

A survey of ultrasound use by academic and community anesthesiologists in Ontario

Sondage sur l'utilisation de l'échographie par les anesthésiologistes en milieu universitaire et communautaire en Ontario

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Abstract

Purpose The use of ultrasound for central venous catheter (CVC) insertion and regional anesthesia (RA) has been recommended to improve efficacy and patient safety. We conducted a survey to evaluate the degree to which ultrasound use has been adopted into routine practice by anesthesiologists in the province of Ontario, Canada.

Methods Following approval by the Research Ethics Board at The Hospital for Sick Children, we conducted a web-based survey of anesthesiologists registered with the College of Physicians and Surgeons of Ontario. The anesthesiologists surveyed were working in academic or community hospitals. The survey elicited information on the degree of routine use of ultrasound for CVC or RA blocks, reasons for non-use of ultrasound, and methods of ultrasound training.

Results A questionnaire was sent to 450 anesthesiologists via e-mail. There were 209 (46%) respondents, six of whom were excluded as the anesthesiologists were no longer in practice, resulting in 203 responses for analysis. Of these, 163 anesthesiologists practiced in academic

hospitals, and 40 practiced in community hospitals. A larger proportion of academic (60%) vs community (33%) anesthesiologists use ultrasound routinely for CVC insertion ($P = 0.004$). Routine use for RA blocks was comparable in both groups. The most common reason given for non-use of ultrasound for CVC insertion was "ultrasound is unnecessary for safe/effective insertion of CVCs". Peer-to-peer training was the most preferred method for improving ultrasound skills.

Conclusions The use of ultrasound is better established in academic than in community anesthesia practice. Anesthesiologists in community practice appear to be adopting ultrasound at a slower pace, which may be explained by lack of equipment and lack of training.

Résumé

Objectif L'utilisation de l'échographie pour l'insertion des cathéters veineux centraux (CVC) et l'anesthésie régionale (AR) a été recommandée afin d'améliorer l'efficacité et la sécurité des patients. Nous avons réalisé un sondage pour évaluer dans quelle mesure l'utilisation de l'échographie a été adoptée dans la pratique de routine des anesthésiologistes dans la province de l'Ontario, au Canada.

Méthode Après avoir obtenu l'approbation du Comité d'éthique de la recherche à l'Hôpital des enfants malades, nous avons réalisé un sondage en ligne destinés aux anesthésiologistes inscrits auprès du Collège des médecins et chirurgiens de l'Ontario. Les anesthésiologistes sondés travaillent dans des hôpitaux universitaires ou communautaires. Le sondage a récolté des informations concernant le degré d'utilisation de routine de l'échographie pour les CVC et les blocs d'AR, les raisons pour la non-utilisation de l'échographie et les méthodes de formation en échographie.

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Résultats Un questionnaire a été envoyé par courrier électronique à 450 anesthésiologistes. Au total, il y a eu 209 (46 %) répondants, dont six ont été exclus étant donné qu'ils ne pratiquaient plus, entraînant un total de 203 réponses pour notre analyse. Parmi ces répondants, 163 anesthésiologistes pratiquent dans un cadre universitaire, et 40 dans des hôpitaux communautaires. Une plus grande proportion des anesthésiologistes travaillant en milieu universitaire (60 %) que communautaire (33 %) utilisent de façon routinière l'échographie pour l'insertion des CVC ($P = 0,004$). L'utilisation de routine pour réaliser des blocs d'AR était comparable dans les deux groupes. La raison la plus fréquemment invoquée pour justifier la non-utilisation de l'échographie pour insérer un CVC était que « l'échographie n'était pas nécessaire pour une insertion sécuritaire / réussie de CVC ». La formation entre collègues était la méthode préférée d'amélioration des compétences en échographie.

Conclusion L'utilisation de l'échographie est plus établie dans la pratique anesthésique universitaire que communautaire. Les anesthésiologistes pratiquant dans les collectivités semblent adopter l'échographie plus lentement, ce qui pourrait s'expliquer par le manque de matériel et de formation.

