Perioperative fellowship curricula in anesthesiology: a systematic review

Curriculums de formation complémentaire (fellowship) en anesthésiologie: une revue systématique

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Abstract

Purpose Perioperative medicine is emerging as a unique area of medical practice. Anesthesiology graduates are particularly well suited for this role given their training. The purpose of this systematic review is to summarize the various fellowships being offered in perioperative medicine and the scope of clinical perioperative practice that currently exists. The common areas of competency covered in these perioperative medicine fellowships are also identified.

Source On July 28, 2014, we conducted a search of the literature from January 1, 1946, to July 28, 2014 through MEDLINE®, EMBASE™ and the World Wide Web for definitions of perioperative medicine and for curricula for fellowships in perioperative care throughout the world.

Principal findings Currently, seven institutions offer postgraduate fellowships in perioperative medicine, including two Canadian universities (University of Manitoba and University of Toronto), two American universities (Stanford University and University of California, Irvine), two Australian institutions (University

of Western Australia, and the Alfred Hospital), and one New Zealand site (North Shore Hospital). Apart from fellowships, we also identified other postgraduate training routes. Graduate master's programs in perioperative medicine were identified in the United Kingdom and in Australia. A new intensive five-day perioperative medicine course was also identified. The scope of the curricula of the fellowships, the main focus of our review, is not uniform, although common elements emerged, including a research component and exposure to pain medicine.

Conclusions There is a paucity of published literature on what perioperative care entails as well as what perioperative fellowship curricula should include. While we suggest certain areas of focus to include, the subspecialty of perioperative medicine would benefit from a cohesive and consensus-based curriculum to which academic fellowships could adhere.

Résumé

Objectif La médecine périopératoire est en train d'émerger comme un domaine unique de la pratique médicale. Les diplômés en anesthésiologie sont particulièrement bien adaptés à ce rôle, compte tenu de leur formation. L'objectif de cette étude systématique est de résumer les différentes formations postdoctorales offertes dans le domaine de la médecine périopératoire et la portée de leur pratique périopératoire clinique actuellement existante. Les domaines communs de compétence couverts dans ces formations complémentaires en médecine périopératoire ont été également identifiés.

Source Le 28 juillet 2014, nous avons effectué une recherche documentaire sur la période s'étendant du 1^{er} janvier 1946 au 28 juillet 2014 dans les bases de données MEDLINE®, EMBASE™ et à travers le Web à la recherche de définitions de la médecine périopératoire

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et de curriculums de formations complémentaires en soins périopératoires dans le monde entier.

Constatations principales Actuellement, sept établissements proposent des formations complémentaires en médecine périopératoire dont deux universités canadiennes (University of Manitoba et University of Toronto), deux universités aux États-Unis (Stanford University et University of Californie, Irvine), deux institutions australiennes (University of Western Australia et le Alfred Hospital) et une institution néo-zélandaise (North Shore Hospital). Hormis ces formations complémentaires, nous avons également identifié d'autres voies de formation postdoctorales. Des programmes de maîtrise en médecine périopératoire ont été identifiés au Royaume-Uni et en Australie. Un nouveau cours intensif de cinq jours en médecine périopératoire a été également identifié. L'étendue des curriculums de ces formations complémentaires, le principal centre d'intérêt de notre recherche, n'est pas uniforme bien que des éléments communs apparaissent, dont une composante de recherche et l'exposition au traitement de la douleur.

Conclusions La littérature publiée sur ce qu'impliquent les soins périopératoires et sur le contenu du curriculum de formation complémentaire en médecine périopératoire est particulièrement pauvre. Même si nous suggérons certains domaines d'intérêt à y inclure, la sous-spécialité de la médecine périopératoire gagnerait à avoir des curriculums plus homogènes reposant sur des consensus auxquels les formations complémentaires universitaires pourraient adhérer.

Throughout the evolution of anesthesiology as a specialty, it has been suggested that the discipline should encompass the breadth of perioperative care.^{1,2} This assertion is based on the role of anesthesiologists as acute care physicians with a skill set that is applicable to a wider scope of practice than the operating room (OR) alone. Traditionally, anesthesiologists manage certain areas of perioperative medicine, such as preoperative assessment and intraoperative care, while other areas, such as postoperative ward management, remain unclear.^{3–5} With the growing utilization of certified registered nurse anesthetists and other allied health professionals, such as anesthesia assistants, delivering basic anesthetic care in the intraoperative setting, the services rendered by physician anesthesiologists need to expand beyond the OR in order to maintain the viability of the specialty.^{1,5} Surveys of anesthesiologists confirm that standardized perioperative training would be welcomed.⁶ Many departments of anesthesiology are incorporating “perioperative care” or

“perioperative medicine” into their titles; however, both the concepts and the pathways to becoming a perioperative physician remain largely undefined.

