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Problem Statement

This study evaluates the usefulness of capnography and transcutaneous carbon dioxide monitoring in bariatric surgery patients at increased risk of postoperative respiratory complications in the PACU.

- Eight percent of bariatric surgery patients experience perioperative respiratory complications [1].
- Respiratory monitoring in the post-anesthesia care unit (PACU) is traditionally accomplished with pulse oximetry, which measures peripheral oxygen saturation (SpO_2).
- However, pulse oximetry has impaired ability to detect hypoventilation when patients are provided supplemental oxygen [2].
- Alternative continuous noninvasive monitoring of arterial carbon dioxide (P_aCO_2) can be done with capnography and transcutaneous sensors.
- Capnography measures end-tidal carbon dioxide ($P_{ET}CO_2$), which approximates P_aCO_2.
- Transcutaneous monitors use electrochemical sensors placed on the skin to measure $P_{TC}CO_2$, which also approximates P_aCO_2

Methods

- IRB-approved written informed consent was obtained from patients aged 18 years or older with body mass index above 30 kg/m^2 undergoing laparoscopic Roux-en-Y gastric bypass surgery.
- Following surgery, patients were monitored in the PACU for vital signs and with capnography and transcutaneous monitors every 5 minutes.
- Capnography: Microstream® Smart CapnoLine® Plus O2 Sampling Line
- Transcutaneous: SenTec monitor
- Primary endpoints included $P_{ET}CO_2$, $P_{TC}CO_2$, peripheral oxygen saturation (SpO_2), respiratory rate, supplemental oxygen, visual analog scale (VAS) pain scores.
- Any adverse respiratory complications were noted e.g. hypoxia, apnea, hypercapnia.
- Data were analyzed at three timepoints: PACU admission, 30 minutes after PACU admission, and at PACU discharge.

Results

- A total of 33 patients were enrolled and monitored. Patient characteristics are below.

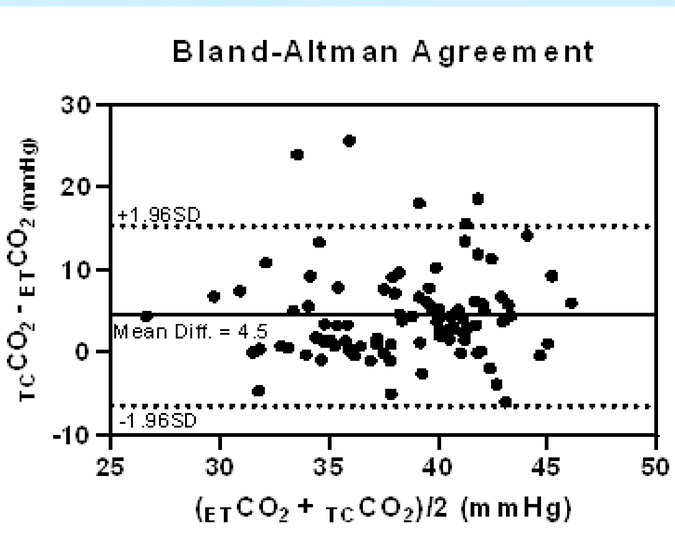
Characteristic	Mean (± SD)
Age (years)	46.0 (±1.6)
Sex	30 females (90.9%) 3 males (9.1%)
Body Mass Index (kg/m^2)	42.3 (±10.9)
Surgery duration (min)	226 (±53.8)
Intraoperative morphine milligram equivalents (MME)	7.2 (±8.2)
Postoperative (PACU) MME	38.2 (±46.4)
PACU stay (min)	137.5 (±54.7)

- Noninvasive P_aCO_2 monitors detected six patients who experienced hypercapnia (PCO_2 > 45 mmHg) while maintaining SpO_2 readings above 94%.

Respiratory Data for 33 Patients (Mean ± SD) During PACU Admission

	$P_{ET}CO_2$ (mmHg)	$P_{TC}CO_2$ (mmHg)	SpO_2 (%)	Patients on Supplemental Oxygen	Respiratory Rate	Pain VAS Scores
PACU Admission	36.7 (±3.7)	41.4 (±5.5)	95.7 (±2.2)	2 of 33	17.9 (±4.7)	2.8 (±3.4)
30 min	35.9 (±4.7)	40.8 (±4.4)	96.1 (±1.9)	4 of 33	18.1 (±4.4)	3.0 (±3.2)
PACU Discharge	35.5 (±5.0)	40.3 (±4.7)	95.7 (±2.1)	12 of 33	17.2 (±4.0)	2.7 (±2.9)
p-value	NS.	NS.	NS.	P<0.05	NS.	NS.

- Average $P_{TC}CO_2$ values were higher than corresponding $P_{ET}CO_2$ measurements by 4.5±5.5 mmHg ($p<0.05$).



Discussion

- Capnography and transcutaneous monitoring have increased sensitivity in detecting early signs of respiratory compromise, compared to pulse oximetry alone.
- Capnography tended to underestimate P_aCO_2 compared to transcutaneous monitors, consistent with the literature.
- Capnography offers rapid breath-by-breath analysis.
- Transcutaneous sensors offer accuracy and patient comfort at the risk of iatrogenic thermal injury and may be affected by poor skin perfusion.
- Limitations: small sample size, single-site data collection, did not measure P_aCO_2 through gold standard arterial blood gas testing.
- Future directions: Use outside PACU, additional types of surgery.
- SELECT Health Systems: Enhance patient safety and improve outcomes after surgery.
- SELECT Leadership: Interprofessionalism in the PACU, new protocols require effective leadership.

Conclusion

- Capnography and transcutaneous monitoring have increased sensitivity when monitoring bariatric surgery patients in the PACU for respiratory complications, compared to pulse oximetry alone.
- Additional research will inform providers on best use of noninvasive P_aCO_2 monitors and in evaluating cost-benefit analysis of these monitors in clinical practice.

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