
Comparison of knowledge of perioperative care in primary care residents versus anesthesiology residents

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Primary care physicians (internal medicine and family practice) are often asked to evaluate patients before surgery and prepare them for the procedure. The goal of our study was to examine primary care and anesthesiology resident physicians' knowledge of preoperative evaluation and preparation as well as perioperative changes during anesthesia and surgery. To this end, a questionnaire was sent to primary care resident physicians and anesthesiology resident physicians in our university hospital system. One hundred twenty questionnaires were distributed, and the overall response rate was 50.8%. Although there was agreement between anesthesiology and primary care residents in many of the areas surveyed, differences were observed in questions related to appropriateness of preoperative instructions regarding medications, utility of routine preoperative testing, and identification of expected physiologic changes during anesthesia and surgery. Of the maximum possible 36 points, the mean score for anesthesiology residents (27.55) was higher than the mean scores for primary care residents (21.4 and 20.24 for internal medicine and family practice, respectively), although overall scores were generally lower than expected for both anesthesiology and primary care residents. The level of training of the respondents did not significantly affect the responses. We conclude that primary care resident physicians were knowledgeable about most perioperative care, although some deficiencies were identified when these residents were compared with anesthesiology residents. Surveys such as ours may be used to identify areas of deficiencies that require further education for both groups of residents.

The number of people in the USA older than 65 years is expected to increase by 13.3% by 2010 and 53.2% by 2020, as baby boomers age and life expectancies lengthen (1). This increase in the population of older individuals will result in increased surgical workload (2–4) and a resulting need for preoperative preparation. Furthermore, more complex procedures are being increasingly performed on sicker and older patients in the outpatient setting. There is therefore a need for comprehensive preoperative evaluation and preparation to minimize the occurrence of perioperative complications.

In an outpatient setting, the initial patient encounter with the anesthesiologist often occurs on the day of surgery (5), so that the responsibility for evaluating these patients before surgery often falls to the primary care physician. When pre-

operative evaluation is done in the inpatient setting, “hospitalists,” a new group of primary care physicians, are likely to be involved in preoperative preparation as many hospitals move to this model of care. Hospitalists work closely with surgeons to care for the medical aspects of preoperative and postoperative management (6). It is therefore important that primary care physicians, including hospitalists, be familiar with optimal preoperative preparation.

Primary care physicians are involved not only in preoperative care but also increasingly in postoperative care (6, 7). The involvement of primary care physicians in preoperative or postoperative care assumes that they have adequate familiarity with the pathophysiologic changes accompanying anesthesia and surgery. Gaps in knowledge and training in this area may lead to inappropriate or inadequate perioperative care (8). To the best of our knowledge, there are no published studies evaluating the knowledge of primary care physicians or anesthesiologists regarding perioperative care.

We hypothesized that there would be no difference in the knowledge of basic perioperative concepts in family medicine and internal medicine residents when compared with anesthesiology residents. Anesthesiology residents were chosen because of their assumed expertise and training in perioperative care. We therefore designed a questionnaire to survey primary care (internal medicine and family practice) resident physicians regarding their knowledge of preoperative evaluation and preparation as well as perioperative changes accompanying anesthesia and surgery when compared with anesthesiology residents.

METHODS

After institutional review board approval, questionnaires were distributed to resident physicians in internal medicine, family medicine, and anesthesiology in our institution. The internal medicine and family medicine residency programs at the University of Texas Southwestern Medical Center comprise 132 residents and 30 residents, respectively, with roughly equal

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Table 1. Perioperative medicine questionnaire with answers from *Miller's Anesthesia*, 6th edition

1. GENERAL

- 1.1. Adult patients undergoing elective surgery should fast (NPO) for 6 to 8 hours before surgery. [Agree; p. 2595]
- 1.2. Intraoperative fluid replacement should include fluid replacement for fasting (NPO), crystalloid replacement for intraoperative blood loss in a 2:1 ratio, as well as evaporative and third space losses up to 10 mL/kg. [Disagree; p. 1789]
- 1.3. Patients undergoing elective surgery should take all their usual medications on the day of surgery except anticoagulants and oral hypoglycemic agents. [Agree; p. 927]
- 1.4. Herbal medications or supplements and over-the-counter medications may interact with anesthetic medications. [Agree; p. 927]

