7. Ghosal S, Chauhan RRPS, Mehta R. Alkaloids of *Sida cordifolia*. Phytother Chem 1975; 14:830-2.
8. Gunatilaka AAL, Sotheeswaran S, Balasubramanian S, Chandrasekara AI, Sriyani HTB. Studies on medicinal plants of Sri Lanka. Planta Med 1980; 39:66-72.
9. Kanth VR, Diwan PV. Analgesic, antiinflammatory and hypoglycaemic activities of *Sida cordifolia*. Phytother Res 1999; 13:75-7.
10. Malan K, Pelissier Y, Marion C, Blaise A, Bessiere JM. The essential oil of *Hyptis pectinata*. Planta Med 1988; 54(6):531-2.
11. Rojas A, Hernandez L, Pereda-Miranda R, Mata R. Screening for antimicrobial activity of crude drug extracts and pure natural products from Mexican medicinal plants. J Ethnopharmacol 1992; 35:275-83.
12. Bispo MD, Mourão RHV, Franzotti EM, Bomfim KBR, Arrigoni-Blank MF, Moreno MPN, Marchioro M, Antoniolli AR. Antinociceptive and antiedematogenic effects of the aqueous extract of *Hyptis pectinata* leaves in experimental animals. J Ethnopharmacol 2001; 76:81-6.
13. Melo CA, Lima AL, Brasil IR, Castro-e-Silva O Jr, Magalhaes DV, Marcassa LG, Bagnato VS. Characterization of light penetration in rat tissues. J Clin Laser Med Surg 2001; 19:175-9.
14. Castro-e-Silva O Jr, Zucoloto S, Ramalho FS, Ramalho LN, Reis JMC, Bastos AAC. Anti-proliferative activity of Copaifera duckei oleoresin on liver regeneration in rats. Phytother Res 2003, in press.
15. Castro-e-Silva O Jr, Zucoloto S, Marcassa LG, Marcassa J, Kurachi C, Melo CA, Ramalho FS, Ramalho LN, Bagnato VS. Spectral response for laser enhancement in hepatic regeneration for hepatectomized rats. Lasers Surg Med 2003; 32:50-3.
16. Castro-e-Silva T, Ramalho FS, Castro-e-Silva O Jr, Ramalho LNZ, Zucoloto S, Marcassa LG, Bagnato VS. Led light–device for enhacement in mitochondrial function and liver regeneration for partially hepatectomized rats. J Clin Laser Med Surg 2003, in press.
17. Morimoto Y, Arai T, Kikuchi M, Nakajima S, Nakamura H. Effect of low-intensity argon laser irradiation on mitochondrial respiration. Lasers Surg Med 1994; 15:191-9.
18. Krasnikov BF, Zorova DB. Stimulation of mitochondrial respiration, induced by laser irradiation in the presence of rhodamine dyes. Biokhimiia 1996; 61(10):1793-9.
19. Kato M, Shinizawa S, Yoshikawa S. Cytochrome oxidase is a possible photoreceptor in mitochondria. Photo-biochem Photobiophys 1981; 2:263-9.
20. Passarella S, Ostuni A, Atlante E, Quagliariello E. Increase in the ADP/ATP exchange in rat liver mitochondria irradiated in vitro by helium-neon laser. Biochem Biophys Res Commun 1988; 156(2):978-86.
21. Karu T. Photobiology of low-power laser effects. Health Phys 1989; 56(5):691-704.
22. Stephenson RP. A modification of receptor theory. Brit J Pharmacol 1956; 11:379-93.
23. Castro-e-Silva O Jr, Zucoloto S, Menegazzo LA, Granato RG, Marcassa LG, Bagnato VS. Laser enhancement in hepatic regeneration for partially hepatectomized rats. Lasers Surg Med 2001; 29:73-77.
24. Bucher NLR, Swaffield MN. Rate of incorporation of labeled thymidine into deoxyribonucleic acid of regenerating rat liver in relation to amount of liver excised. Cancer Res 1964; 24:1611-25.
25. Castro-e-Silva Jr O, Ceneviva R, Ferreira AL, Foss MC, Delucca FL. Liver trophism in dogs made diabetic by total pancreatectomy or alloxan administration. Braz J Med Biol Res 1987; 20:269-76.
26. Janssens D, Delaive E, Houbion A, Eliaers F, Remacle J, Michiels C. Effect of venotropic drugs on the respiratory activity of isolated mitochondria and in endothelial cells. Brit J Pharmacol 2000; 130:1513-24.
27. Janssens D, Remacle J, Drieu K, Michiels C. Protection of mitochondrial respiration activity by bilobalide. Biochem Pharmacol 1999; 58:109-119.
28. Jennings R, Ganote C. Mitochondrial structure and function in myocardial ischemia. Circul Res 1976; 38:80-91.
29. Trump B, Mergner W, Kahng M, Salandino A. Studies on the subcellular pathophysiology of ischemia. Circulation 1976; 53:17-26.
30. Duan J, Karmazym M. Relationship between oxidative phosphorilation and adenine nucleotide translocase activity of two populations of cardiac mitochondria and mechanical recovery of ischemic hearts following reperfusion. Can J Physiol Pharmacol 1989; 67:704-9.

