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COMPARING THE FLOW RATE REQUIRED TO MAINTAIN NORMOCARBIA USING BAIN'S CIRCUIT IN LAPAROSCOPIC SURGERY BEFORE AND AFTER INITIATING PNEUMO PERITONEUM.

Anaesthesiology

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ABSTRACT

Background: Familiarity with Bain's circuit and flow rate requirements is helpful in emergency situations.
AIM: To study the flow rate and respiratory rate requirements before and during pneumoperitoneum.
Design: prospective randomised study done in a tertiary care setting.
Methods: 30 patients undergoing different laparoscopic surgeries were with bains circuit with flow rate and respiratory rate adjusted to maintain narmocarbia.Statistical analysis : we assume the flow rate and respiratory rate will be the same before and during pneumoperitoneum considering null hypothesis.As the respiratory parameters need to changed to maintain normocarbia during pneumoperitoneum Null hypothesis is rejected.
Results: We have to increase the fresh gas flow rate from 80 ml to 110 ml/kg during pneumoperitoneum and respiratory rate from 12 to 14 to maintain normocarbia with Bain's circuit in laparoscopic surgery.

KEYWORDS

Laparoscopic surgery,Bain's circuit, Flow rate, respiratory rate,normocarbia.

INTRODUCTION

Among the breathing circuits without Carbon Dioxide absorption, Bain's circuit is the best for general anaesthesia with controlled ventilation. The Fresh gas flow rate required to maintain normocarbia during general anaesthesia is recommended as 70ml to 100 ml per kg/min with a tidal volume of 10 ml/kg and respiratory rate of 12 to 14 /min by Bain, spoerel and Aitken.

But laparoscopy is unique in that during the initial period before initiating pneumoperitoneum the fresh gas flow rate , frequency and tidal volume set to achieve normocarbia is complicated after initiating pneumoperitoneum with CO_2 insufflation

Aim of this study is to find out whether the initial flow rate and respiratory rate is enough for maintaining normocarbia during pneumoperitoneum. For the study we assume that the initial flow rate and respiratory rate will be adequate throughout the surgery thus assuming null hypothesis.

MATERIALS AND METHODS

Patients belonging to ASA physical status 1 and 2 were taken up for the study. After Ethical Committee approval and getting consent 30 patients between age groups 16 to 60 were included in the study.Exclusion criteria includes ASA Physical Status 3 and above, BMI 30 and above, COPD patients, smokers and heart disease patients. In this study we have included 30 patients undergoing laparascopic surgery for cholecystitis , appendicitis and ovarian cyst.All patients were premedicated with glycopyrolate and midazolam. Fentanyl for analgesia and Propofol for induction. After intubation all patients were connected to Bain's circuit and ventilated with a FGF of 70ml/kg and respiratory rate of 12/min with a standard tidal volume of 10ml/kg. With this parameters we were able to maintain normocarbia around baseline value till the initiation of pneumoperitoneum. The time to initiate pneumoperitoneum varies between less than 20 min to more than 40 min in few cases. For pneumoperitoneum pressure limit of 12mmhg and flow rate of 8 litres were set as standard for all cases.

In all the cases we were able to maintain inspired CO_2 absorption at 0 with the flow rate and respiratory rate. But the etco2 rises gradually within 5min of onset of pneumoperitoneum . We increased the flow rate to 90ml/kg once the $ETCO_2$ level rises more than 10% of baseline value. After increasing the flow rate as the $ETCO_2$ continues to rise we tried to increase respiratory rate.Increasing respiratory rate results in inspired CO_2 rising more than 2-3. So we increased the flow rate to 100ml/kg and the respiratory rate to 14/min. With this parameters we were able to maintain normocarbia with 2 to 3 mmHg inspired CO_2. So we increased the flowrate to 110ml/kg .With this flow rate we were able to maintain normocarbia with inspired CO_2 of 0.

As each patient acts as a control and test before and after initiating pneumoperitoneum, the need to analyse the demographic profile does not arise.

