

Progressive Preoperative Pneumoperitoneum for Giant Inguinoscrotal Hernia: A Case Report and Literature Review

AUTHORS:

Kelsey A. Musgrove, MD; Paul R. Burchard, MS4;
David C. Borgstrom, MD, FACS

CORRESPONDENCE AUTHOR:

David C. Borgstrom, MBA, FACS
West Virginia University
Department of Surgery
1 Stadium Drive
Morgantown WV 26505
(304) 598-4890
dcborgstrom@hsc.wvu.edu

AUTHOR AFFILIATIONS:

West Virginia University
Department of Surgery
1 Stadium Drive
Morgantown WV 26505

Background	Progressive preoperative pneumoperitoneum (PPP) is a technique well described for the repair of giant ventral and incisional hernias with loss of domain allowing for gradual enlargement of the abdominal cavity in the preoperative period thereby increasing the likelihood of fascial closure and decreasing the likelihood of compartment syndrome. To date, few case reports have been published discussing PPP in the repair of giant inguinoscrotal hernias without determination of optimal gas agent, duration, frequency, or volume.
Summary	A 71-year-old Caucasian male presented with a giant inguinoscrotal hernia. He underwent progressive preoperative pneumoperitoneum through a peritoneal dialysis catheter. Nine days of room air insufflation was performed with maximal volumes titrated based on clinical exam and patient discomfort. The hernia was successfully repaired at that time and the patient was discharged the day of surgery with no complications noted on follow up. Although the use of progressive preoperative pneumoperitoneum is well documented throughout the literature, there are no clear recommendations on optimal gas agent, duration, frequency, or volume. Carbon dioxide, nitrous oxide, and room air have all been used with wide ranges of duration, volume, and frequency.
Conclusion	Progressive preoperative pneumoperitoneum is a useful technique for the repair of giant inguinoscrotal hernias with loss of domain. Our case demonstrates that using room air appears to be a viable less costly option. Variable duration, volumes, and gas agent have been successful in the literature and more research is needed to determine optimization and safety profiles of each. However, it appears titrating these variables based on clinical exam is effective.
Keywords	Progressive preoperative pneumoperitoneum, PPP, giant inguinoscrotal hernia

DISCLOSURES STATEMENT:

The authors whose names are listed immediately above certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

To Cite: Musgrove KA, Burchard PR, Borgstrom DC. Progressive Preoperative Pneumoperitoneum for Giant Inguinoscrotal Hernia: A Case Report and Literature Review. ACS Case Reviews in Surgery. 2018;1(4):28-31.

Case Description

Progressive preoperative pneumoperitoneum (PPP) is a technique well described for the repair of giant ventral and incisional hernias with loss of domain and rarely used for repair of giant inguinoscrotal hernias. PPP allows for gradual enlargement of the abdominal cavity in the preoperative period thereby increasing the likelihood of fascial closure intraoperatively and decreasing the complications of abdominal compartment syndrome postoperatively.¹ To date, few case reports have been published discussing PPP for inguinal hernia repair and optimal gas agent, duration, frequency, and volume have not been determined. Our case report aims to present PPP using a peritoneal dialysis catheter to deliver room air preoperatively for the repair of a giant inguinoscrotal hernia with loss of domain.

A 71-year-old Caucasian male presented with a giant inguinoscrotal hernia (Figure 1). Contrast enhanced CT imaging revealed an inguinoscrotal hernia with contents of large and small bowel, including the ileocecal valve (Figure 2).



Figure 1. Pre-operative appearance of giant inguinoscrotal hernia



Figure 2. Contrast enhanced CT of the abdomen and pelvis in coronal, sagittal, and axial views

He was admitted as inpatient for placement of peritoneal dialysis (PD) catheter for insufflation of his abdomen nine days prior to hernia repair. He remained inpatient until definitive hernia repair due to long travel distance and to monitor for potential air embolism although no specific maneuvers were performed to reduce this risk. He was in semi recumbent position during insufflation, but was encouraged to be upright as much as possible throughout the day. Spandex compression shorts were worn continuously. Room air was used for insufflation using a 50 cc syringe and three way stop cock. Air was insufflated each morning during inpatient rounds until the patient demonstrated discomfort with either shoulder pain or abdominal distension. On the first day, a second insufflation was attempted on afternoon rounds but symptoms occurred more rapidly; consequently we decided on once a day insufflation. Maximum volume was reached in approximately 3 to 5 minutes. Daily insufflation volumes are outlined in Table 1.