2. PREOPERATIVE TESTING

- 2.1. Routine preoperative blood tests and urinalysis should be obtained for all patients since abnormal tests help to diagnose disease and result in an improved perioperative outcome. [Disagree; pp. 940, 942]
- 2.2. The most important screening test is a thorough history and physical examination. [Agree; pp. 939, 943]
- 2.3. Normal blood tests within the previous year have a high likelihood of being abnormal when repeated for preoperative testing. [Disagree; p. 947]
- 2.4. All patients require a baseline electrocardiogram. [Disagree; p. 951]

COMMON MEDICAL CONDITIONS

3. Hypertension

- 3.1. Elective surgery may be performed in patients with diastolic blood pressures at or above 110 mm Hg as long as they have an invasive blood pressure monitor. [Disagree; p. 1058]
- 3.2. Hypertension is of no concern since anesthesia medications lower blood pressure and will normalize the blood pressure. [Disagree; p. 1054]

4. Coronary artery disease (CAD)

- 4.1. Patients with stable angina and no symptoms of heart failure can undergo low- or intermediate-risk procedures without further workup. [Agree; p. 1074]
- 4.2. Patients who have undergone percutaneous transluminal coronary angioplasty or coronary artery bypass grafting with good results should have an exercise stress test before proceeding with high-risk surgery. [Disagree; p. 1073]
- 4.3. Patients with atypical chest pain or a remote history of myocardial infarction can generally proceed to surgery without further workup. [Disagree; p. 1061]

5. Congestive heart failure (CHF)

- 5.1. CHF is not a contraindication to general anesthesia if a pulmonary artery catheter is placed. [Disagree; p. 1074]
- 5.2. In patients with CHF, all medications should be discontinued since they can interact with anesthetics. [Disagree; p. 927]
- 5.3. Regional anesthesia is safer in patients with CHF. [Disagree; pp. 193, 1658]

6. Diabetes mellitus

- 6.1. Diabetic patients are at increased risk of aspiration pneumonitis. [Agree; p. 1025]

- 6.2. Diabetic patients should be assessed for difficult endotracheal intubation because of atlanto-occipital joint sclerosis. [Agree; p. 1780]
- 6.3. Patients on oral hypoglycemic drugs should not take them on the morning of surgery, and type 1 diabetics should not inject insulin on the morning of surgery. [Disagree; p. 1779]
- 6.4. The risk of cardiovascular complications is not increased in diabetic patients. [Disagree; p. 1780]

ANESTHESIA

7. Induction of anesthesia

- 7.1. Induction of general anesthesia usually results in hypertension and bradycardia. [Disagree; p. 1227]
- 7.2. Subsequent laryngoscopy and tracheal intubation result in tachycardia and hypertension. [Agree; p. 1227]

8. Anesthesia and the respiratory system

- 8.1. General anesthesia attenuates the normal cough reflex, which can extend into the postoperative period. [Agree; pp. 163–165]
- 8.2. Regional anesthesia is preferred to general anesthesia in the patient with preexisting pulmonary disorders. [Disagree; p. 1660]

9. Anesthesia and the cardiovascular system

- 9.1. Anesthetic agents are myocardial stimulants; they increase cardiac output as well as decrease systemic vascular resistance and left ventricular stroke volume in a dose-dependent fashion. [Disagree; pp. 216, 361, 362]
- 9.2. Spinal or epidural anesthesia has little or no overall effect on the cardiovascular system. [Disagree; p. 1658]
- 9.3. The goal of general anesthesia is to maintain the appropriate heart rate, preload, afterload, and contractility while maintaining unconsciousness. [Agree; p. 1054]

