



Experience with the use of tissue adhesives in pediatric endoscopic surgery

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Abstract

Background: Due to technological improvements, the use of tissue adhesives and glues for tissue approximation and hemostasis in surgery has increased. We report our preliminary experience with this technology in pediatric endosurgery.

Methods: Between 1997 and 2000, we employed tissue adhesives in 48 pediatric patients during laparoscopic procedures. In 25 patients, the glue was adopted for the hemostasis of parenchymal organs (liver in 24 cases and spleen in one). In three cases, the glue was used to repair organ perforation, in 19 it was used to close the distal part of a patent processus vaginalis in case of congenital inguinal hernia. In the final case, the glue was adopted to achieve optimal airtightness in case of pulmonary biopsy. The glue was injected with the aid of a needle positioned transperietally.

Results: The procedure was easy and rapid in all cases, and there were no problems or complications related to glue positioning at a mean follow up of 51 months.

Conclusion: Tissue adhesives are a very versatile product for use in pediatric laparoscopic surgery. It is likely that their usage will increase as the technology improves and more effective products are developed.

Key words: Glue — Laparoscopy — Pediatric endosurgery — Cyanocrylate

Tissue adhesives or glues used in open and endoscopic surgical practice can be classified into three major categories on the basis of their origin: biological, synthetic, and genetically engineered polymer protein glues [3, 5, 6]. All cyanoacrylate (CA) and noncyanoacrylate products such as polymeric sealants are considered to be of synthetic origin, whereas fibrin glues (human origin)

and animal-derived hemostatic agents (bovine, porcine, etc.) are considered to be of biological origin [5, 14]. Fibrin glues (FGs) are the main biological tissue adhesives and have long been used in surgical practice [4, 13].

Cyanoacrylates have recently been introduced in surgical procedures and are mainly used as embolic agents by interventional radiologists and endoscopists [7, 8]. Several reports indicate that CAs are easy to use compared to the other types of tissue adhesives [1, 2, 6]. We discuss our clinical and personal experience with the use of tissue adhesives in pediatric laparoscopic surgery.

Materials and methods

Between 1997 and 2000, we employed tissue adhesives in 48 pediatric patients who underwent laparoscopic or thoracoscopic procedures. We adopted a new tissue adhesive, a synthetic *N*-butyl-cyanoacrylate glue (Glubran, GEM, Viareggio, Italy), the first one to be EC certified for internal surgical use. This product polymerizes quickly (1–2 sec to 1 min) when in contact with liquids and tissues, generating a low polymerization temperature (45°C). Glubran creates a tight transparent film that is permeable to oxygen but not liquids [6]. These features do not influence the normal healing process. Moreover, Glubran is not associated with foreign body reactions and is eliminated through hydrolytic degradation after 30–40 days to 6 months. Glubran polymerizes only when it is in contact with tissues and blood, without undesired polymerization in the needle during injection.

In 25 patients, the glue was adopted to ensure perfect hemostasis of parenchymal organs—in 24 after a wedge liver biopsy and in one after a resection of the splenic cyst of the upper pole. In three cases, the glue was used to close organ perforations: an esophageal perforation that occurred during Heller's procedure, a colic perforation during a laparoscopic total colectomy, and a gastric perforation (Fig. 1). In 19 children with congenital inguinal hernia, the glue was used to close the patent processus vaginalis (Fig. 2). The patent processus vaginalis was closed with a purse string suture in nonresorbable material and the glue was injected into the duct to permit the perfect closure of its distal part. In the final case, the glue was adopted to achieve optimal airtightness after pulmonary wedge resection using an automatic stapler. In all cases, the glue was injected with the aid of a needle positioned transperietally.

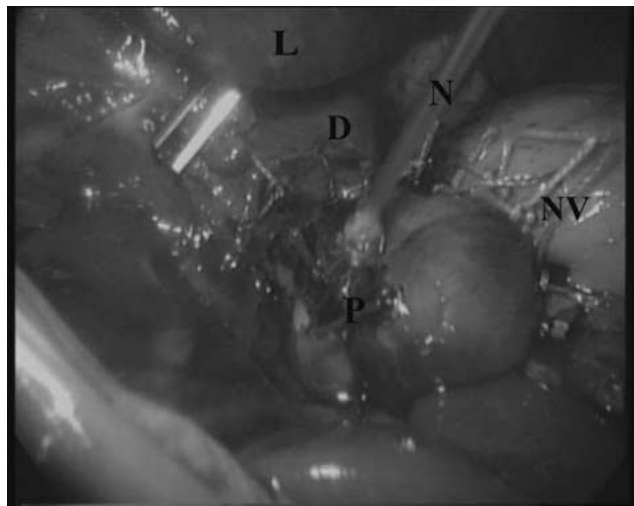


Fig. 1. The glue is extremely useful in cases of complications, such as in this perforation of the right side of the valve during a Nissen fundoplication. NV, Nissen valve; N, needle; L, liver; D, diaphragm; P, perforation.

