Deep neuromuscular blockade versus remifentanyl or sevoflurane to augment measurable laparoscopic workspace during bariatric surgery

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Background:

It is unclear whether anesthetics, deep neuromuscular blockade (NMB), or high-dose opioids increase laparoscopic workspace. We were able to objectively gauge the laparoscopic workspace, using abdominal compliance (C) and pressure at zero volume (PV0) calculated from a 3-point measurement of the abdominal pressure-volume relationship.(1)

Methods:

This study was approved by our institutional ethics committee. Upon granting written informed consent, a total of 50 patients >18 years old who elected laparoscopic gastric bypass surgery were enrolled. Anesthesia was induced by administering propofol (3 mg/kg IBW), ketamine (0.25 mg/kg IBW), dexmedetomidine (1 ug/kg IBW as 15-min loading dose), lidocaine (1.5 mg/kg IBW), and succinylcholine (1 mg/kg total body weight). For maintenance anesthesia, propofol (5-10 mg/kg IBW/h), lidocaine (0.75-2.25 mg/kg IBW/h), dexmedetomidine (0.5-1.4 ug/kg IBW/h), and ketamine (0.125-0.375 mg/kg IBW/h) were infused and all adapted according to BIS value (kept around 40) and hemodynamic parameters (HR kept below 100 and SAP below 140 mmHg).

After insufflating the abdomen, the first trocar was placed and its position verified, and the stomach was visually confirmed as emptied (by gastric tube). The first APVR measurement was taken by the surgeon as follows: All air was expelled from the abdomen by manual pressure and rotation of the open trocar. The abdomen was then re-inflated incrementally to 0.5, 1.0, and 1.5 liters of intra-abdominal volume (IAV); and at each point, the intra-abdominal pressure (IAP) was measured, with inflation stopped for a short moment. The lowest IAP during an insufflation stop is the end expiration pressure. (maximum, 15 mm Hg). The abdominal end expiration pressure-volume data were fit using a linear least squares regression, where the slope is abdominal elastance (E), the intercept is the abdominal pressure at zero volume (PV0), and the predicted inflated volume at 15 mmHg is (15-PV0)/E. (Mulier 2009)

Following APVR determination, patients in group A received a bolus of remifentanyl (2 µg/kg IBW), followed by remifentanyl infusion (10-50 ug/kg IBW/h). Propofol and dexmedetomidine were also infused, but dosages were adjusted after further APVR determinations.

Members of Group B each received sevoflurane inhalation in N₂/O₂ via fresh gas flush of the ventilator (using end-tidal control function) until end-tidal concentration reached 1 MAC, and the propofol infusion was stopped.

A bolus dose of rocuronium (1 mg/kg IBW) was given to each member of Group C, while propofol and dexmedetomidine infusion was continued.

After 5 min, APVR was measured again by the same method.

After the second APVR measurement the insufflator was set at 15 mmHg, the IAV was calculated and the surgeon continued the laparoscopy. He was polled to determine if more working space was needed for full operative access and if muscle movements took place and disturbed his work. The objective measured IAV above which never a complaint of insufficient workspace was given is determined as the minimum required IAV. The objective measured IAV below which there is always a complaint of insufficient workspace is determined as the IAV that should always be avoided.

Results: Minimum workspace required at 15 mmHg:

- Insufficient workspace when IAV: 0 - 3.11 liters (2.07±1.01),
- Sufficient workspace when IAV: 2.58 - 8.5 liters (4.58±1.21).
- The minimum IAV = 3.11 liters and always avoid < 2.58 liters.

Results and Discussion:

Table 1: Demographics of the three treatment groups

Mean +/- SD	A/Remifentanyl	B/Sevoflurane	C/Rocuronium	D/excluded	p value
Age	40.67 (7.33)	36.50 (8.40)	38.93 (5.54)	40,13 (11.94)	p>0,05
Man/woman	4/9	4/10	4/11	2/6	p>0,05
Gravidity	1.63 (0.98)	1.44 (1.07)	1.00 (0.83)	0.67 (0.93)	p>0,05
Length	168 (8)	171 (12)	170 (9.0)	167.88 (10.23)	p>0,05
Weight	111 (19)	116 (19)	116 (33)	118.63 (11.65)	p>0,05
Weight drop	6.0 (8.32)	3.43 (3.75)	5.98 (6.17)	1.63 (2.50) *	0,014*
BMI	39.14 (5,13)	39.19 (2.74)	39.88 (7.10)	42.22 (4.32)	p>0,05

*Kolmogorov-Smirnov

Table 2: Muscle movements after receiving the test drugs. Insufficient workspace following the second APVR, with IAP at 15 mmHg.

Group	lap possible	insufficient space	movements
Failure to insufflate (8)	0	not measurable	8
A: Remifentanyl (12)	8 (66%)	4 (roc given)	0
B: Sevoflurane (14)	0 (0%)	6 (roc given)	8 (roc given)
C: Rocuronium (16)	13 (81%)	3 (IAP increase)	0

Table 3: Who had movements, who had appreciably insufficient workspace at an insufflation pressure of 15 mmHg?

Mean (SD)	movements	insufficient workspace	suf space / no movements
Age	44 (14)	53 (18) *	65 (19)
Man/woman	3 / 5	2 / 10	6 / 15
Length	172.75 (12.59)	168.33 (8.37)	169.38 (9.23)
Weight	118.31 (22.58)	117.46 (13.69)	118.83 (30.87)
Weight loss	6.36 (7.2)	7.07 (8.1)	3.32 (3.7)
BMI	39.37 (3.61)	38.87 (2.88)	39.76 (6.74)
Elastance	2.00 (0.53)	3.77 (1.36) *	2.07 (0.55)
PV0	6.71 (0.84)	8.21 (3.93) *	5.99 (1.15)
Workspace	4.45 (1.45)	2.07 (1.01) *	4.58 (1.21)

Table 4: Calculated E and PV0, Insufflation volumes achieved at 15 mmHg before and after treatment.

Group mean (SD)	E	*p	PV0	*p	IAV at 15 mmHg	*p
° p	0.453		0.001		0.007	
A: before	2,58 (1,0)		6,50 (1,5)		3,64 (1,21)	
After Remifentanyl	2,50 (0,8)	0.86	6,58 (1,39)	0.59	3,65 (1,14)	0.78
B: before	2,57 (0,76)		7,90 (3,37)		3,11 (1,70)	
After Sevoflurane	2,71 (1,44)	0.91	8,29 (3,60)	0.63	3,22 (2,12)	0.98
C: before	2,66 (1,38)		7,30 (1,16)		3,35 (1,13)	
After Rocuronium	2,53 (1,23)	0.59	5,70 (1,00)	0.001	4,29 (1,64)	0.086

* p < 0.05 Change in value before – after treatment drug in one group Mann-Whitney
° p < 0.05 Change in value between groups two way Anova

Required IPA to achieve 3 l IAV

Conclusions:

- The use of remifentanyl and NMB prevented muscle movements, but only deep NMB reduced PV0 and increased laparoscopic workspace.
- Pre operative weight drop facilitated insufflation without NMB.
- Calculation of E and PV0 helped implement the lowest IAP possible without compromise of laparoscopic workspace.
- At our center, a 3-liter insufflation volume seems minimal for optimal bariatric surgery, although this was unattainable in all the patients studied (despite some exclusions) if restricting insufflation pressure to a maximum of 15 mmHg.

References:

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