

SPECIMEN RETRIEVAL BAG

DECREASING OPERATIVE TIME IN HAND-ASSISTED LAPAROSCOPIC RADICAL NEPHRECTOMY

SARAH SANDOCK, JOSH KOLZ, CLAIRE WARDROP, VIVIAN CHEN, KEVIN BEENE

CLIENT: SUTCHIN PATEL, M.D. ADVISOR: MITCHELL TYLER

INTRODUCTION

Specimen retrieval bags are necessary during a hand-assisted laparoscopic radical nephrectomy for the safe removal of a cancerous kidney from the abdominal cavity. The aim of this project is to design and construct a more efficient specimen retrieval bag to decrease the total operative time of the nephrectomy. Tests were conducted using an artificial environment that simulates a human abdomen. Future work for next semester will be for medical students to practice the nephrectomy in an animal lab on campus to test the total time and ergonomics of the final designs while minimizing the risk of metastasis.

BACKGROUND

- Removal of a cancerous kidney from the abdominal
- Four incisions are made in the abdomen for the surgery: laparoscope, a pair of graspers, machine to inflate abdomen, surgeon's hand port
- Prevention of metastasis, the spread of cancerous cells
- Facilitate removal of kidney:
 - Limited space within abdominal cavity
 - Kidney is larger than surgeon's hand
 - Kidney has considerable weight (2-5 kg)

Motivation: Decrease total operative time by decreasing time taken to remove kidney

COMPETITION

There is no industry standard bag for this procedure. Our client currently uses the Cook LapSac. Some surgeons construct their own bags to use during the procedure.



Figure 1: (left) LapSac Surgical Tissue Touches by Cook, (center) Endocatch by Tyco, (right) Homemade Nadiad Bag (Ganpule et al, 2010)

FINAL DESIGNS

SPECIMEN BAG DESIGN CRITERIA

- Decrease time required to place kidney in bag
- Should not increase chance of metastasis
- Fit through the hand port in deflated state
- Protect abdominal cavity
- Cannot cause trauma to surrounding tissue
- Fit through incision while containing the kidney
- Sterile, non-permeable, watertight
- Support weight of removed organ
- Can be used with one hand and graspers

ACCORDION

Materials used: 4 mil polyethylene, nylon string, impulse heat sealer



Figure 2: Prototype of accordion bag, (left) side view, (right) top view

- Accordion shape allows the bag to expand and contract
- Can be compressed into a disk and placed at the bottom of the abdominal cavity
- The severed kidney will be placed on the disk, and the sides of the bag are pulled upwards to enclose the kidney
- Can be closed using the drawstring to prevent metastasis
- Maintains its shape and opening, allowing quick insertion of the severed kidney into the bag

FINGER-PORT

Materials used: 4 mil polyethylene, nylon string, impulse heat sealer



Figure 3: Prototype of finger-port bag, (left) side view, (right) bottom view

- Three finger ports on each side allow surgeon to easily find the finger ports
- Finger ports allow surgeon to hold the mouth of the bag open to insert kidney into the bag
- Drawstring and watertight seals prevent metastasis
- Takes less than 20 minutes to construct each bag
- Allows for multiple bag sizes and thicknesses to be used based on surgeon preference
- Surgeon has the option to insert hand into abdomen with fingers in finger ports

TESTING

WEIGHT CAPACITY



Figure 4: Seal provided by impulse heat sealer with standing about 4 kg of weight provided by metal pieces

WATERPROOF



For the prevention of metastasis, the seal must be watertight. As shown, the seal used on our prototypes provides a watertight bag.

Figure 5: Seal provided by impulse heat sealer protecting against water leakage

TIMING OF KIDNEY REMOVAL



Figure 6: Josh handling a pair of graspers and using a single hand to remove cancerous kidney model from model abdomen while using web-camera as laparoscopic element

The motivation of this project is to decrease total operative time by changing the design of the specimen retrieval bag. Change of retrieval bag design might facilitate the removal of the kidney. Because this variable is largely dependent on surgeon preference and ability, multiple bags were tested to assess what might be more efficient. For testing, in addition to prototype construction, a model of a cancerous kidney and an abdomen were built.

Table 1: Time testing for removal of cancerous kidney model from model abdomen

	Cook (s)	Finger Port (s)	Finger Port (Hand in) (s)	Accordion (s)
Josh	81	58	30	21
Sarah	44	32	22	20
Vivian	30	43	50	21
Claire	45	94	38	23
Kevin	75	120	34	19

CONCLUSION

- ✓ Finger port bag constructed
- ✓ Specifications of common retrieval bag met
- ✓ Accordion bag constructed
- ✓ Decreased operative time proven by student testing
- ✓ Prototypes excelled in tested areas
- ✗ Decreased operative time proven by surgeon testing

Although we have constructed two functional prototypes that theoretically should decrease operative time, this variable will be largely dependent on surgeon preference and ability. To confirm this, further testing will be conducted.

FUTURE

Immediate Future

- Find moldable material that suits our needs
- Have surgeon test our prototypes in our model environment
- Make more prototypes so that we can be ready for future testing (one time use bags)

Future Semester(s)

- Find an impulse heating sealer that allows more flexibility in sealing
- Make bags with more flowing seals as opposed to straight line seals
- Have prototypes tested by interns in pig labs

REFERENCES:

Crownshield, Roy D., and Orhan K. Muratoglu. (2010). "How have new sterilization techniques and new forms of polyethylene influenced wear in total joint replacement?" *Journal of the American Academy of Orthopaedic Surgeons*, 16 (2008): 582-85. Web 20 Oct 2010. <http://www.jaao.org/cgi/content/abstract/16/suppl_1/582p>
 Dhobada, Sateesh, Suresh Prasad, and Babu G. (2009). "Post-Op Metastasis after Laparoscopic Radical Nephrectomy for renal Cell Carcinoma." *Journal of Endourology*, 23 (2009): 319-22. Print.
 Ganpule, Arvind P., and E. Gotoy, et al. (2010). "Novel Cost-effective Specimen Retrieval Bag in Laparoscopy: Nadiad Bag." *Urology*, 75.5 (2010): 1213-16. Print.
 Patel, Sutchin. Personal Interview. 9 Aug 2010.