It has been suggested that the focus of anesthesiology should expand beyond intraoperative and technical skills to the practice of perioperative medicine.^{4,7} The definition of perioperative medicine, as proposed by Rock as well as Grocott, encompasses all aspects of medical care pertaining to a patient in the course of an operative intervention.^{1,2} The U.S. National Heart, Lung, and Blood Institute has advocated formalized training in perioperative assessment, optimization, risk stratification, and harm reduction.⁸ The scope of perioperative medicine further includes intraoperative anesthetic care and immediate postoperative stabilization, pain management, and management of any postoperative complications until discharge from hospital.^{1,4,7} Sometimes perioperative care can extend to post-discharge time, e.g., with regional anesthesia programs that provide a home catheter system for prolonged regional pain management.⁹

In this review, we describe the current status of subspecialty training opportunities in the form of fellowships in perioperative medicine for postgraduate anesthesiologists. We also aim to summarize the spectrum of perioperative care models that currently exist.

Methods

In accordance with the PRISMA statement and with the assistance of a research librarian, a search of the literature from 1946 to 2014 was performed on MEDLINE® and EMBASE™.¹⁰ The search strategy consisted of the following key words: “perioperative”, “perioperative anesthesia”, “perioperative medicine”, “perioperative care”, “perioperative education”, “perioperative professional”, “perioperative medical”, “perioperative continuing education”, “perioperative graduate”, “perioperative anesthesiology”, “perioperative period”, “perioperative training”, “perioperative certification”, “curriculum”, “curricula”, “Education”, “graduate”, “school”, “outline”, “syllabus”, “fellow (s)”, “fellowship”, “postgraduate”, “certification”, “skill (s)”, “program (s)”, “development”, and “pilot project”. The last search was performed on August 5, 2014. We included all English language papers. The search strategy is presented in the Appendix (available as Electronic Supplementary Material).

Program selection

Two authors (A.G., J.W.) independently reviewed the articles generated by our search query to determine

relevance. A third author (F.C.) resolved any conflicts. Relevant articles had to contain information on at least one of the following: 1) the description of an existing hospital-based service that provides clinical perioperative care; 2) the role of anesthesiologists in perioperative services in the out-of-OR environment; or 3) complete or partial information about perioperative training programs during postgraduate fellowships. Exclusion criteria included an alternate focus of the fellowship (such as solely cardiothoracic anesthesia, echocardiography, organ transplantation, or critical care), specific patient populations (e.g., pediatrics, ambulatory or regional anesthesia patients), and emphasis primarily on surgery, nursing, or simulation.

Since perioperative medicine is an evolving specialty, for completeness, a search of the World Wide Web was conducted on August 5, 2014 for perioperative fellowships offered throughout the world. Two authors (A.G. and J.W.) manually reviewed all websites for relevancy and included those containing information about postgraduate perioperative training.

The following search string was used: (“perioperative medicine” | “perioperative anesthesia” | “perioperative anaesthesia” | “anesthesia & perioperative medicine” | “anesthesiology & perioperative medicine” | “anaesthesiology & perioperative medicine”) (fellow | fellows | fellowship | fellowships) (program | programs | programme | programmes | master | masters | master’s | postgraduate).

Data extraction

Data extraction was performed independently by two reviewers (A.G., J.W.). The following data were extracted: curricula as it pertained to perioperative medicine or a description of goals and objectives for trainees of perioperative training programs, as well as duration of training, funding sources, eligibility criteria for applicants, exposure to pain medicine, and any research component. Funding source was included because funding sources may be different among fellowships. For example, one program may be funded mainly by clinical work in the OR, while another may be independently funded by hospital departments with no time commitments outside the fellowship focus. Research time was considered because it allows a comparison of the relative weight each program devotes to clinical *vs* academic endeavours.

Results

The literature search yielded 1,075 citations from MEDLINE and EMBASE combined. After a manual

review of the abstracts of these articles, 32 were reviewed fully and 14 met our defined criteria for relevancy and were included in the qualitative analysis.^{1–4,6–8,11–17} The reasons for exclusion are described in the Figure.

With respect to the relevant published literature on training and fellowships in perioperative medicine, the relevant articles focused on the variety of current definitions for perioperative medicine. Their common components included preoperative assessment, intraoperative care, postoperative pain and complication management, and forecasting various ways that the scope of the field of perioperative medicine could expand.^{1,3,4,7} One article elaborated on the evolving role of echocardiography in non-cardiac perioperative care and the anticipation of future widespread training for anesthesiologists in this modality.¹¹ Another article described a case-based model that proved successful in training residents in topics relevant to perioperative care, such as cardiac evaluation for non-cardiac surgery.¹² While the majority of the results were articles supporting the expanding role of anesthesiologists as perioperative physicians, there is a paucity of published literature specifically on fellowship training programs offered in perioperative medicine.^{1–4,6–8,13–17}

The search of the World Wide Web on Google Scholar yielded 1,800 websites. All titles and descriptions were reviewed, and only seven were deemed relevant and reviewed in detail. The training programs with perioperative medicine fellowships included two Canadian (University of Manitoba and University of Toronto), two American (Stanford University and University of California, Irvine), two Australian (The Alfred Hospital, and University of Western Australia), and one New Zealand site (North Shore Hospital). A comparison of their curricula, as described on their institutional websites or elsewhere on the Web, is presented in the Table. Unfortunately, there are very few online descriptions for the program curricula in Australia and New Zealand.

