Hemodynamic stability and recovery outcomes for anesthetic combinations with propofol, midazolam or remimazolam in interventional radiology procedures at a freestanding ambulatory surgery center

Presenter: Joanna Serafin, PhD

Background

- Monitored Anesthesia Care (MAC) in conjunction with proceduralist administered local anesthetic common for outpatient interventional radiology (IR) procedures
- Our outpatient surgery center provides MAC for oncologic IR procedures for diagnosis, treatment, or palliative care
- Anesthetic combinations include propofol, midazolam, and most recently, remimazolam, to provide patient comfort while maintaining hemodynamic stability, rapid recovery, and safety
- **Aim: compare anesthetic combinations to highlight their relative safety**
- **Hypothesis: rates of intraoperative hypotension would vary by intraoperative anesthetic combination**

Methods

- IRB-approved retrospective study
- 1,440 patients underwent MAC for outpatient IR procedures 1/4/2021-7/8/2022 (first procedure included); 254 excluded based on procedure duration > 30 mins, age < 18 years old and less common anesthetic combination
- Most frequent anesthetic combinations evaluated
  1. propofol/midazolam/fentanyl, 2. propofol/fentanyl, 3. propofol only, 4. midazolam/fentanyl, 5. remimazolam/fentanyl
- Primary outcome: intraoperative hypotension (IOH) defined:
  1. systolic blood pressure (SBP) < 90 mmHg,
  2. mean arterial pressure (MAP) < 60 mmHg
- Multivariable two-part model simultaneously quantified the association between anesthetic combinations
  1. IOH event via logistic regression
  2. IOH duration among patients with IOH via linear regression while adjusting for relevant patient and intraoperative factors
- Frequencies of intraoperative bradycardia were compared using Fisher's exact test

Median **intraoperative hypotension** (IOH) **duration** was **highest for midazolam with fentanyl; remimazolam with fentanyl** had **optimal hemodynamic stability** with low IOH rates and least variability in duration

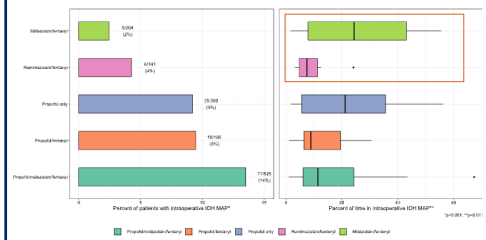

Figure 1. (Left) Proportion of patients who had intraoperative hypotension (IOH) defined as systolic blood pressure (SBP) < 90 mmHg and (right) the duration of hypotension among those who had it as percentage of total time. The total time is approximated as 5 minutes after anesthesia start till post anesthesia care unit entry to account for anesthesia onset and procedure duration. P-values provided are the global p-values for difference in outcomes among anesthetic groups derived from the multivariable two-part model adjusting for age, sex, American Society of Anesthesiologists physical status score and intraoperative vasopressor use (for hypotension duration only)

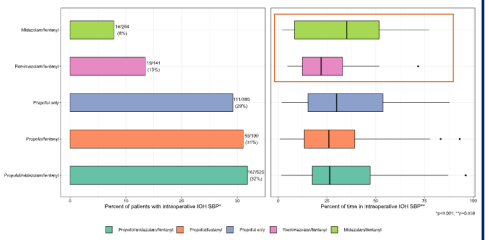

Figure 2. (Left) Proportion of patients who had intraoperative hypotension (IOH) defined as mean arterial pressure (MAP) < 60 mmHg, and (right) the duration of hypotension among those who had it as percentage of total time. The total time is approximated as 5 minutes after anesthesia start till post anesthesia care unit entry to account for anesthesia onset and procedure duration. P-values provided are the global p-values for difference in outcomes among anesthetic groups derived from the multivariable two-part model adjusting for age, sex, American Society of Anesthesiologists physical status score and intraoperative vasopressor use (for hypotension duration only).

Table 2. Descriptive summary of perioperative data at patient level.

