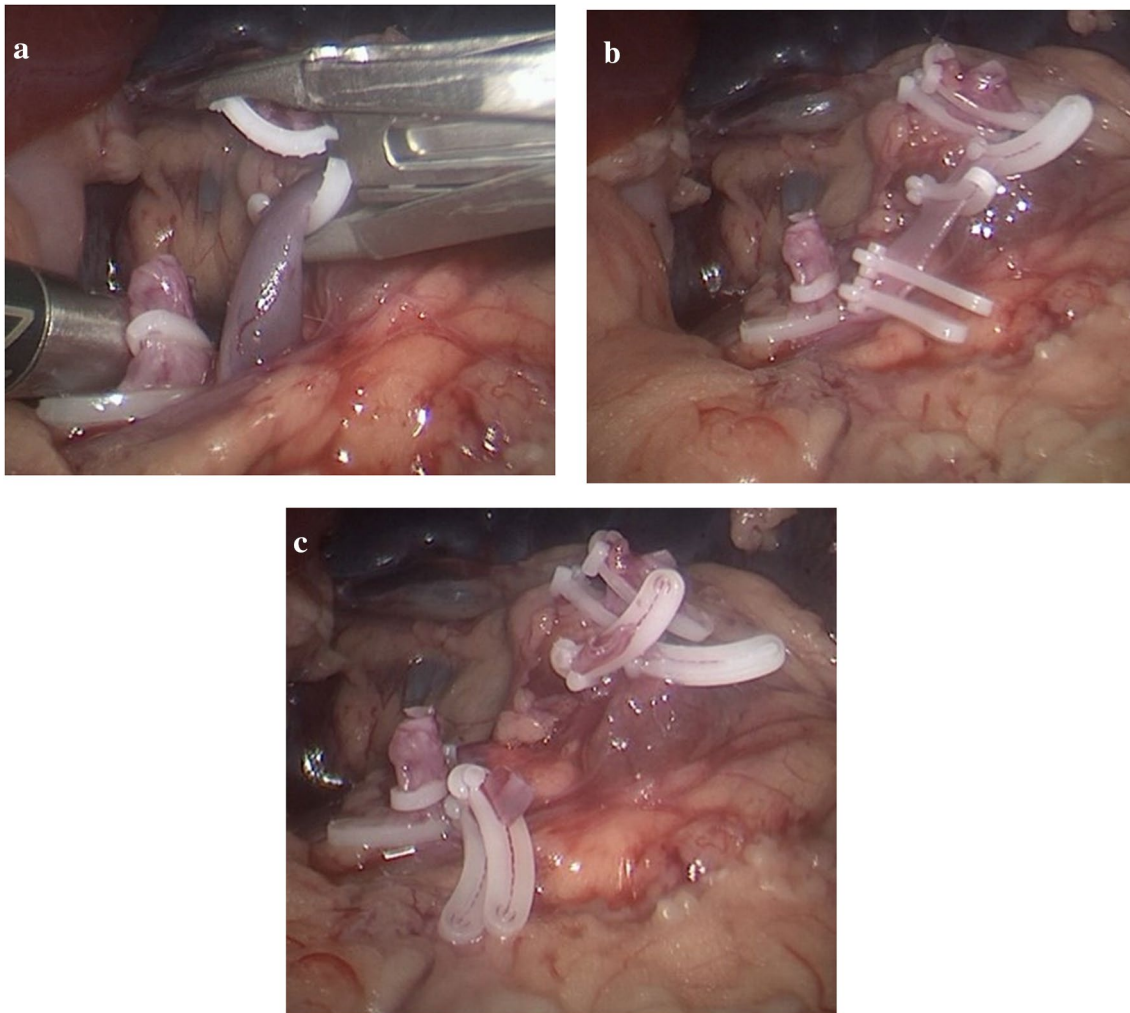


Fig. 1 a–c Laparoscopic splenectomy; **a** main splenic artery has been ligated. Hem-o-Lok clip is placed on main splenic vein **b** four Hem-o-Lok clips are placed **c** the vessel is divided between clips leaving two clips proximally

The patients in our study who underwent thoracoscopic resection had a median weight of 12.0 kg which demonstrates the small size of these patients and thus the small working space. Thermal injury is thus a reasonable concern with the use of energy devices which have shown a thermal spread of 1–3 mm [7]. The use of LigaSure to divide the vessel after clips have been applied is utilised by some [8] and may maintain the seal if the clip were to migrate. However, the potential for unrecognised thermal injury presents a concern of delayed major haemorrhage with potentially catastrophic consequences. The Hem-o-Lok clip is a cold sealing system presenting no risk of thermal injury when used without the concomitant use of an energy device.