The fellowships range from six months to one year in duration and offer various supplementary areas of focus in their curricula. Clinical workload in terms of days spent in the OR, where available, also varies across institutions. Three of the seven programs explicitly define eligibility criteria requiring board certified anesthesiology graduates, while the other four did not describe eligibility criteria for potential applicants (Table).

The University of Manitoba had the most detailed description of the curriculum for their perioperative medicine fellowship. The fellowship covers rotations in a Surgical Special Care Unit (a high-acuity unit), surgical Intensive Care Unit (ICU), pre-admission clinic,

Figure Flow diagram of systematic review results

cardiology-led echocardiography, cardiac anesthesia rotation focused on transesophageal echocardiography (TEE), surgical infectious disease consultation service, and electives.¹⁸

The University of Toronto offers a perioperative fellowship with a wide scope of clinical experiences and research opportunities. The clinical aspects cover preoperative evaluation, smoking cessation, blood conservation, varying approaches to airway management, regional anesthesia, and ambulatory experience. The research opportunities are focused on the expertise of the supervisors of the fellowship; however, fellows have the ability to choose their own topics as well.¹⁹

The California-based universities (Stanford University and University of California, Irvine) have very similar fellowships covering issues mainly around the management

and administration of perioperative services.^{20,21} Administrative skills play an important role in the curricula of some perioperative medicine fellowships, particularly those training physicians for a position as director of a department. Stanford University has a postgraduate fellowship in the “Management of Perioperative Services” which focuses on developing the expertise of anesthesiologists in the logistics of managing an OR environment.²¹ Similarly, the fellowship at the University of California, Irvine is a one-year perioperative fellowship largely focusing on resource management of perioperative services.²⁰ This program involves courses and meetings offered to instruct fellows about OR resource management and value economics of hospital and surgical services. Perioperative fellows are trained in leadership skills, organizational behaviour, quality assurance, and

Table Comparisons of perioperative fellowship programs

Insitution	University of Manitoba	University of Toronto	Stanford University	University of California – Irvine	The Alfred Hospital, Melbourne, Australia	University of Western Australia	North Shore Hospital, Auckland, New Zealand
Duration of fellowship	One year	One year	One year	One year	One year	Six months	One year
Additional focus of fellowship	Critical care and TTE ^A	Airway management, blood conservation, and perioperative OSA ^B management	Entrepreneurship, management and leadership skills	Business organization, management, operations, and finances	Perioperative management of high-risk patients (not further defined)	Point-of-care TTE, management of an outpatient surgical centre vs acute inpatient care	Cardiopulmonary exercise testing, review and optimization of high-risk patients (not further defined)
Source of funding	Clinical workload billing in OR ^C one day per week.	Clinical workload billing in OR four days per week	Clinical workload billing in OR 12 hours per week.	Clinical workload billing in OR two days per week	Not declared	Not declared	Not declared
Applicant eligibility	Anesthesiology graduates	Not declared	Not declared	Board certified for eligible anesthesiologists	Not declared	Not declared	Not declared
Exposure to pain medicine	Suggested for elective rotation	Included	Not declared	Included	Not declared	Not declared	Not declared
Research component	Expected but dedicated time not declared	20% of time protected for research	Expected but dedicated time not declared	Expected but dedicated time not declared	Not declared	Not declared	Expected and dedicated time allotted

A = transthoracic echocardiography; B = obstructive sleep apnea; C = operating room

performance improvement. There is training on how to develop and implement clinical pathways and protocols, for example, patient selection for ambulatory surgery or postoperative management of patients with obstructive sleep apnea.²² Interested fellows have the option to learn about the development and integration of technological applications for clinical purposes (e.g., smartphone applications). Interpersonal training is offered through conflict management seminars and workshops where fellows gain expertise in conflict resolution. While not as relevant to the Canadian system, business development and marketing is also covered along with budgeting and accounting.²³

In Melbourne, Australia, the Alfred hospital offers a one-year fellowship focused on the perioperative management of high-risk patient populations. The definition of high-risk patients, however, was not available online. Sir Charles Gairdner Hospital of the University of Western Australia offers a six-month perioperative medicine fellowship with a balanced focus on preoperative assessment and optimization of elective outpatients and acute inpatients scheduled for surgery. They also provide certifiable training in point-of-care echocardiography during protected academic time. In Auckland, New Zealand, a one-year perioperative medicine fellowship is available at North Shore Hospital. The focus of this fellowship is on cardiopulmonary exercise testing, review of complex patients, preoperative assessments, and protected research time.²⁴

We also found non-fellowship postgraduate training opportunities through our Web search. In particular, two United Kingdom sites have graduate studies in perioperative medicine leading to a master's degree.^{23,25} The Scandinavian Society of Anesthesiology and Intensive Care Medicine offers a new five-day educational course in Sweden aimed at providing specialized training for anesthesiologists in perioperative medicine.²⁶ This course has a greater focus on administration and management of surgical services as opposed to clinical medicine.