Ultrasonography plays an increasingly important role in various clinical procedures performed by anesthesiologists, such as vascular access and regional anesthesia (RA). Advantages of ultrasound (U/S) use for placement of central venous catheters (CVC) compared with the standard landmark technique include a decreased number of attempts and a reduction in the failure rate.^{1,2} According to several studies, U/S use in RA results in fewer needle passes, faster block onset times, and increased block success rates.³ Some authors regard the use of U/S guidance as the “gold standard” for the placement of regional blocks.^{4,5} In the United Kingdom, the National Institute for Clinical Excellence has published guidelines promoting the use of U/S to improve safety of CVC insertion.⁶ Canadian anesthesia residency programs now include training in ultrasonography for the performance of CVC insertion and RA blocks.

A survey by Brull *et al.* reported on the use of U/S in regional blocks by members of the American Society for Regional Anesthesia (ASRA), but the survey did not mention patterns of U/S use by ASRA members practicing in Canada.⁷ The purpose of this current survey was to evaluate current practice patterns of academic and community anesthesiologists in the province of Ontario with respect to their use of U/S for the placement of CVC and RA blocks. We hypothesized that a larger proportion of

academic anesthesiologists than community anesthesiologists use U/S for CVC insertion and RA.

Methods

After approval by the Research Ethics Board at The Hospital for Sick Children, a list of physicians was created who are registered as anesthesiologists with the College of Physicians and Surgeons of Ontario (CPSO) and who practice full- or part-time within the province of Ontario. This information is maintained by the CPSO in the public domain at www.cpsso.on.ca. We were able to obtain e-mail addresses for 450 anesthesiologists. Many community hospitals do not have work-based e-mails, resulting in a significant number of community anesthesiologists using personal e-mail accounts not listed in the public domain. Furthermore, professional bodies do not share their member e-mail address lists for ethical reasons.

Survey design

A 16-item questionnaire was developed through an iterative process. This process involved pilot testing by three clinical anesthesia fellows followed by formal testing by five staff anesthesiologists, half of whom use U/S routinely for CVC insertion or for RA blocks (Appendix; available as Electronic Supplementary Material). Questions were designed to elicit information on anesthesiologists':

1. location and years of practice;
2. frequency of performing CVC insertion or RA blocks within the previous two years – classified as: never; infrequently (once to a few times a *year*); moderately (once to a few times a *month*); and frequently (once to a few times a *week*);
3. routine use of U/S for either CVC insertion or RA blocks – defined as > 75% of the time while performing either CVC insertion or RA block;
4. reasons for non-use of U/S for CVC and R/A blocks;
5. previous training in U/S use; and
6. future training in U/S use.

The survey was constructed using the online tool, SurveyMonkey®, at www.surveymonkey.com using previously published guidelines for the creation of online surveys.^{8,9}

Data collection

The study utilized convenience sampling with the sample population comprised of anesthesiologists who worked in academic and non-academic community centres. We defined academic anesthesiologists as those who work in

tertiary university-affiliated institutions and community anesthesiologists as those practicing in non-tertiary institutions. Anesthesiologists were contacted via e-mail (e-mail addresses were obtained from either departmental websites or departmental administrators) and given an explanation of the study and a link to the online survey. They were sent a second e-mail after two weeks. Respondents were given one month to respond. All responses were anonymous and delinked from identifying information. All responses were stored on SurveyMonkey and exported to a Microsoft® Excel spreadsheet.

Data analysis

Data analysis was performed using GraphPad Prism version 5.0b for Mac OS X (GraphPad Software, San Diego, CA, USA; www.graphpad.com). Descriptive statistics were used to summarize the data, and two-tailed Fisher's exact test was used to analyze nominal data. A value of $P < 0.05$ was considered to indicate statistically significant differences.

Results

Demographics

Four hundred and fifty anesthesiologists were surveyed. There were 209 respondents (response rate = 46%), six of whom indicated they were no longer in clinical practice and did not complete the survey, resulting in 203 completed surveys for analysis. Of these, 163 anesthesiologists practiced in academic hospitals, and 40 practiced in community hospitals. The response rate of the academic anesthesiologists was comparable with that of the community-based anesthesiologists (Table 1). Non-responder bias was not assessed due to the lack of demographic information for reasons of confidentiality.