Day (after PD catheter)	Room air (cc)
1	2000
2	2100
3	2100
4	0
5	900
6	1400
7	1080
8	1300

Table 1. Preoperative insufflation with room air after PD catheter placement.

Nine days after PD catheter placement, the patient was taken to surgery. Prior to incision, the PD catheter was opened to allow air to leave the abdomen. A generous oblique incision in the right groin was made. The hernia sac was identified, small bowel reduced, the spermatic cord dissected from the hernia sac, the distal sac excised, and peritoneum was closed. The remaining scrotal contents fell back into the pre-peritoneal space without difficulty. A tension free repair using Prolene mesh and 0 Prolene sutures was then performed. A Jackson Pratt (JP) drain was placed. He was discharged the day of surgery. Six days later the scrotal drain was removed, his incision was healing well without hematoma, and he had no complaints (Figure 3).



Figure 3. Post-operative appearance of right open inguinal hernia repair

Discussion

The use of preoperative peritoneal pneumoperitoneum (PPP) for the repair of large abdominal hernias has been well described since 1940 and determined to be safe by others.² Less frequently, this technique has been used for the repair of giant inguinoscrotal hernias. Indications for PPP are reported as inability to perform the hernioplasty due to loss of domain and in patients at risk of developing abdominal compartment syndrome after reduction of the hernia.³ PPP has been shown to effectively increase available space for hernia repair by increasing the length of abdominal muscles and stretching the fascia⁴ thereby increasing the volume of the abdominal cavity.

There are no clear recommendations on optimal gas agent, duration, frequency, or volume. In the literature carbon dioxide, nitrous oxide, and room air have been used, between 4-60 days of preoperative insufflation, and volumes between 500 and 7400 cc daily.^(1, 5-7) In reviewing the literature, most discussion is regarding PPP with abdominal or incisional hernias, with fewer than 10 percent of cases applying PPP to giant inguinoscrotal hernia repair. Two

cases were presented by Piskin et al. using nitrous oxide insufflation through a peritoneal dialysis catheter. The first case insufflated with 2000 to 7400 cc of nitrous oxide daily over 18 days with plateau of abdominal enlargement at 13 days and maximal intra-abdominal pressure of 29 mmHg. The second case insufflated with 1500 to 3000 cc of nitrous oxide daily for 4 days since abdominal circumference reached 11 cm at that time and this was determined as plateau in their prior patient. These patients were discharged on postoperative days 14 and 13 respectively.⁵ Another case reported 18 days of PPP in addition to right hemicolectomy and transverse colectomy in order to create space for the definitive hernia repair.⁸ In another case of giant inguinoscrotal hernia repair, debulking by omentectomy without pneumoperitoneum was sufficient.⁹

In review of the literature, the use of room air appears to be as effective as nitrous oxide and carbon dioxide with the slowest absorption rate in addition to being the lowest cost. A Cochrane review of the literature consisted of nine randomized control trials comparing carbon dioxide to nitrous oxide (3 trials), helium (5 trials), and room air (1 trial) for intra-operative pneumoperitoneum and showed decreased hospital costs with room air but overall evidence of safety is low and more trials are recommended¹⁰. Rate of carbon dioxide absorption through the peritoneum during laparoscopy ranges between 14 and 48 mL/min based on peritoneal cavity gas clearance estimates and on peritoneal blood flow being between two and seven percent of cardiac output, to be ~100 mL/min.¹¹ One literature review compared various gases used in laparoscopy and determined carbon dioxide is the most rapid dissolution. Nitrous oxide is less frequently reabsorbed but has higher risk of combustion. Helium, air, and nitrogen dissolve much more slowly but have increased risk of venous emboli.¹²

This feared complication of air embolism with room air pneumoperitoneum has been described previously.¹³ One case report by Rhee et al reported air embolism during bilobectomy five minutes after injecting 700 cc of atmospheric air into the peritoneal cavity through the right diaphragm in order to elevate it.¹³ Despite this mentioned complication, air has been previously and frequently used for PPP in abdominal hernias beginning in 1940 with Goni Moreno. Others including Koontz and Graves in the 1950s injected 0.5 to 1.5L at the first injection and up to several liters at one sitting until the point of slight respiratory distress. This was done via a needle through the linea semilunaris. No complications were reported in these cases.¹⁴

In summary, it appears that more research needs to be conducted to establish optimal gas agent and safety profiles, duration, frequency, and amount of gas used in preoperative peritoneal pneumoperitoneum for hernia repair. However, the literature reviewed and our particular case suggest that room air is a less costly option than carbon dioxide or nitrous oxide and that the optimal amount of gas varies between patients. In our case, a total of 10,880 cc of room air was used with successful open repair of giant inguinoscrotal hernia and he was discharged the day of surgery. Insufflation was successfully titrated with a maximum amount injected determined by the patient's abdominal discomfort or shoulder pain, providing evidence that each variable can be determined by patient specific tolerance.