10. Anesthesia and the liver

- 10.1. Chronic liver disease can result in prolongation of drug effect and intensity. [Agree; p. 1111]
- 10.2. Hepatitis related to inhaled anesthetics is quite common. [Disagree; p. 1111]
- 10.3. Regional anesthesia is unsafe in the patient with liver disease even if no coagulation abnormalities exist. [Disagree; pp. 1110, 1111]

11. Anesthesia and the kidneys

- 11.1. Anesthetic agents decrease renal blood flow and glomerular filtration rate. [Agree; p. 800]
- 11.2. Preoperative dialysis improves the risk and safety of anesthesia in patients with uremia. [Agree; p. 1103]
- 11.3. Electrolyte balance, especially calcium balance as well as fluid balance, is vital in chronic renal failure patients presenting for surgery. [Agree; p. 1102]

12. REGIONAL ANESTHESIA

- 12.1. No difference in cardiac morbidity and mortality compared with general anesthesia. [Agree; pp. 1653, 1654]
- 12.2. Advantageous in selected patient populations with increased risk for vasoocclusive events. [Agree; pp. 1658–1660]
- 12.3. Risk of sudden cardiovascular collapse in selected populations. [Agree; p. 1670]

distribution at all levels of training. Internal medicine residents are exposed to and trained in perioperative medicine through a 4-week rotation on the medicine consult service and continuing experience throughout training. There is no formal rotation for family medicine residents; however, there is continuing exposure throughout residency training. The anesthesiology residents undergo a formal 4-week rotation in perioperative medicine during the first year of training in addition to continuing exposure throughout training. The general training and experience of the residents in both internal medicine and family medicine programs at our institution are comparable to those of other large US residency programs based on performance on board certification examinations taken at the end of training (9, 10).

The questionnaire asked about medical specialty and level of training (postgraduate year 1–5) and then listed the five available responses for each question: agree, somewhat agree, neutral, somewhat disagree, and disagree (Likert scale), with an option for comments at the end of each question. Thirty-six questions were included (Table 1), addressing preoperative instructions to patients, preoperative testing, common medical conditions seen in the perioperative period, effects of anesthesia on organ systems, and regional anesthesia. Survey questions were generated after searching MEDLINE and OVID for articles relevant to perioperative care between January 1983 and October 2003. We identified content areas of interest and specific questions. Other questions were developed based on commonly known misconceptions among primary care physicians regarding anesthesia and surgery (8, 11–14). The “correct” answers to the questions asked were obtained from a standard reference textbook of anesthesia (15). Each correct answer received 1 point, for a maximum score of 36 points. Data were collected over 4 months. Reminders were sent 2 months after the initial distribution of questionnaires.

The data were analyzed using SAS Version 9.1 (SAS Inc, Cary, NC). For the purpose of analysis, the “agree” and “somewhat agree” responses were combined, and the “disagree” and “somewhat disagree” responses were also combined. Questionnaire responses were evaluated utilizing the Fisher exact test since expected cell values were often low, therefore not satisfying the assumptions for valid chi-square contingency table analysis. Additionally, overall scores were calculated for each participant. A two-way analysis of variance was used to detect the influence of specialty and level of training on questionnaire score. The Student-Newman-Keuls multiple comparisons test was applied for pairwise comparisons of questionnaire scores between the given specialties. A *P* value <0.05 was considered statistically significant.

RESULTS

We distributed 120 questionnaires, and the overall response rate was 50.8%. The response rate for anesthesiology residents was 57.1%, while that for internal medicine and family practice residents was 52% and 48%, respectively. Two questionnaires were only partially answered and were not included in the analysis. Overall, mean questionnaire scores were significantly higher for the anesthesiology residents (27.55) than for the in-

Table 2. Analysis of variance: impact of specialty on questionnaire score

Specialty	N	Mean score*	Standard deviation	F statistic	df	P value
Anesthesiology	20	27.55	3.83	18.93	2	<0.001
Internal medicine	21	21.40	3.28			
Family medicine	19	20.24	5.13			

*The maximum possible score was 36.