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Conflitos de Interesse- nenhum.

Apoio FAPESPeCNPq

4 – ARTIGO ORIGINAL

Is CO2 gas unsufflator necessary for laparoscopic training in animals?[1]

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Tiraboshi RB, Domingos ALA, Dias-Neto JA, Paschoal RM, Travassos J, Martins ACP, Suaid HJ, Cologna AJ, Tucci Jr S. Is CO2 gas insufflator necessary for laparoscopic training in animals? Acta Cir Bras [serial online] 2003 vol 18 suppl 5. Available in www.scielo.br/acb.

ABSTRACT – Objective – To verify the efficacy and safety of compressed air to produce pneumoperitoneum for laparoscopic surgery in pigs for a training program of residence. **Methods -** Dalland pigs weighing 15-17kg underwent general anethesia and mechanical ventilation. They were divided in 3 groups: A – (38) the pneumoperitnoneum was established with an automatic CO_2 insufflator, B – (7) as in A except the CO_2 gas was changed by compressed air, and C – (11) abdomen insufflation was obtained with compressed air directly from hospital pipe network system. Intra-abdominal pressure in all groups was kept between 12 and 15 mmHg. The laparoscopic procedures performed were distributed proportionally among groups: 20 bilateral nephrectomy, 20 dismembered pyeloplasty and 16 partial nephrectomy. Arterial blood sampling for gasometry was obtained before and 2h after establishment of pneumoperitoneum in 5 pigs of group C. **Results –** The cost of 25 4,5kg CO_2 container used in group A was R$ 3,150.00 (U$ 1,050.00). The mean length time of surgeries in groups A, B and C were respectively: 181±30min, 196±39min e 210±47min ($p>0.05$). Respiratory alkalosis occurred in 3 out of 5 pigs of group C. No animal exhibited signs of gas embolism or died during surgery. **Conclusion –** The use of compressed air for laparoscopy in pigs was safe, reduced costs and did not require the use of an automatic gas insufflator.

KEY WORDS – Laparoscopy. Nephrectomy. Pyeloplasty. Partial nephrectomy. Pneumoperitoneum. CO_2 gas. Compressed air.

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INTRODUCTION

Kelling reported the observation of the abdominal cavity of dogs and humans through an air-filled abdomen for the first time in 1,902[1]. This procedure named "coelioscopy" became a routine in humans in 1,914[2]. To reduce the risk of a blind puncture of the abdomen, Goetze developed an automatic needle in 1,918 and reported as ideal the practice of initially establishing a pneumoperitoneum using oxygen[3]. Since the development of the first automatic CO_2 gas insufflator, in 1,966[4,5], the practice of creating and maintaining the pneumperitoneum was universally adopted using such a device. The method of animals' abdomen insufflation with CO_2 gas under physiological control in hands on laparoscopic training courses, or residency programs are now a standard procedure.

Considering the costs of maintenance of the automatic insufflator, the CO_2 gas and the machine electric energy consume as well as the historic reference of air use for abdomen insufflation, it is worthwhile to try a cheaper method of abdominal insufflation by using compressed air in training programs. The aim of this study is to test the safety of air-compressed to establish pneumoperitoneum in our training program of laparoscopy.

METHODS

From February to September of 2,003, 52 Dalland pigs weighting 15-17kg (40-45 days of age) were used in the Urology laparoscopic residence-training program in the Laboratory of Experimental Surgery of the Hospital das Clínicas – FMRP-USP.