Central venous catheter insertion

The majority (82%) of academic anesthesiologists perform CVC insertions “moderately” to “frequently” (once a month to a few times per week), while 53% of community

anesthesiologists perform CVC insertions “infrequently” (once to a few times per year) (Table 2). A larger proportion of academic anesthesiologists (98/163; 60%) compared with community anesthesiologists (13/40; 33%) use U/S routinely for CVC insertion ($P = 0.004$) (Table 3). Both groups use U/S most often for internal jugular vein cannulation (Table 3). The most common reason chosen by academic anesthesiologists for not using U/S was the opinion that “ultrasound is not necessary for safe or effective insertion of CVCs”. Community anesthesiologists also chose “lack of training in U/S use” and “lack of equipment” as common reasons (Table 4). Of those respondents who currently use U/S routinely for CVC insertion, 82% (80/98) of academic anesthesiologists do not anticipate an increase in their use of U/S over the next 12 months, whereas 54% (7/13) of current routine users among community anesthesiologists do anticipate an increase.

Regional anesthesia

The frequency at which academic anesthesiologists perform RA blocks varied widely, whereas the majority of community anesthesiologists perform RA blocks at least “moderately”

(once to a few times a month) (Table 2). A similar proportion of academic anesthesiologists (64/163; 39%) and community anesthesiologists (12/40; 30%) use U/S routinely for RA, ($P = 0.08$) (Table 3). Ultrasound was used most often for transversus abdominus plane (TAP) and brachial plexus blocks, often in combination with nerve stimulation (Table 3). Lack of training was the most common reason cited for non-use of U/S by both academic and community anesthesiologists (Table 4). Almost as

Table 2 Respondents' frequency of performing central venous catheter insertion and regional anesthesia blocks

	Never ^a	Infrequently ^b	Moderately ^c	Frequently ^d
CVC insertion				
Academic <i>n</i> = 163	1 (0.6)	27 (16.6)	66 (40.5)	69 (42.3)
Community <i>n</i> = 40	0 (0)	21 (52.5)	15 (37.5)	4 (10)
RA blocks				
Academic <i>n</i> = 163	17 (10.4)	43 (26.4)	47 (28.8)	56 (34.3)
Community <i>n</i> = 39	0 (0)	0 (0)	8 (21)	31 (79)

Data are presented as number (%)

CVC = central venous catheter; RA = regional anesthesia

^a Never = I do not perform; ^b Infrequently = once to a few times a year; ^c Moderate = once to a few times a month; ^d Frequently = once to a few times a week

Table 1 Demographics of respondents

Type of hospital practice	Academic	Community
Number of surveys sent	337	107
Total number of respondents, number (%)	163 (48.4)	40 (37.4)
Years in practice, median [IQR]	10 [5-21]	9.5 [6-15]

IQR = interquartile range

Table 3 Specific indications of ultrasound use for all respondents who perform central venous catheter insertion and regional anesthesia blocks

	Academic	Community
Respondents' "routine use" ^a of U/S for CVC insertion, number/total (%)	98/163 (60.1)	13/40 (32.5)*
U/S use by CVC insertion site, number/total users (%)		
Internal jugular vein	98/98 (100.0)	13/13 (100.0)
Femoral vein	45/98 (45.9)	2/13 (15.3)
Other, e.g., external jugular vein, brachial vein	17/98 (17.3)	0/0 (0)
Respondents' "routine use" ^a of U/S (\pm NS) for RA, number/total (%)	64/163 (39.3)	12/40 (30)
U/S use by RA block type, number/total users (%)		
Brachial plexus (interscalene, supraclavicular, infraclavicular, axillary)	54/64 (84.3)	10/12 (90.9)
Lumbar/ thoracic epidural	14/64 (21.9)	1/12 (8.3)
Ilioinguinal nerve	20/64 (32.3)	4/12 (33.3)
TAP block	45/64 (70.3)	5/12 (41.6)*
Femoral nerve	43/64 (67.2)	7/12 (58.3)
Sciatic nerve (gluteal and popliteal)	33/64 (51.6)	7/12 (58.3)

U/S = ultrasound;
 CVC = central venous catheter;
 RA = regional anesthesia;
 NS = nerve stimulation;
 TAP = transversus abdominus plane; ^a "routine use" = > 75% of the time. * $P < 0.05$

Table 4 Specific reasons for non-use of ultrasound for central venous catheter insertion and regional blocks