Characteristic	Overall, N = 1440[1]	Propofol /midazolam /fentanyl N = 525[1]	Propofol /fentanyl N = 190[1]	Propofol only N =380[1]	Midazolam /fentanyl N = 204[1]	Remimazolam /fentanyl N = 141[1]
Procedure length (minutes)	17.0 (14.0, 21.0)	18.0 (14.0, 22.0)	17.0 (14.0, 21.0)	16.0 (13.0, 19.0)	17.0 (14.0, 22.0)	18.0 (14.0, 22.0)
Intraoperative vasopressors	161 (11%)	78 (15%)	35 (18%)	34 (8.9%)	6 (2.9%)	8 (5.7%)
Time to discharge criteria met (minutes)	18 (11, 34)	18 (11, 35)	19 (12, 34)	18 (11, 30)	19 (12, 45)	16 (11, 28)
PACU LOS (hours)[2]	1.11 (0.88, 1.40)	1.15 (0.88, 1.43)	1.12 (0.92, 1.40)	1.03 (0.85, 1.27)	1.20 (0.90, 2.01)	1.03 (0.85, 1.33)
PACU Antiemetics	12 (0.8%)	5 (1.0%)	2 (1.1%)	3 (0.8%)	1 (0.5%)	1 (0.7%)
Time to awake in PACU (minutes)						
[0-15) minutes	939 (65%)	328 (62%)	122 (65%)	262 (69%)	138 (68%)	89 (63%)
[15-30) minutes	277 (19%)	108 (21%)	39 (21%)	80 (21%)	24 (12%)	26 (18%)
[30-45) minutes	129 (9.0%)	53 (10%)	19 (10%)	28 (7.4%)	12 (5.9%)	17 (12%)
[45-60) minutes	60 (4.2%)	24 (4.6%)	8 (4.2%)	8 (2.1%)	17 (8.4%)	3 (2.1%)
>= 60 minutes	33 (2.3%)	12 (2.3%)	1 (0.5%)	2 (0.5%)	12 (5.9%)	6 (4.3%)
Unknown	2	0	1	0	1	0

[1]n (%), median (IQR); IQR, interquartile range; PACU, post anesthesia care unit; LOS, length of stay

Table 3. Odds ratios and beta estimates with associated 95% confidence intervals from multivariable two-part model for intraoperative hypotension as **defined by systolic blood pressure < 90 mmHg.**

	Part 1: logistic regression on IOH event			Part 2: linear regression on duration of IOH[1]		
Characteristic	OR[2]	95% CI[2]	p-value[3]	β	95% CI[2]	p-value[3]
Intraoperative anesthetics			<0.001			0.038
Propofol/midazolam/fentanyl	—	—		—	—	
Propofol/fentanyl	1.13	0.77, 1.65		1.01	-5.48, 7.51	
Propofol only	0.95	0.71, 1.28		7.22	1.87, 12.57	
Midazolam/fentanyl	0.20	0.11, 0.34		6.37	-5.12, 17.85	
Remimazolam/fentanyl	0.36	0.21, 0.59		-4.71	-14.82, 5.41	
Age	0.99	0.98, 1.00	0.11	-0.37	-0.54, -0.19	<0.001
Sex			0.003			0.2
Female	—	—		—	—	
Male	0.67	0.52, 0.87		-3.13	-8.01, 1.74	
ASA			0.061			0.7
ASA 1-2	—	—		—	—	
ASA 3	0.72	0.52, 1.02		-2.11	-7.90, 3.68	
ASA 4	1.15	0.59, 2.18		0.80	-10.93, 12.53	
Intraoperative vasopressors[4] use				9.12	4.43, 13.80	<0.001

[1]Model fit among 377 patients who had IOH SBP. The duration was estimated via linear interpolation of the longitudinal hemodynamic measurements and scaled by the approximate total duration from 5 minutes after anesthesia start till PACU entry to account for anesthesia onset and procedure duration; [2]OR = Odds Ratio, CI = Confidence Interval, [3]Global p-value presented; [4]The use of intraoperative vasopressors are expected to have been introduced after the first IOH event and thus only included in the 2nd model for IOH duration as an adjusting factor; IOH, intraoperative hypotension, SBP, systolic blood pressure, ASA, American Society of Anesthesiologists physical status score, PACU, post anesthesia care unit

Table 4. Odds ratios and beta estimates with associated 95% confidence intervals from multivariable two-part model for intraoperative hypotension as **defined by mean arterial pressure < 60 mmHg.**