All animals received Ketamine (20mg/kg) as premedication and were submitted to general anesthesia induced with intravenous Thionembutal (40mg/kg) followed by endotracheal intubation, and mechanical controlled ventilation (Takaoka™ device) with 100% O_2. Maintenance of anesthesia was accomplished through additional doses of Thionembutal as required. During the laparoscopic surgery hydration was carried out with intravenous physiologic saline at a speed of 4ml/kg/h.

The pigs were divided in 3 groups at random. In the group A with 38 animals pneumoperitoneum was established and maintained by an automatic CO_2 gas insufflator (Astus™). In group B of 7 pigs, abdomen insufflation was performed as in group A but the CO_2 gas was changed by air from the hospital network pipe of the central compressed air system. The pneumoperitoneum, in group C of 11 pigs, was produced directly with compressed air as in group B however without the use of the automatic insufflator. In all groups intra-abdominal pressure during laparoscopy was kept between 12 and 14mmHg. In groups A and B the pressure control was achieved by adjusting gas pressure and flow through the automatic insufflator. In group C air pressure was monitored through a manometer connected to the compressed air tubing system, and the pressure control was achieved by adjusting manually the valve opening of such system. All laparoscopic surgeries were performed with a Storz™ equipment.

The following procedures were performed: 20 bilateral total nephrectomy (A – 14; B – 3; C – 3); 20 bilateral dismembered pyeloplasty (A – 15; B – 3; C – 2); and 16 bilateral partial nephrectomy (A – 8; B – 4; C – 4).

The surgical time was registered for each animal. The number of CO_2 gas containers consumed to operate on 38 pigs of group A was registered.

In 5 pigs of group C arterial blood sampling for gasometry was obtained before and 2h after establishing the pneumoperitoneum.

At the end of the surgery all pigs were sacrificed by a lethal intravenous injection of 10ml of sulfur ether.

The comparison of operating time among groups was performed by using the unpaired t test (Graphpad Prism, version 3.0). The level of significance was established as <5%.

RESULTS

No death or adverse effect was observed during the surgery in any animal.

The operating time in each group was A – 181±30min, B – 196±39min and C - 210±47min ($p>0.05$).

The number of 4,5kg CO_2 gas containers consumed in 38 pigs of group A was 25 with a cost of U$ 1,050.00. The air flow required to keep pneumoperitoneum in group C was 5-7L/minute.

The results of gasometry are shown in Table 1.

Animals	Before*				After*			
	pH	pCO_2 mmHg	HCO_3 mEq/l	BE mEq/l	pH	pCO^2 mmHg	HCO_3 mEq/l	BE mEq/l
C1	7.48	33.4	24.3	1.5	7.61	26.0	25.5	5.4
C2	7.42	44.2	28.5	3.5	7.36	39.1	21.9	-3.1
C3	7.45	39.6	27	3.0	7.38	51.6	29.8	3.5
C4	7.56	30.9	27.5	6.0	7.64	23.9	25.4	6.1
C5	7.38	43.9	25.7	0.4	7.61	30.5	30.0	8.9

* Before and after pneumoperitoneum; BE – base excess.

DISCUSSION

Although at least 5 different gases or mixture of gases have been used to perform pneumoperitoneum, carbon dioxide is used almost exclusively. Such a gas is rapidly absorbed and excreted and does not support combustion. It is the most soluble in blood of all agents used for abdomen insufflation and is safer than oxygen, air and nitrous oxide (N_2O) in preventing gas embolism[6,7]. However, there is no general agreement on the subject[8,9]. The absorpsion of CO_2 into the blood

contributes to hypercarbia, acidosis, and its tension is raised about 8mmHg in patients undergoing laparoscopy procedures with CO_2 pneumoperitoneum when compared with patients with N_2O insuflation[10]. Hypercarbia contributes to hypertension, tachycardia, cardiac arrhythmias, vasodilatation and myocardial depression. Patients breathing spontaneously with halothane-N_2O-oxygen anesthesia react by increasing their respiratory rate despite a reduction in tidal volume, but hypoxia, respiratory and metabolic acidosis may result[11,12]. It is well known that pneumoperitoneum reduces respiratory compliance and diaphragmatic movement[11], so it is generally recommended that respiratory and acid-base homeostasis be maintained with mild hyperventilation under general anesthesia and use of endotracheal intubation[12,13]. In contrast with CO_2 pneumoperitoneum, laparoscopy using abdomen wall retractor is not associated with hemodynamics or gas exchange[14].