The use of Hem-o-Lok clips is well described in the adult literature in procedures such as laparoscopic cholecystectomy and laparoscopic or retroperitoneoscopic nephrectomy

[9–12]. There are rare reports of clip migration into surrounding viscera [13, 14] which have not been documented in the paediatric population but should remain an important consideration. We acknowledge the short duration of follow-up to date but note that no patients in this study have reported symptoms post-operatively that could be attributable to clip migration.

Conclusions

This case series demonstrates that Hem-o-Lok polymer clips are a safe, reliable, alternative to the use of energy devices for major vascular control during minimally invasive surgery in small children.

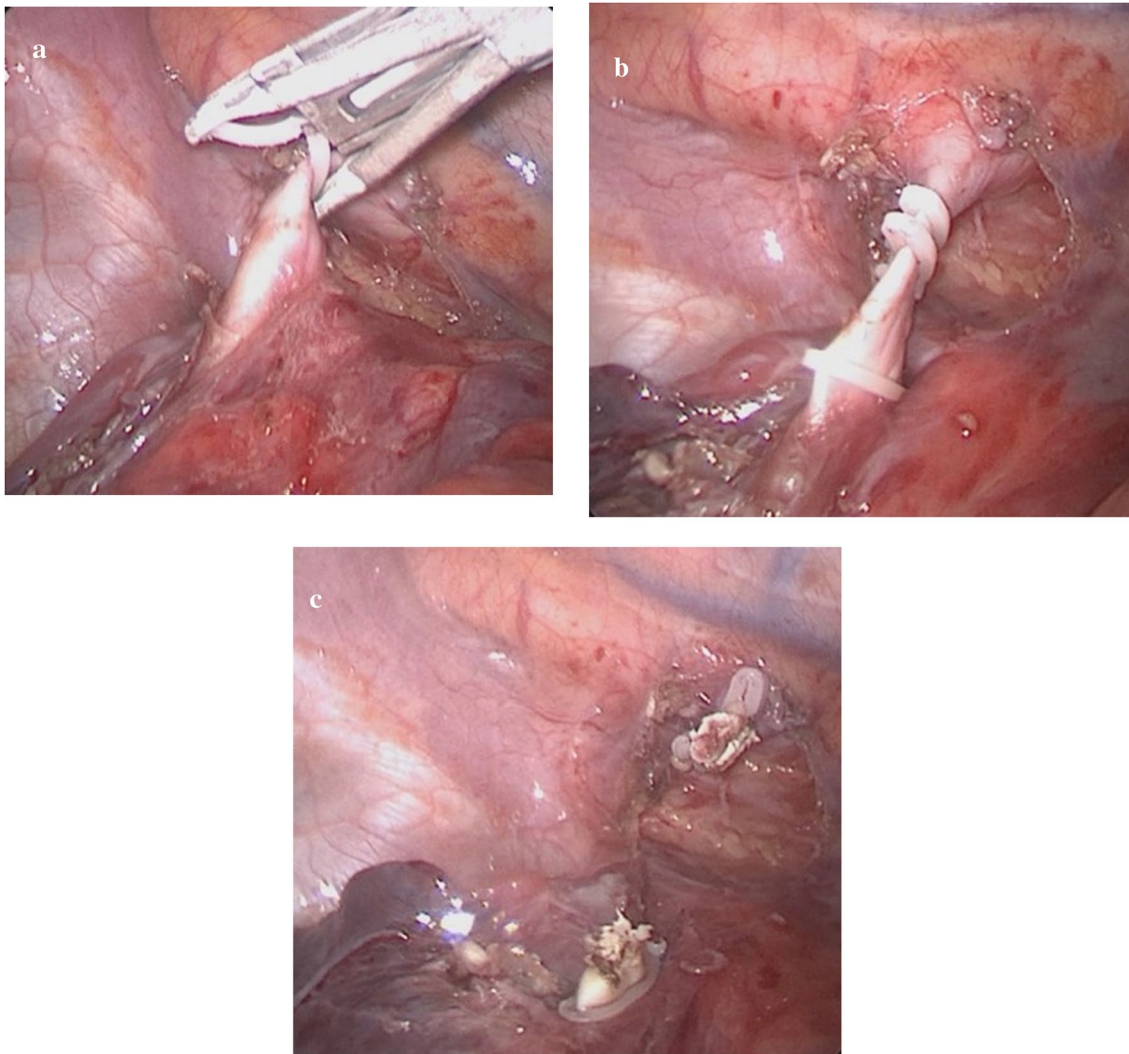


Fig. 2 a–c Thoracoscopic resection of pulmonary sequestration. **a** Hem-o-Lok clips are placed on the systemic sequestration vessel. **b** 3 Hem-o-Lok clips are placed. **c** The vessel is divided leaving two clips proximally

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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