Apart from the mentioned fellowships and graduate studies, unique residency programs were also found during the literature search. Three centres in the United States (University of California, San Diego, Stanford University School of Medicine, and the Medical College of Wisconsin Affiliated Hospitals) offer residency programs with a hybrid curriculum that covers the core competencies required by the professional boards for both anesthesiology and internal medicine.²⁷ Graduates of these programs are eligible to sit the board examinations for both specialties, allowing dual board certification after five years of combined residency vs six years if the residencies were completed separately.²⁵ These are unique residency training programs attempting to capture the

scope of perioperative medicine by covering the required rotations of two specialties in parallel.

Discussion

There is support for the implementation of postgraduate fellowship programs aimed at enhancing the skills of anesthesiologists in perioperative medicine.^{1,2,4-6,14,15,17,28} Nevertheless, there is no consensus-based curriculum that clearly outlines the topics and skills that fellowship programs in perioperative medicine should offer. This lack of consensus regarding the scope of clinical responsibilities of perioperative physicians has resulted in a wide variety of curricula in fellowship training in perioperative medicine.

Specialties other than anesthesiology are also expanding their scope into perioperative medicine. Some residency programs, such as internal medicine, have developed methods to teach perioperative medicine specifically to non-anesthesia trainees. For example, the University of California, San Francisco has implemented a case-based curriculum to cover some core topics in perioperative concepts for residents in internal medicine.¹² The topics range from perioperative cardiopulmonary assessment to management of anticoagulation and endocarditis prophylaxis. They show that case-based learning for perioperative medicine is qualitatively an effective method for teaching core materials.¹² In Canada, the University of Toronto is formulating a new two-year "perioperative medicine" fellowship for internal medicine residents. While not yet recruiting, this fellowship is intended to follow completion of the core internal medicine residency. It is possible that graduates from other specialties, such as anesthesia, may also be eligible to apply for this fellowship. Consolidating core competencies and approaches to perioperative medicine across specialties would be in keeping with the aims and recommendations of the National Heart, Lung, and Blood Institute's statement on perioperative medicine.⁸

Fellowship training in perioperative medicine is in its infancy. Other subspecialties related to anesthesiology have also undergone similar rites of passage. For example, the currently well-outlined examinable and certifiable subspecialties of critical care and pain medicine were not always as such. Nevertheless, both subspecialties now enjoy a defined curriculum through the Royal College of Physicians and Surgeons of Canada (RCPSC), the American Board of Anesthesiology (critical care and pain), and the American Board of Internal Medicine (critical care).²⁹⁻³² Other subspecialties, such as sleep medicine, are in the process of gaining certification from the RCPSC.

Given that perioperative medicine is just beginning to emerge and take root, few structured fellowship programs are currently offered, with each program tailored in a different way. In our review, we found only 14 published articles about the definition, scope, or potential of training methods in clinical perioperative medicine.^{1,3,4,7,11,12} With respect to training programs, we found only seven programs offering fellowship training in perioperative medicine.^{18–21,24} These programs generally offer similar basic components such as training in preoperative assessment and optimization, intraoperative care, and postoperative pain management. Several of the programs are integrating the use of ultrasound in perioperative settings, particularly for transthoracic echocardiography (Table). When available, perioperative critical care and resuscitation training is delivered through rotations in critical care units, courses, or simulations.

Pain medicine is an area that emerges as a common theme. Both acute and chronic pain management is covered through most fellowships.^{18–21} While the basics of acute and chronic pain management are usually covered in anesthesiology residencies, complex chronic pain, however, is a subspecialty that generally requires further fellowship training. While perioperative physicians need not be subspecialized to the same extent as interventional pain physicians who conduct invasive pain blocks, it is still prudent for them to have expertise in complex pain management beyond that which is covered in residency. For example, the ability to use a greater variety of analgesic adjuncts, such as lidocaine and ketamine infusions, would be useful.³³ Therefore, in the authors' opinion, it behooves any perioperative fellowship program to incorporate exposure to complex pain management.

Like basic pain management, other areas of perioperative care are incorporated into anesthesiology residency programs to ensure adequacy of training of anesthesiologists. In Canada for example, topics such as perioperative management of diabetes mellitus,^{34–39} obstructive sleep apnea,^{22,40–42} pacemakers and automated implantable cardioverter defibrillators (AICDs),^{43–45} anticoagulation,^{46,47} and fluid management^{48,49} are covered under the national curriculum during residency to ensure all anesthesiologists are qualified to manage these common conditions and situations.⁵⁰ Nevertheless, other more specialized areas demand fellowship training, such as focused cardiac ultrasound to manage hemodynamic instability, administrative management skills, complex sleep disordered breathing, advanced preoperative patient counselling, and roles similar to hospitalists.