Table 3. Analysis of variance: impact of level of training on questionnaire score

Level of training	N	Mean score	Standard deviation	F statistic	df	P value
Postgraduate years 1 or 2	36	22.00	4.77	3.89	1	0.054
Postgraduate years 3, 4, or 5	25	24.48	5.58			

ternal medicine residents (21.40) and family medicine residents (20.24) (*P* < 0.001) (Table 2). Questionnaire scores between family medicine and internal medicine residents were not significantly different (*P* = 0.391). No statistically significant difference could be detected for the impact of level of training on questionnaire score (*P* = 0.054) (Table 3).

Individual questions were examined for differences in response for the three specialty areas. Significant differences in responses were detected when comparing anesthesiology, internal medicine, and family medicine residents. When internal medicine and family medicine residents were grouped as primary care residents, most of the differences persisted. Finally, there were no significant differences in responses when comparing internal medicine and family medicine residents (Table 4).

DISCUSSION

Since primary care physicians are increasingly involved in perioperative patient care (16, 17), it is important for them to be familiar with perioperative pathophysiology. Our findings indicate that primary care residents were knowledgeable about preoperative preparation, except in areas involving preoperative instructions and preoperative testing, in which the primary care physicians favored the preoperative ordering of routine blood tests, urinalysis, and electrocardiograms (*P* = 0.001) (18). This is in contrast to the recommendations of the practice guidelines of the American Society of Anesthesiologists (19), which state that preoperative tests should be performed selectively to guide or optimize perioperative management. The guidelines also recommend that indications for such testing should be based on information obtained from the medical records, patient interview, and physical examination, as well as the type and invasiveness of the planned procedure.