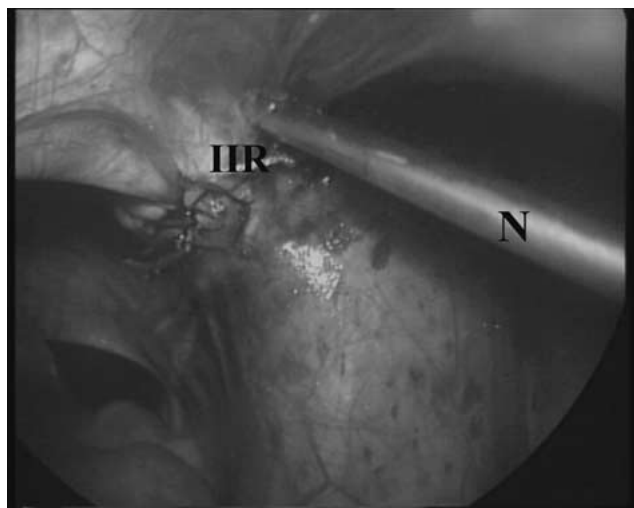


Fig. 2. The glue was adopted to close a patent processus vaginalis in a congenital inguinal hernia. N, needle; IIR, internal inguinal ring.

Results

The procedures were successful in all cases, especially those in which hemostasis was required. In general, on liver and spleen, hemostasis was achieved 30–60 sec after glue positioning. The procedure was easy and fast in all patients. At long-term follow-up, varying from 2 to 5 years (mean, 51 months) there were no problems or complications related to the application of the glue.

Two boys in our series operated on for a right inguinal hernia were reoperated using laparoscopy 2 years later (20 and 25 months) for a left varicocele. The right inguinal region was anatomically perfect with no remnant glue or any other problems (e.g., adhesions) related to the glue positioned during the hernia repair 2 years previously.

Discussion

Perfect hemostasis similar to that achieved in open surgery is one of the main problems in pediatric laparoscopic surgery. Several products (i.e., titanium or reabsorbable clips, ultrasonic scalpel, and bipolar and tripolar forceps) have been developed to help solve this problem.

Tissue adhesives have been employed in pediatric surgery with the aim to reduce the risk of postoperative complications, especially in cases of parenchymal resection or vascular anastomoses [6, 12, 17]. Until now, the majority of indications for tissue adhesives have been for open surgery [9, 14, 15].

In our experience, the glue that we adopted seems to be a good means of controlling bleeding in the case of intervention on the spleen or liver as well as a valid method to complete and secure the sutures in case of organ perforation. We consider these advantages to be of even greater applicability for pediatric laparoscopic surgery.

Our series shows that glues can be adopted for several conditions in pediatric laparoscopic surgery, especially in more complex cases, because they reduce the rate of possible complications. In our experience, the use of adhesives has proven to be of great interest and efficacy. In particular, in esophageal or gastric perforation Glubran has a twofold fundamental advantage—sealing and consolidation. It acts within a very short time (1 or 2 sec to 1 min), with an immediate effect following its application on sutures and anastomoses; it is thus possible to obtain rapid consolidation and sealing of the suture [3].

We think that tissue adhesives for use in laparoscopic surgery must meet certain criteria, and Glubran seems to meet these requirements. Glubran is easy to use, does not polymerize in the needle, acts rapidly, and does not give foreign body reactions, as reported in the two cases in our series who had a second laparoscopic procedure.

Given our extremely encouraging preliminary experience, we strongly support the use of Glubran for emergencies in laparoscopy surgery. In our experience, the glue was extremely useful in the three cases of organ perforation to consolidate the suture or control the hemostasis in case of bleeding. In addition, as shown in our series, tissue adhesives are useful not only in abdominal surgery but also in thoracic surgery and urology [1].

We nevertheless think that correct use of Glubran requires a perfect knowledge of the product since a small amount of product (one drop per square centimeter) is sufficient to achieve the best results. We found that if we used more than one drop of product, the result was a glassy aggregate on tissues.

According to reports by medical teams during the Vietnam War and to unpublished literature, CAs may be associated with the occurrence of malignant tumors on the liver or spleen. We have initiated an experimental study on the cancerogenicity of CAs, and our preliminary results (unpublished) have failed to find any association with malignant transformation [10, 11, 16].

Moreover, the manufacturer (GEM) is evaluating this aspect by *in vitro* studies with three endpoint mutagenic tests: Ames test, micronucleus, and exchange of chromatids. The results also demonstrate that Glubran has no cancerogenic properties.

In our experience, tissue adhesives are extremely useful in pediatric laparoscopic surgery. They should be easy to handle, quick acting, and nontoxic and characterized by good hemostasis and resistance to traction. Glubran has shown all these features in our series.

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