These special skills and enhanced areas of competency are emerging and are being incorporated into the fellowships we found in our search. One skill that

anesthesiologists have rapidly accrued is perioperative echocardiography.¹¹ Transesophageal echocardiography has long been incorporated into the perioperative management of cardiac surgery patients, and most cardiac anesthesiologists now receive formalized training in TEE.⁵¹ More recently, transthoracic cardiac ultrasonography, e.g., the Focused Cardiac Ultrasound (FOCUS) course, is gaining popularity among non-cardiac anesthesiologists as a perioperative assessment skill, particularly in urgent settings, and is therefore being incorporated into perioperative fellowships.^{18,52,53} Focused Cardiac Ultrasound training can also be obtained outside of fellowships via courses. Evidence exists that a FOCUS examination can guide management of acutely ill patients by ruling in or out a limited number of pathologies (e.g., pericardial effusion).⁵⁴ Given the availability of ultrasound technology, it is not unreasonable that perioperative physicians will be expected to become familiar with its use, and therefore, it should be incorporated into perioperative fellowships.

With respect to administrative skills, representation by anesthesiologists on executive administrative boards of hospitals and medical councils increases public awareness about the services rendered by the specialty.⁴ It also increases the influence of anesthesiologists on the organization of an institution's perioperative surgical services.⁴ Training in administrative areas, such as those mentioned in the two American fellowships, is therefore invaluable in a perioperative fellowship for graduates to acquire excellent skills relevant to administrative positions.

Sleep-disordered breathing is a prevalent condition that is often unmasked or exacerbated perioperatively secondary to exposure to anesthetic agents.^{22,40,41} It has significant implications for anesthesiologists, and extensive perioperative guidelines have been published with respect to its management.^{22,55–57} The newly formed Society of Anesthesia and Sleep Medicine indicates the wide interest in this area.⁵⁸ The role of sleep medicine will continue to gain recognition in anesthesia as increasing numbers of patients are being screened for and diagnosed with this previously unrecognized condition.^{59,60} As mentioned, sleep medicine is currently under review for subspecialty certification by the RCPSC. It is essential to incorporate sleep medicine in the core curriculum of any perioperative fellowship program because it has relevance in multiple areas of anesthesia, such as out-of-OR sedation, perioperative airway management with positive airway pressure techniques, and as a comorbidity in the management of pain-related disorders.^{42,61}

With respect to other respiratory conditions, cigarette smoking continues to be prevalent in the surgical population. Effective preoperative counselling on smoking cessation is not emphasized in residency

curricula.⁵⁰ It has been shown that perioperative smoking cessation interventions not only decrease perioperative respiratory and wound healing complications, but they also lead to abstinence from smoking that lasts long after a surgical intervention.^{62–65} Perioperative smoking cessation should therefore be considered as part of the curriculum in perioperative fellowships.

We recognize that care of the hospitalized patient is emerging as a specialized area of practice, now examinable through the American Board of Internal Medicine.⁶⁶ Hospitalists are physicians of varied training backgrounds who provide care to the hospitalized patient and facilitate transition to an outpatient status.⁶⁷ Anesthesiologists could play a vital role as consultants to hospitalists once a decision is made for an operative intervention in a hospitalized patient. Such consultative care could also follow postoperatively on the ward to stabilize complex patients, as defined elsewhere.⁶⁸ This approach could minimize perioperative risk to the patient by ensuring seamless preoperative optimization, fewer cancellations, and postoperative stabilization. Sometimes cardiorespiratory compromise occurs beyond the postanesthesia care unit (PACU), which is where anesthesiologists' duties usually end. We envision lengthening the time that anesthesiologists care for postoperative patients to include a period of time on the ward to maintain cardiorespiratory stability beyond the PACU. The time frame for anesthesiologists to be engaged in this extended monitoring and stabilization would be predetermined by the combination of patient characteristics and the corresponding surgical procedure. Such a model would behoove perioperative physicians to obtain extended critical care training as part of their perioperative fellowships.

Given expected logistical challenges, criteria for establishing such extended perioperative care would need to be delineated and approved by consensus and based on existing guidelines for high-risk patients or procedures.^{5,68}

Overall, movements to implement perioperative roles are already underway, e.g., the new Perioperative Surgical Home website set up by the American Society of Anesthesiologists.⁶⁹ Such efforts highlight the need for a perioperative physician role and therefore formalized and defined training. Emerging evidence suggests potential benefits for implementing protocols for perioperative care in specific surgical interventions.⁷⁰ One such example is the recent study from Miller showing reduced length of hospital stay in patients on the Enhanced Recovery After Surgery (ERAS) pathway.⁷¹

Despite our extensive review of the literature and World Wide Web to identify the variety of available perioperative postgraduate fellowships and the definition and scope of perioperative medicine, our study is limited by the search

strings we used. Certain publications in other databases may have been missed, and some terms may have been missed in our search strategy. We tried to limit this risk by relying on an academic librarian for our search and by utilizing the peer-review process.

Conclusion

Perioperative medicine is emerging as a subspecialty of anesthesiology. Anesthesiologists already fulfill responsibilities in out-of-OR areas such as pre-admission clinics, ward consultations for preoperative optimization, or postoperative pain management. Despite its expanding scope, this systematic review shows that few centres offer perioperative medicine fellowships, and those that exist do not have uniformly defined objectives in their curricula. While we recommend that certain relevant topics be included in perioperative curricula, such as focused echocardiography, sleep medicine, smoking cessation, extended postoperative care by anesthesiologists, and complex pain management, we recognize that this is only the starting point for discussion. Further collaboration among academic institutions and professional organizations is important for the development of a cohesive clinical syllabus. Consensus guidelines are needed in perioperative medicine in order to provide future anesthesiologists with sufficient training in this growing subspecialty so that standardized care is rendered and continually improved.