Table 4. Response to questionnaire by specialty*

Question	Anesthesiology (An)			Internal medicine (IM)			Family medicine (FM)			Comparisons: Fisher exact <i>P</i> value		
	Agree	Neutral	Disagree	Agree	Neutral	Disagree	Agree	Neutral	Disagree	All†	An vs FM	IM vs FM
1.1	20 (100%)	0 (0%)	0 (0%)	21 (100%)	0 (0%)	0 (0%)	17 (89%)	1 (5%)	1 (5%)	0.0966	1.0000	0.2192
1.2	13 (65%)	1 (5%)	6 (30%)	17 (81%)	3 (14%)	1 (5%)	13 (68%)	3 (16%)	3 (16%)	0.2435	0.1520	0.5841
1.3	17 (85%)	0 (0%)	3 (15%)	20 (95%)	0 (0%)	1 (5%)	16 (84%)	0 (0%)	3 (16%)	0.5407	0.6763	0.3306
1.4	20 (100%)	0 (0%)	0 (0%)	19 (90%)	2 (10%)	0 (0%)	19 (100%)	0 (0%)	0 (0%)	0.3226	0.5480	0.4885
2.1	3 (15%)	1 (5%)	16 (80%)	14 (67%)	1 (5%)	6 (29%)	14 (78%)	0 (0%)	4 (22%)	0.0002	<0.0001	0.8487
2.2	20 (100%)	0 (0%)	0 (0%)	21 (100%)	0 (0%)	0 (0%)	18 (100%)	0 (0%)	0 (0%)	NA	NA	NA
2.3	2 (10%)	2 (10%)	16 (80%)	3 (14%)	4 (19%)	14 (67%)	2 (11%)	2 (11%)	14 (78%)	0.9077	0.9032	0.7823
2.4	1 (5%)	0 (0%)	19 (95%)	15 (71%)	1 (5%)	5 (24%)	9 (50%)	1 (6%)	8 (44%)	<0.0001	<0.0001	0.4427
3.1	3 (15%)	2 (10%)	15 (75%)	4 (19%)	4 (19%)	13 (62%)	2 (11%)	4 (21%)	13 (68%)	0.8330	0.6486	0.8083
3.2	0 (0%)	0 (0%)	20 (100%)	1 (5%)	0 (0%)	20 (95%)	0 (0%)	2 (11%)	17 (89%)	0.1299	0.6961	0.2192
4.1	8 (40%)	1 (5%)	11 (55%)	10 (48%)	2 (10%)	9 (43%)	4 (21%)	2 (11%)	13 (68%)	0.4515	0.9213	0.2088
4.2	15 (79%)	0 (0%)	4 (21%)	12 (57%)	2 (10%)	7 (33%)	14 (74%)	0 (0%)	5 (26%)	0.4289	0.4964	0.4993
4.3	1 (5%)	2 (10%)	17 (85%)	1 (5%)	1 (5%)	19 (90%)	1 (5%)	0 (0%)	18 (95%)	0.8879	0.5290	1.0000
5.1	4 (20%)	2 (10%)	14 (70%)	8 (38%)	6 (29%)	7 (33%)	8 (44%)	5 (28%)	5 (28%)	0.0801	0.0212	0.9217
5.2	0 (0%)	0 (0%)	20 (100%)	0 (0%)	4 (19%)	17 (81%)	1 (5%)	0 (0%)	18 (95%)	0.0258	0.3886	0.1079
5.3	9 (45%)	3 (15%)	8 (40%)	11 (52%)	8 (38%)	2 (10%)	11 (58%)	4 (21%)	4 (21%)	0.1703	0.0852	0.4125
6.1	18 (90%)	2 (10%)	0 (0%)	8 (38%)	6 (29%)	7 (33%)	7 (37%)	5 (26%)	7 (37%)	0.0013	0.0001	1.0000
6.2	10 (53%)	7 (37%)	2 (11%)	7 (33%)	9 (43%)	5 (24%)	5 (26%)	5 (26%)	9 (47%)	0.1261	0.1040	0.3754
6.3	14 (70%)	1 (5%)	5 (25%)	16 (76%)	0 (0%)	5 (24%)	14 (74%)	0 (0%)	5 (26%)	0.9755	0.5623	1.0000
6.4	0 (0%)	0 (0%)	20 (100%)	1 (5%)	1 (5%)	19 (90%)	0 (0%)	1 (5%)	18 (95%)	0.9182	0.6961	1.0000
7.1	0 (0%)	1 (5%)	19 (95%)	2 (10%)	6 (30%)	12 (60%)	4 (21%)	3 (16%)	12 (63%)	0.0319	0.0205	0.4842
7.2	18 (90%)	2 (10%)	0 (0%)	8 (42%)	6 (32%)	5 (26%)	12 (63%)	3 (16%)	4 (21%)	0.0163	0.0078	0.4820
8.1	13 (65%)	3 (15%)	4 (20%)	17 (85%)	2 (10%)	1 (5%)	14 (74%)	2 (11%)	3 (16%)	0.6458	0.4873	0.6337
8.2	16 (80%)	2 (10%)	2 (10%)	17 (85%)	3 (15%)	0 (0%)	16 (84%)	1 (5%)	2 (11%)	0.6618	0.8605	0.3492
9.1	3 (15%)	0 (0%)	17 (85%)	9 (47%)	5 (26%)	5 (26%)	8 (44%)	4 (22%)	6 (33%)	0.0011	0.0002	1.0000
9.2	0 (0%)	1 (5%)	19 (95%)	9 (45%)	2 (10%)	9 (45%)	5 (26%)	1 (5%)	13 (68%)	0.0023	0.0018	0.4154
9.3	15 (79%)	1 (5%)	3 (16%)	16 (80%)	3 (15%)	1 (5%)	16 (84%)	2 (11%)	1 (5%)	0.7035	0.3744	1.0000
10.1	19 (95%)	0 (0%)	1 (5%)	20 (100%)	0 (0%)	0 (0%)	19 (100%)	0 (0%)	0 (0%)	1.0000	0.3390	NA
10.2	0 (0%)	1 (5%)	19 (95%)	2 (10%)	8 (40%)	10 (50%)	5 (26%)	7 (37%)	7 (37%)	0.0007	0.0004	0.4898
10.3	0 (0%)	1 (5%)	19 (95%)	2 (11%)	2 (11%)	15 (79%)	1 (5%)	1 (5%)	17 (89%)	0.5567	0.6748	0.6939
11.1	13 (65%)	2 (10%)	5 (25%)	16 (80%)	3 (15%)	1 (5%)	11 (58%)	4 (21%)	4 (21%)	0.3664	0.4536	0.2602
11.2	17 (85%)	1 (5%)	2 (10%)	12 (60%)	7 (35%)	1 (5%)	15 (79%)	2 (11%)	2 (11%)	0.1246	0.2318	0.2263
11.3	17 (85%)	1 (5%)	2 (10%)	17 (85%)	3 (15%)	0 (0%)	19 (100%)	0 (0%)	0 (0%)	0.1082	0.2096	0.2308
12.1	6 (30%)	3 (15%)	11 (55%)	1 (5%)	4 (20%)	15 (75%)	3 (16%)	2 (11%)	14 (74%)	0.2917	0.1528	0.5063
12.2	15 (75%)	1 (5%)	4 (20%)	14 (70%)	5 (25%)	1 (5%)	14 (74%)	3 (16%)	2 (11%)	0.3616	0.1683	0.7637
12.3	18 (90%)	0 (0%)	2 (10%)	11 (55%)	8 (40%)	1 (5%)	7 (41%)	7 (41%)	3 (18%)	0.002	0.001	0.465