	Academic	Community
Respondents who do not use U/S for CVC insertion, number/total	65/163	27/40
Reasons for not using ultrasound for CVC insertion, number/total (%)		
No ultrasound equipment	11/65 (16.9)	10/27 (37.0)*
I have not received training in ultrasound use	6/65 (9.2)	14/27 (51.9)*
Ultrasound is not necessary for safe or effective insertion of CVCs	46/65 (70.8)	9/27 (33.3)*
No appropriate surgical cases	9/65 (9.2)	2/27 (7.4)
Respondents who do not use U/S for RA block, number/total (%) ^a	82/163 (50.3)	28/40 (70.0)
Reasons for non-use of U/S for R/A blocks, number/total (%)		
No ultrasound equipment	11/82 (13.4)	10/28 (35.7)*
I have not received training in ultrasound use	46/82 (56.1)	13/28 (46.4)
Ultrasound is not necessary for safe or effective insertion of CVCs	20/82 (24.4)	9/28 (32.1)*
No appropriate surgical cases	28/82 (34.1)	2/28 (7.1) *
Time/efficiency constraints in the OR	8/82 (9.4)	7/28 (25.0)*

U/S = ultrasound;
 CVC = central venous catheter;
 RA = regional anesthesia;
 OR = operating room; ^a = 17 academic respondents skipped this question. * $P < 0.05$

frequently, however, community anesthesiologists also mentioned "lack of equipment" and "operating room time or efficiency constraints". Of those respondents who currently use U/S routinely for RA blocks, (11/12; 92%) of community anesthesiologists anticipate an increase in their use of U/S over the next 12 months compared with only (33/64; 50%) of academic anesthesiologists.

Methods of U/S training

A comparable proportion of academic and community anesthesiologists received previous U/S training, 125/146

(86%) and 32/40 (80%), respectively (Table 5). Peer-to-peer teaching was the most common training method reported by academic anesthesiologists, whereas community anesthesiologists reported multiple methods, such as peer-to-peer teaching, workshops, and printed material (textbooks, brochures, pamphlets) (Table 5). Sixty-nine percent (27/40) of community hospital anesthesiologists planned to undertake first-time or additional U/S training in the next 12 months compared with 41% (67/163) of academic anesthesiologists. All respondents chose peer-to-peer teaching was the most preferred method for improving their skills in the future; however, community

Table 5 Ultrasound training methods

	Academic	Community
How have you received previous U/S training? number/total (%) ^a		
No previous training	16/146 (10.9)	5/40 (12.8)
Residency	22/146 (15.1)	14/40 (15.4)
Fellowship	30/146 (20.5)	9/40 (5.1)*
Peer-to-peer	98/146 (67.1)	2/40 (46.2)*
Single-day seminar	54 (37.0)	23/40 (59.0)*
Multiple-day seminar	36/146 (24.7)	15/40 (38.5)
Internet-based	36/146 (24.7)	16/40 (41.0)*
Handheld devices (iPhone, Blackberry, PDA, etc)	3/146 (2.1)	1/40 (2.6)
DVD	16/146 (12.3)	7/40 (17.9)
Printed Material (textbooks, brochures, pamphlets)	57/146 (39.0)	18/40 (46.2)
What are your preferred methods for receiving future U/S training? number/total (%)		
Peer-to-peer	109/163 (66.9)	25/40 (62.5)
Single-day seminar	74/163 (45.3)	21/40 (52.5)
Multiple-day seminar	53/163 (32.5)	21/40 (52.5)*
Internet-based	50/163 (30.7)	22/40 (55.0)*
Handheld devices (iPhone, Blackberry, PDA, etc.)	14/163 (8.6)	6/40 (15.0)
DVD	32/163 (19.6)	11/40 (27.5)*
Printed Material (textbooks, brochures, pamphlets)	36/163 (22.1)	16/40 (40.0)*

U/S = ultrasound; ^a = 17 academic respondents skipped this question. **P* < 0.05

Table 6 Reasons for not seeking future ultrasound training

	Academic	Community
Do you plan to undertake ultrasound training (additional or for the first time) in the next 12 months? number/total (%)		
Yes	67/163 (41.1)	27/40 (67.5)
No	96/163 (58.9)	13/40 (32.5)
Reasons for not pursuing future ultrasound training, number/total (%)		
No need for my practice	20/96 (20.8)	3/13 (30.8)
No time or resources for training	24/96 (25.0)	2/13 (15.4)
No interest in ultrasound training	7/96 (7.3)	2/13 (23.1)
I have training in ultrasound use	48/96 (50.0)	7/13 (61.5)

anesthesiologists also frequently chose workshops (single-day and multiple-day) and internet-based training (Table 5). Twenty-five percent (24/96) of academic anesthesiologists reported “no time or resources” as an obstacle to undertaking U/S training in the next 12 months (Table 6).