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References

1. Rock P. The future of anesthesiology is perioperative medicine. *Anesthesiol Clin North America* 2000; 18: 495-513, v.
2. Grocott MP, Pearce RM. Perioperative medicine: the future of anaesthesia? *Br J Anaesth* 2012; 108: 723-6.
3. Carli F. Perioperative medicine. Are the anesthesiologists ready? *Minerva Anestesiol* 2001; 67: 252-5.
4. Coursin DB, Maccioli GA, Murray MJ. Critical care and perioperative medicine. How goes the flow? *Anesthesiol Clin North America* 2000; 18: 527-38.
5. Webster NR. The anaesthetist as peri-operative physician. *Anaesthesia* 2000; 55: 839-40.
6. Kumar G, Wong B, Walker D. Identifying training requirements in perioperative care for anaesthetists. *J Biomed Educ* 2013; available from URL: <http://dx.doi.org/10.1155/2013/534245> (accessed November 2014).
7. Beattie C. Training perioperative physicians. *Anesthesiol Clin North America* 2000; 18: 515-25, v-vi.

8. Mangano DT. Perioperative medicine: NHLBI working group deliberations and recommendations. *J Cardiothorac Vasc Anesth* 2004; 18: 1-6.
9. University of British Columbia. Department of Anesthesiology, Pharmacology and Therapeutics. Available from URL: <http://apt.med.ubc.ca/anesthesiology/divisions/division-of-regional-anesthesia/sites/> (accessed November 2014).
10. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Int J Surg* 2010; 8: 336-41.
11. Glas KE. Training in perioperative echocardiography. *Curr Opin Anaesthesiol* 2006; 19: 640-4.
12. Chou C. Case-based teaching of perioperative medicine. *Acad Med* 2001; 76: 558-9.
13. Kumar G, Walker D. Perioperative medical education: the time is now. *Trends Anaesth Crit Care* 2014; 4: 60-2.
14. Vetter TR, Goeddel LA, Boudreaux AM, Hunt TR, Jones KA, Pittet JF. The perioperative surgical home: how can it make the case so everyone wins? *BMC Anesthesiol* 2013; DOI:10.1186/1471-2253-13-6.
15. Bould MD, Naik VN, Hamstra SJ. Review article: New directions in medical education related to anesthesiology and perioperative medicine. *Can J Anesth* 2012; 59: 136-50.
16. Soreide E, Kalman S, Aneman A, et al. Shaping the future of Scandinavian anaesthesiology: a position paper by the SSAI. *Acta Anaesthesiol Scand* 2010; 54: 1062-70.
17. Kneebone R, Nestel D, Chrzanowska J, et al. The perioperative specialist practitioner: developing and evaluating a new surgical role. *Qual Saf Health Care* 2006; 15: 354-8.
18. University of Manitoba. Fellowship Perioperative Medicine. Available from URL: <http://umanitoba.ca/faculties/medicine/units/anesthesia/education/fellowperiomed.html> (accessed November 2014).
19. University of Toronto. Perioperative Anesthesia Fellowship. Available from URL: <http://www.anesthesia.utoronto.ca/edu/fellowship/offered/twhperi.htm> (accessed November 2014).
20. University of California - Irvine. Fellowship in Management of Perioperative Services. Available from URL: http://www.anesthesiology.uci.edu/education_perioperativemanagementfellowship.shtml (accessed November 2014).
21. Stanford University. Fellowship in Management of Perioperative Services. Available from URL: http://med.stanford.edu/anesthesia/education/periop_fellowship.html (accessed November 2014).
22. Gross JB, Bachenberg KL, Benumof JL, et al. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea. *Anesthesiology* 2006; 104: 1081-93; quiz 1117-8.
23. University College London Centre for Anaesthesia Critical Care & Pain Medicine. MSC Postmasters Programme in Perioperative Medicine. Available from URL: <http://www.ucl.ac.uk/anaesthesia/education/perioperativemedicine> (accessed August 2014).
24. Special interest groups. Perioperative medicine. Available from URL: <http://www.anzca.edu.au/fellows/special-interest-groups/perioperative-medicine> (accessed August 2014).