In dry atmospheric air at a barometric pressure of 760mmHg the partial pressures of the main constituent gases would be pO_2= 158mmHg, pCO_2= 0,3mmHg and pN_2= 600mmHg[15]. Thus, abdomen insufflation with atmospheric air is supposed to offer a lower risk of producing hypercarbia or acidosis due to CO_2 absorption inasmuch as venous blood pCO_2 in physiologic conditions is 40mmHg[15]. As a matter of fact our results show that 3 out of 5 pigs with air-filled abdomen developed mild respiratory alkalosis instead of acidosis, possibly due to mechanical controlled hyperventilation.

Central venous blood pressure is nearly 1.4mmHg. As gas pressure required to obtain a good abdomen distension to facilitate laparoscopic procedures is 12-14mmHg the risk of embolism is overwhelming. Besides the gas diffusion through tissues, the main risk seems to be its direct entrance into opened veins since the gas pressure in the abdomen is higher than blood venous pressure. During laparoscopic surgery sometimes the surgeon sees small gas bubbles entering the venous system through the overture of opened veins. Prophylaxis of gas embolism requires a rapid, safe and secure hemostasis as well as to lower as much as possible the intra-abdominal pressure during surgery. The third step in preventing gas embolism would be to choose the most soluble gas in blood which is CO_2. Our data, however, show that compressed air is safe enough to perform videolaparoscopy in training programs in pigs. No animal exhibited signs of gas embolism.

CONCLUSION

The use of compressed air for laparoscopy in pigs was safe, reduced costs and did not require the use of an automatic gas insufflator.

REFERENCES

1. Kelling G. Ueber die Oesophagoscopie, Gastroskoppie und Caoelioskopie. Muench Med Wochenschr 1902; 49:21-4.
2. Jacobaeus HC. Konnen durch die durch die Laparoskopie Indikationen zu chiruugischen Eingriffen gewonnen werden? Nord Med Ark 1914; 14:1-5.
3. Goetze O. Die Rontgendiagnostik bet bei gasgefullter Bauchhohle. Eine neue methode. Muench Med Wochenschr 1918; 65:1275-9.
4. Eisenburg J. Ueber eine Apparatur zur schonenden und kontrollierbaren Gasfullung der Bauchhohle fur die Laparoskopie. Klin Wochenschr 1966; 44:593-7.
5. Semm K. Das Pneumoperitoneum mit CO2. Visum 1967; 6:1-4.
6. Scott DB. Some effects of peritoneal insufflation of carbon dioxide at laparoscopy. Anesthesia 1970; 25:590-5.
7. Graff TD, Arbegast NR, Phillips OC, Harris LC, Frazier TM. Gas embolism: a comparative study of air and carbon dioxide as embolic agents in the systemic venous system. Am J Obstet Gynecol 1959; 78:259-63.
8. O´Boyle CJ, deBeaux AC, Watson DI, Ackrovd R, Luffarde T, Leong JY, Williams JA, Jamieson GG. Helium vs carbon dioxide insufflation with or without saline lavage during laparoscopy. Surg Endosc 2002; 16:620-5.
9. Tsereteli Z, Terry ML, Bowsers SP, Spivak H, Archer SB, Galloway KD, Hunter JG. Prospective rendomized clinical trial comparing nitrous oxide and carbon dioxide pneumoperitoneum for laparoscopic surgery. J Am Coll Surg 2002; 195:173-9.
10. Alexander GD, Noe FE, Brown EM. Anesthesia for pelvic laparoscopy. Anesth Analg 1969; 48:14-8.
11. Lewis DG, Ryder W, Burn N, Wheldon JT, Tacchi D. Laparoscopy – an investigation during spontaneous ventilation with halothane, Br J Anesth 1972; 44:685-9.
12. Seed RF, Shakespeare TF, Muldoon MJ. Carbon dioxide homeostasis during anesthesia for laparoscopy. Anaesthesia 1970; 25:223-8.
13. Magno R, Medegard A, Bengtsson R, Tronstad SE. Acid-base balance during laparoscopy. Acta Obstet Gynecol Scand 1979; 58:81-6.
14. Rademaker BM, Meyer DW, Bannenberg JJ, Klopper PJ, Kalkman CJ. Laparoscopy without pneumoperitoneum. Effects of abdominal wall retraction versus carbon dioxide insufflation on hemodynamics and gas exchange in pigs. Surg Endosc 1999; 9:797-801.
15. Cantarow A, Trumper M. Clinical Biochemistry, 6th Ed., WB Saunder, Philadelphia, 1962, p. 776.