Conclusion

Progressive preoperative pneumoperitoneum is a useful technique for the repair of giant inguinoscrotal hernias with loss of domain. Our case demonstrates that using room air appears to be a viable less costly option. Variable duration, volumes, and gas agent have been successful in the literature and more research is needed to determine optimization and safety profiles of each. However, it appears titrating these variables based on clinical exam is effective.

Lessons Learned

Our case demonstrated progressive preoperative pneumoperitoneum using room air with volumes determined by patient discomfort is a viable less costly option for the repair of giant inguinoscrotal hernias with loss of domain.

References

1. Elstner KE, Read JW, Rodriguez-Acevedo O, Ho-Shon K, Magnussen J, Ibrahim N. Preoperative progressive pneumoperitoneum complementing chemical component relaxation in complex ventral hernia repair. *Surg Endosc.* 31(4):1914-1922.
2. Alam NN, Narang SK, Pathak S, Daniels IR, Smart NJ. Methods of abdominal wall expansion for repair of incisional hernia: a systematic review. *Hernia.* 2016 Apr; 20(2): 191-9.
3. Mayagoitia JC, Suárez D, Arenas JC, Díaz de León V. Preoperative progressive pneumoperitoneum in patients with abdominal-wall hernias. *Hernia.* 2006;10:213-217.
4. Dumont F, Fuks D, Verhaeghe P, Brehant O, Sabbagh C, Riboulot M, Yzet T, Regimbeau JM. Progressive pneumoperitoneum increased the length of abdominal muscles. *Hernia.* 2009 Apr; 13(2): 183-7.
5. Piskin T, Cemalettin A, Barut B, Dirican A, Kayaalp C. Preoperative progressive pneumoperitoneum for giant inguinal hernias. *Ann Saudi Med.* 2010 Jul-Aug; 30(4):317-320.
6. Willis S, Schumpelick. Use of progressive pneumoperitoneum in the repair of giant hernias. *Hernia.* 2000 Jun; 4(2): 105-111.
7. Caldironi MW, Romano M, Bozza F, Pluchinotta AM, Pelizzo MR, Toniato A, Ranzato R. Progressive pneumoperitoneum in the management of giant incisional hernias: a study of 41 patients. *Br J Surg.* 1990 Mar; 77(3): 306-7.
8. Vasiliadis K, Knaebel HP, Djakovic N, Nyarangi-Dix J, Schmidt J, Buchler M. Challenging surgical management of a giant inguinoscrotal hernia: report of a challenging case. *Surg Today.* 2010 Jul; 40(7):684-7.
9. Karthikeyan VS, Sistla SC, Ram D, Ali SM, Rajkumar N. Giant inguinoscrotal hernia – report of a rare case with literature review. *Int Surg.* 2014 Sep; 99(5): 560-564.
10. Cochrane Database of Systematic Reviews: Plain Language Summaries. Different gases for insufflation of the abdominal cavity during key-hole abdominal surgery. Sept 14, 2016.
11. Niedzielski A, Gizewski J, Staraczewski A, Rozewski S. Nineteen years of laparoscopy in the gynecology clinic IPG-PAM. *Ginekol Pol.* 1992;63:596-599.
12. Menes T, Spivak H. Laparoscopy: searching for the proper insufflation gas. *Surg Endosc.* 2000 Nov; 14(11): 1050-60.
13. Ott DE. Subcutaneous Emphysema – beyond the pneumoperitoneum. *JSLs.* 2014 Jan; 18(1):1-7.
14. Rhee HY, Kim DH, Kwak YT, Lee JW, Kim SH. Cerebral Air Embolism as a Result of Inducing Pneumoperitoneum after Bilobectomy. *Ann Thoracic Surg.* 2011 Jan; 91(1):293-295.
15. Koontz AR, Graves JW. Preoperative pneumoperitoneum as an aid in the handling of gigantic hernias. *Ann Surg.* 1954;140:759-762.