25. Monash University - The Alfred Hospital. Master of Perioperative Medicine. Available from URL: <http://www.masters.periopmedicine.org.au/images/Master%20of%20Medicine%20Student%20Guide%20-%20April%202014.pdf> (accessed August 2014).
26. The Scandinavian Society of Anaesthesiology and Intensive Care Medicine. Perioperative Medicine and Management (PoMM). Available from URL: <http://www.ssai.info/education/training-programs/pomm.html> (accessed August 2014).
27. American Board of Internal Medicine. Internal Medicine. Anesthesiology Policies. Available from URL: www.abim.org/certification/policies/combined-training/internal-medicine-anesthesiology.aspx (accessed November 2014).
28. Kain ZN, Vakharia S, Garson L, et al. The perioperative surgical home as a future perioperative practice model. *Anesth Analg* 2014; 118: 1126-30.
29. Royal College of Physicians and Surgeons of Canada. Critical Care Medicine. Available from URL: http://www.royalcollege.ca/rc/faces/oracle/webcenter/portalapp/pages/ibd.jspx;jsessionid=GmqMEhO2gLcyzc_hJquZFUUK86P7VvVqzqmF5uWAFY_zrCbv0P8!-1538745610?lang=en&_afzLoop=5238233059402674&_afzWindowMode=0&_afzWindowId=null#%40%3F_afzWindowId%3Dnull%26_afzLoop%3D5238233059402674%26lang%3Den%26_afzWindowMode%3D0%26_adf.ctrl-state%3D156e0zfeaq_4 (accessed November 2014).
30. Royal College of Physicians and Surgeons of Canada. Pain Medicine. http://www.royalcollege.ca/rc/faces/oracle/webcenter/portalapp/pages/ibd.jspx?lang=en&_afzLoop=5238379025858674&_afzWindowMode=0&_afzWindowId=156e0zfeaq_1#%40%3F_afzWindowId%3D156e0zfeaq_1%26_afzLoop%3D5238379025858674%26lang%3Den%26_afzWindowMode%3D0%26_adf.ctrl-state%3D156e0zfeaq_17 (accessed November 2014).
31. American Board of Internal Medicine. Examable Subspecialties. Available from URL: <http://www.abim.org/exam/cert-dates-blueprints-scoring.aspx> (accessed November 2014).
32. American Board of Anesthesiology. Examinations of Subspecialties. Available from URL: http://www.theaba.org/home/examinations_certifications (accessed November 2014).
33. Tumbler PS. Optimizing perioperative analgesia for the complex pain patient: medical and interventional strategies. *Can J Anesth* 2014; 61: 131-40.
34. Jacober SJ, Sowers JR. An update on perioperative management of diabetes. *Arch Intern Med* 1999; 159: 2405-11.
35. Meyers EF, Alberts D, Gordon MO. Perioperative control of blood glucose in diabetic patients: a two-step protocol. *Diabetes Care* 1986; 9: 40-5.
36. Joshi GP, Chung F, Vann MA, et al. Society for Ambulatory Anesthesia consensus statement on perioperative blood glucose management in diabetic patients undergoing ambulatory surgery. *Anesth Analg* 2010; 111: 1378-87.
37. Griesdale DE, de Souza RJ, van Dam RM, et al. Intensive insulin therapy and mortality among critically ill patients: a meta-analysis including NICE-SUGAR study data. *CMAJ* 2009; 180: 821-7.
38. Ahmed Z, Lockhart CH, Weiner M, Klingensmith G. Advances in diabetic management: implications for anesthesia. *Anesth Analg* 2005; 100: 666-9.
39. American Diabetes Association. Standards of medical care in diabetes—2009. *Diabetes Care* 2009; 32(Suppl 1): S13-61.
40. ASMBs Clinical Issues Committee. Peri-operative management of obstructive sleep apnea. *Surg Obes Relat Dis* 2012; 8: e27-32.
41. Joshi GP, Ankichetty SP, Gan TJ, Chung F. Society for Ambulatory Anesthesia consensus statement on preoperative selection of adult patients with obstructive sleep apnea scheduled for ambulatory surgery. *Anesth Analg* 2012; 115: 1060-8.
42. Setaro J. Obstructive sleep apnea: a standard of care that works. *J Perianesth Nurs* 2012; 27: 323-8.
43. Healey JS, Merchant R, Simpson C, et al. Canadian Cardiovascular Society/Canadian Anesthesiologists' Society/Canadian Heart Rhythm Society joint position statement on the perioperative management of patients with implanted