Tiraboshi RB, Domingos ALA, Dias-Neto JA, Paschoal RM, Travassos J, Martins ACP, Suaid HJ, Cologna AJ, Tucci Jr S. O insuflador de gás CO2 é necessário para treino de laparoscopia em animais?Acta Cir Bras [serial online] 2003 vol 18 suppl 5. Disponível em www.scielo.br/acb.

RESUMO – Objetivo – Testar a eficácia e segurança do pneumoperitônio com ar comprimido para cirurgias videolaparoscópicas em porcos em treinamento de residência médica. **Métodos –** Porcos da raça Dalland de peso variável de 15 a 17kg foram submetidos a anestesia geral e respiração controlada. Eles foram divididos em 3 grupos: A – 38 animais com pneumoperitônio feito com insuflador automático de CO_2 usando este gás; B – 7 animais sujeitos ao mesmo procedimento exceto que o CO_2 foi substituído por ar comprimido; e, C – 11 animais em que o pneumoperitônio foi feito com ar comprimido diretamente da rede hospitalar. Nos 3 grupos a pressão intra-abdominal foi mantida entre 12 e 14mmHg. Os procedimentos realizados foram distribuídos proporcionalmente nos 3 grupos: nefrectomia bilateral – 20, pieloplastia desmembrada – 20 e nefrectomia parcial – 16. Antes e 2h após o pneumoperitônio foi colhido sangue arterial para gasometria em 5 porcos do grupo C. **Resultados –** Foram consumidos 25 torpedos de 4,5kg de CO_2 a um custo total de R$ 3.150,00 no grupo A. A duração média da cirurgia nos grupos A, B e C foram respectivamente: 181±30min, 196±39min e 210±47min (p>0.05). Alcalose respiratória foi observada em 3/5 porcos testados do grupo C. Nenhum animal apresentou sinais de embolia gasosa ou faleceu durante o procedimento. **Conclusão -** O uso de ar comprimido para laparoscopias em porcos mostrou-se método seguro com redução de custos e tornou desnecessário o uso de insuflador automático.

DESCRITORES – Laparoscopia. Nefrectomia. Pieloplastia. Nefrectomia. Parcial. Pneumoperitônio. CO_2. Ar comprimido.

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5 – ARTIGO ORIGINAL

Study of corpus callosum in experimental hydrocephalic wistar rats[1]

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Lopes LS, Machado HR, Lachat J-J. Study of corpus callosum in experimental hydrocephalic wistar rats. Acta Cir Bras [serial online] 2003 vol 18 suppl 5. Avaliable in www.scielo.br/acb

ABSTRACT – Purpose: Hydrocephalus causes countless cerebral damages, especially on the structures around the ventricles. Hydrocephalic children present deficiencies in the nonverbal skills more than in the verbal skills, and not always revertible with an early treatment. As the corpus callosum has an important role in the nonverbal acquisition it is possible that the injuries in this structure are responsible for the cognitive dysfunctions of these children. This present study tries to establish the alterations caused by hydrocephalus on the corpus callosum of developing Wistar rats, induced by intracisternal injection of kaolin. **Methods:** Seven, fourteen and twenty one days after the injection, the animals were killed, and the corpus callosum was dissected and prepared for the study of the axonal fibers. **Results and Conclusion:** The seven-day old rats in hydrocephalus development presented a delay in myelination in relation to the control rats. With the fourteen-day old rats in hydrocephalus development the corpus callosum showed a recovery of myelin, but with the twenty one-day old rats in hydrocephalus development the axonal fibers were damaged and reduced in number.

KEY WORDS: Corpus callosum, Hydrocephalus, Myelin, Wistar rat, Development.

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