*Questions with response differences reaching statistical significance (*P* < 0.05) are shaded.

†An vs FM and IM combined.

Many primary care residents did not correctly identify the physiologic changes that accompany induction of anesthesia and subsequent laryngoscopy and tracheal intubation. Presumably, the understanding of anticipated hemodynamic changes during the perioperative period will result in better patient preparation.

There were also knowledge gaps concerning the safety and effect of regional anesthesia on organ systems and disease states.

The perception that “neuraxial blockade” does not affect the cardiovascular system may in part be responsible for recommendations favoring regional anesthesia in patients with significant cardiovascular comorbidities.

It is remarkable that the anesthesiology residents did not perform as well as would be expected on the survey (average score, 27.5 [± 3.8]; maximum possible, 36 points), even though nearly all the residents that participated in our survey had com-

pleted their perioperative care rotation. The lower-than-expected scores may reflect the content of the anesthesia perioperative medicine rotation in our institution and represent an opportunity for improvement in the quality of the rotation.

The limitations of our study include a relatively low response rate from our subjects. The reasons for this are unclear. Possible reasons include lack of interest in perioperative care, a perception that perioperative medicine is outside the scope of their specialty, or a perception that physician extenders could be better utilized in this role. It is likely that responders may have been more likely than nonresponders to feel that they had adequate knowledge of preoperative care. It is also possible that physicians who have completed training, rather than the residents surveyed, would have different responses to the questions asked, although we did not find a significant difference when responses were analyzed based on level of training. Another limitation may be related to the way questions were framed. The questions with negative answers may have led to some confusion and resulted in conflicting responses.

In conclusion, our study showed that although primary care physicians are knowledgeable about preoperative preparation, there is a need for a better-defined perioperative medicine curriculum in primary care training programs and for continuing education among primary care physicians. This training would provide relevant information about perioperative events to which primary care physicians are typically not exposed but which are important for adequate preoperative preparation. Perioperative medicine is not a subspecialty of internal medicine or family medicine but rather a body of medical knowledge that enables physicians to manage medical illness during the perioperative period, assess operative risk, and respond to complications.

As hospitalists continue to play a more significant role in the care of perioperative patients, other physician groups with interest in perioperative care (anesthesiologists, cardiologists, etc.) will need to work closely with hospitalists to further improve perioperative care. Cooperation between these groups to update existing guidelines and formulate new guidelines represents an opportunity to standardize teaching about perioperative medicine. Finally, surveys such as ours may be used to detect deficiencies in knowledge and to identify areas requiring more education.

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