- pacemakers, defibrillators, and neurostimulating devices. *Can J Cardiol* 2012; 28: 141-51.
44. Crossley GH, Poole JE, Rozner MA, et al. The Heart Rhythm Society (HRS)/American Society of Anesthesiologists (ASA) expert consensus statement on the perioperative management of patients with implantable defibrillators, pacemakers and arrhythmia monitors: facilities and patient management: executive summary this document was developed as a joint project with the American Society of Anesthesiologists (ASA), and in collaboration with the American Heart Association (AHA), and the Society of Thoracic Surgeons (STS). *Heart Rhythm*. 2011; 8: e1-18.
 45. American Society of Anesthesiologists. Practice advisory for the perioperative management of patients with cardiac implantable electronic devices: pacemakers and implantable cardioverter-defibrillators: an updated report by the American Society of Anesthesiologists Task Force on perioperative management of patients with cardiac implantable electronic devices. *Anesthesiology* 2011; 114: 247-61.
 46. Douketis JD, Spyropoulos AC, Spencer FA, et al. Perioperative management of antithrombotic therapy: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest* 2012; 141(2 Suppl): e326S-50S.
 47. Healey JS, Brambatti M. Periprocedural management of oral anticoagulation in patients with atrial fibrillation: approach in the era of new oral anticoagulants. *Can J Cardiol* 2013; 29(7 Suppl): S54-9.
 48. Ramirez JM, Blasco JA, Roig JV, et al. Enhanced recovery in colorectal surgery: a multicentre study. *BMC Surg* 2011; 11: 9.
 49. Pearse RM, Ackland GL. Perioperative fluid therapy. *BMJ* 2012; 344: e2865.
 50. Spadafora SM, Houston P, Levine M. A national curriculum in anesthesia: rationale, development, implementation, and implications. *Can J Anesth* 2012; 59: 636-41.
 51. American Society of Anesthesiologists and Society of Cardiovascular Anesthesiologists Task Force on Transesophageal Echocardiography. Practice guidelines for perioperative transesophageal echocardiography. An updated report by the American Society of Anesthesiologists and the Society of Cardiovascular Anesthesiologists Task Force on transesophageal echocardiography. *Anesthesiology* 2010; 112: 1084-96.
 52. Spencer KT, Kimura BJ, Korcarz CE, Pellikka PA, Rahko PS, Siegel RJ. Focused cardiac ultrasound: Recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr* 2013; 26: 567-81.
 53. Botker MT, Vang ML, Grofte T, Sloth E, Frederiksen CA. Routine pre-operative focused ultrasonography by anesthesiologists in patients undergoing urgent surgical procedures. *Acta Anaesthesiol Scand* 2014; 58: 807-14.
 54. Jensen MB, Sloth E, Larsen KM, Schmidt MB. Transthoracic echocardiography for cardiopulmonary monitoring in intensive care. *Eur J Anaesthesiol* 2004; 21: 700-7.
 55. Seet E, Chung F. Management of sleep apnea in adults – functional algorithms for the perioperative period: continuing professional development. *Can J Anesth* 2010; 57: 849-64.
 56. Eastwood PR, Malhotra A, Palmer LJ, et al. Obstructive sleep apnoea: from pathogenesis to treatment: current controversies and future directions. *Respirology* 2010; 15: 587-95.
 57. Adesanya AO, Lee W, Greulich NB, Joshi GP. Perioperative management of obstructive sleep apnea. *Chest* 2010; 138: 1489-98.
 58. Society of Anesthesia and Sleep Medicine. Available from URL: <http://www.anesthesiaandsleep.org> (accessed August 2014).
 59. Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y. High STOP-Bang score indicates a high probability of obstructive sleep apnoea. *Br J Anaesth* 2012; 108: 768-75.
 60. Kaw R, Chung F, Pasupuleti V, Mehta J, Gay PC, Hernandez AV. Meta-analysis of the association between obstructive sleep apnoea and postoperative outcome. *Br J Anaesth* 2012; 109: 897-906.
 61. Roizenblatt S, Neto NS, Tufik S. Sleep disorders and fibromyalgia. *Curr Pain Headache Rep* 2011; 15: 347-57.
 62. Lee SM, Landry J, Jones PM, Buhrmann O, Morley-Forster P. The effectiveness of a perioperative smoking cessation program: a randomized clinical trial. *Anesth Analg* 2013; 117: 605-13.
 63. Wong J, Abrishami A, Yang Y, et al. A perioperative smoking cessation intervention with varenicline: a double-blind, randomized, placebo-controlled trial. *Anesthesiology* 2012; 117: 755-64.
 64. Hawn MT, Houston TK, Campagna EJ, et al. The attributable risk of smoking on surgical complications. *Ann Surg* 2011; 254: 914-20.
 65. Moller AM, Villebro N, Pedersen T, Tonnesen H. Effect of preoperative smoking intervention on postoperative complications: a randomised clinical trial. *Lancet* 2002; 359: 114-7.
 66. American Board of Internal Medicine. Hospital Medicine Exam. Available from URL: <http://www.abim.org/exam/hospital-moc-exam-schedule.aspx> (accessed November 2014).
 67. Society Hospital Medicine. Core Competencies in Hospital Medicine. Available from URL: http://www.hospitalmedicine.org/Content/NavigationMenu/Education/CoreCurriculum/Core_Competencies.htm (accessed November 2014).
 68. Fleisher LA, Beckman JA, Brown KA, et al. ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: executive summary: a report of the american college of cardiology/american heart association task force on practice guidelines (writing committee to revise the 2002 guidelines on perioperative cardiovascular evaluation for noncardiac surgery): developed in collaboration with the american society of echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, and Society for Vascular Surgery. *Circulation* 2007; 116: 1971-96.
 69. American Society of Anesthesiologists. Perioperative Surgical Home. Available from URL: <http://www.asahq.org/psh> (accessed November 2014).
 70. Shafer SL, Donovan JF. Anesthesia & Analgesia's collection on the perioperative surgical home. *Anesth Analg* 2014; 118: 893-5.
 71. Miller TE, Thacker JK, White WD, et al. Reduced length of hospital stay in colorectal surgery after implementation of an enhanced recovery protocol. *Anesth Analg* 2014; 118: 1052-61.