OBSERVATION AND RESULTS

Out of 30 patients 26 were female and 4 patients were male. Among surgeries 7 were laparoscopic appendicectomy and 7 were laparoscopic ovarian cystectomy and 16 were laparoscopic cholecystectomy. Body mass index of the patients range from 20 to 29.9. 7 patients were in the normal BMI range of 18.5 to 24.9. 23 patients were in the overweight range 25 to 29.9. We have excluded obese patients.

Minute ventilation used before pneumoperitoneum is 10ml/kg and 12 respiratory rate.

So for a 50 kg patient the minute ventilation is 6 litres / min. FGF rate is 70ml/kg. For 50 kg it is 3.5 litres per minute. FGF/MV is 3.5/6 which is 0.58.

During pneumoperitoneum with a tidal volume of 10 ml and RR of 14/min MV becomes 7 litres. FGF of 110ml/kg makes 5.5 litres for a 50kg patient. So FGF/MV is 5.5/7 is 0.78.

Age group of the patients – Table - I

Age less than 20 years	5 cases
20 to 30 years	8 cases
30 to 40 years	9 cases
40 to 50 years	4 cases
More than 50 years	4 cases

Time to Initiate pneumoperitoneum - Table II.

Less than 20 min	2 cases
20 to 30 min	8 cases
30 to 40 min	14
More than 40 min	6 cases

In all cases we were able to maintain normocarbia with a flow rate of 70ml/kg and respiratory rate of 12/min before pneumoperitoneum irrespective of the time to establish pneumoperitoneum. After creating pneumoperitoneum we were able to maintain normocarbia after increasing the flow rate to110ml/kg and respiratory rate of 14/min.
All the patients were extubated on the table and there was no delayed recovery.

DISCUSSION

Bain's circuit is the best among circuits without CO_2 absorption for

General anaesthesia with controlled ventilation. It is the most economical circuit. Nowadays it is mostly used for anaesthesia in remote locations, MRI suite and in minor operation theatres where circle absorbtion system is not available. With in the operating room it is used when there is a leak in the circle absorbtion system or when you need to change the exhausted sodalime.

As it is used less frequently, the confidence in using Bain's circuit by young anaesthesiologist is low. FGF of 70ml/kg and FGF/MV ratio 0.5 to 0.6 is recommended to avoid hypercapnia during controlled ventilation. But fgf/mv ratio of 0.5 to0.6 is not adequate for laparoscopic surgery. We need to maintain a ratio of 0.75 to 0.8 as shown in our results to maintain normocarbia in laparoscopic surgery. So if we use Bain's circuit with controlled ventilation for laparoscopic surgeries, we have to use a flow rate of 110ml/kg and respiratory rate of 14/min to maintain normocarbia. Even if the $ETCO_2$ monitors fails during the surgery we can be confidently maintain normocarbia with this respiratory parameters.

CONCLUSION

Nowadays all the laparoscopic surgery patients are ventilated with circle absorption system with $ETCO_2$ absorption. The confidence of young anaesthesiologist for using bain's circuit is less as they use it rarely. With increasing number of surgeries being done by laparoscopic method, situation may arise to use Bain's circuit in the middle of the surgery like exhausted sodalime, leaking circuit and stuck unidirectional valve. Guidelines given by Bain and Spoerelfor controlled respiration is 70 ml/kg and respiratory rate of 12 to 14 to achieve normocarbia for non laparoscopicsurgery. For Laparoscopic surgeries we need to keep a flow rate of 100 to 110ml/kg with respiratory rate of 14/min to maintain normocarbia.

Limitations

We did not use ABG during or after surgery to substantiate our study as it becomes invasive. We planned to take ABG for cases with delayed recovery. As all the cases recovered immediately we didnot check ABG in anyof the patient. During recovery we need to increase the flow rate to 200ml/kg or switch to closed circuit as Bain's circuit is not efficient in spontaneous respiration.

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