	Part 1: logistic regression on IOH event			Part 2: linear regression on duration of IOH[1]		
Characteristic	OR[2]	95% CI[2]	p-value[3]	β	95% CI[2]	p-value[3]
Intraoperative anesthetics			<0.001			0.011
Propofol/midazolam/fentanyl	—	—		—	—	
Propofol/fentanyl	0.79	0.43, 1.38		-3.67	-11.10, 3.77	
Propofol only	0.68	0.43, 1.06		7.04	1.00, 13.08	
Midazolam/fentanyl	0.19	0.06, 0.43		15.62	0.47, 30.77	
Remimazolam/fentanyl	0.31	0.12, 0.69		-4.76	-16.65, 7.14	
Age	1.00	0.98, 1.01	0.5	-0.11	-0.30, 0.08	0.3
Sex			<0.001			0.5
Female	—	—		—	—	
Male	0.40	0.25, 0.61		2.27	-4.01, 8.56	
ASA			0.3			0.3
ASA 1-2	—	—		—	—	
ASA 3	0.70	0.44, 1.13		0.93	-5.17, 7.04	
ASA 4	0.89	0.31, 2.27		-9.98	-24.89, 4.93	
Intraoperative vasopressors use[4]				4.79	-0.49, 10.07	0.075

[1]Model fit among 377 patients who had IOH SBP. The duration was estimated via linear interpolation of the longitudinal hemodynamic measurements and scaled by the approximate total duration from 5 minutes after anesthesia start till PACU entry to account for anesthesia onset and procedure duration; [2]OR = Odds Ratio, CI = Confidence Interval, [3]Global p-value presented; [4]The use of intraoperative vasopressors are expected to have been introduced after the first IOH event and thus only included in the 2nd model for IOH duration as an adjusting factor; IOH, intraoperative hypotension, MAP, mean arterial pressure, ASA, American Society of Anesthesiologists physical status score, PACU, post anesthesia care unit

Results

- Patient characteristics comparable among the five combinations

Table 1. Descriptive summary of baseline characteristics. 1n (%) and median (IQR); IQR, interquartile range; ASA, American Society of Anesthesiologists physical status score; eGFR, estimated glomerular filtration rate

Characteristic	Overall, N = 1440[1]	Propofol /midazolam /fentanyl N = 525[1]	Propofol /fentanyl N = 190[1]	Propofol only N =380[1]	Midazolam /fentanyl N = 204[1]	Remimazolam /fentanyl N = 141[1]
Age	65 (55, 72)	60 (50, 68)	73 (62, 78)	66 (57, 74)	66 (57, 72)	66 (58, 73)
Female	872 (61%)	341 (65%)	103 (54%)	245 (64%)	108 (53%)	75 (53%)
ASA						
ASA 1-2	216 (15%)	106 (20%)	21 (11%)	59 (16%)	7 (3.4%)	23 (16%)
ASA 3	1147 (80%)	400 (76%)	162 (85%)	310 (82%)	168 (82%)	107 (76%)
ASA 4	77 (5.3%)	19 (3.6%)	7 (3.7%)	11 (2.9%)	29 (14%)	11 (7.8%)
eGFR						
>= 60	1213 (84%)	456 (87%)	142 (75%)	331 (87%)	166 (82%)	118 (84%)
16-59	218 (15%)	68 (13%)	45 (24%)	48 (13%)	36 (18%)	21 (15%)
<= 15	7 (0.5%)	1 (0.2%)	3 (1.6%)	1 (0.3%)	1 (0.5%)	1 (0.7%)
Unknown	2	0	0	0	1	1

- Propofol presence → higher intraoperative vasopressor use
  - 9 - 18% vs. 3 - 6% for no propofol groups
- Midazolam/fentanyl group
  - highest variability in time until meeting discharge criteria
  - highest proportion of patients requiring ≥45 minutes until awake 14.3% vs. ≤6.9% in other groups
- Remimazolam or midazolam + fentanyl □ lower odds of IOH compared to those receiving propofol/midazolam/fentanyl
- Of the 1440 patients, 22 (1.5%) experienced bradycardia and the frequencies did not differ by group (p=0.07)

Conclusions

- Odds and duration of IOH vary by MAC combination in short outpatient oncologic IR procedures
- Fentanyl with either remimazolam or midazolam → lower odds of IOH relative to propofol/midazolam/fentanyl
- Median IOH duration highest for midazolam/fentanyl
- Remimazolam/fentanyl → optimal hemodynamic stability with low IOH rates and least variability in duration

Co-authors

Ellesa Naito; Jasme Lee, MS; Kay See Tan PhD, Bridget Marcinkowski MD; Kara Barnett, MD FASA

Memorial Sloan Kettering Cancer Center, New York

Acknowledgements

This research was funded in part through National Institutes of Health/National Cancer Institute Cancer Center Support Grant (P30-CA008748) to Memorial Sloan Kettering Cancer Center

Memorial Sloan Kettering Cancer Center