Discussion

While anesthesiologists may frequently perform CVC insertions or RA blocks, the findings of this survey suggest that the use of U/S is not routine. In the province of Ontario, academic anesthesiologists reported a higher degree of routine use of U/S for CVC insertion compared with community anesthesiologists. The routine use of U/S for RA was similar in both groups. Academic anesthesiologists tend to refrain from using U/S routinely for a

single reason, i.e., they feel that it is not “necessary for safe or effective insertion of CVC”. Community anesthesiologists report multiple reasons, most notably “lack of U/S equipment” and “operating room time and efficiency constraints”.

To date, most surveys of U/S use by anesthesiologists have shown relatively low rates of use. A survey published in 2002 found that only 22% of UK critical care units had U/S machines available, and only 11% of those used the machines routinely for CVC insertion.¹⁰ In 2008, McGrattan *et al.*¹¹ reported that only 27% of senior anesthesiologists in the UK used U/S imaging as their first choice for internal jugular vein cannulation. This despite the introduction in 2002 of the National Institute for Clinical Excellence Technology Appraisal Guideline Number 49⁶ promoting the use of U/S in placement of internal jugular venous cannula. A survey of members of the Society of Cardiovascular Anesthesiologists in 2007

found a similar low rate (15%) of U/S use for CVC insertion.¹² In contrast, a survey from Wales in 2009 reported that 63% of consultants surveyed used U/S routinely for the placement of central venous cannula.¹³ Furthermore, our study reports a higher degree of U/S use for RA techniques, such as brachial plexus blocks, than reported by Brull *et al.* in a 2008 survey of ASRA members (33% vs 15%, respectively).⁷ Although there is only a two-year difference between these respective studies, the increase in U/S use may reflect a rapid rate of adoption of U/S over a relatively short period of time.

The greater use of U/S by academic anesthesiologists may be multifactorial. For example, academic centres are often the first to adopt and promote new techniques, and they may have more financial resources to buy the necessary equipment. There may be fewer operating room time constraints in academic hospitals, thus allowing for more opportunities to learn and teach new techniques. The transfer of new techniques from academic to community practice takes time as trainees become independent community practitioners. This transfer may be further delayed if adoption of U/S by community anesthesiologists faces additional obstacles, such as time constraints and a lack of equipment. Thus, transfer of knowledge and skill may not be enough to narrow the gap in U/S use between academic and community anesthesiologists. The greater use of U/S for CVC insertion than for RA may reflect the longer time U/S has been used for this indication and the fact that more anesthesiologists perform CVC insertion than perform RA.

Although peer-to-peer teaching is important for both groups, community anesthesiologists also appear to rely on other formats, such as workshops. This applies not only to past training but also to preferences for future training. An implication of these multiple and varied training methods may be the need for standardization and accreditation. The Royal College of Radiologists in the UK recently published recommendations on U/S training for medical and surgical specialties.¹⁴ The recommendations state that non-radiologists should receive training to the same standard as radiologists. Furthermore, they recommend that the radiology department should oversee any training received, and a radiologist should continue to act as a mentor after training is completed. The extent to which the adoption of such recommendations would affect U/S use by anesthesiologists and other non-radiology specialists remains to be seen.

Our study was limited by some methodological issues. First, non-responder bias was unavoidable, as is typical of anonymized electronic surveys.¹⁵ Possibly the individuals who did not respond had no interest in U/S. Second, the 45% response rate was relatively low but comparable to the response rates of 26%–46% in other published electronic surveys of health professionals.^{16–18} Our results highlight

the practice of more than 200 anesthesiologists with a wide range of years from practice, which may mitigate non-responder bias. Furthermore, our survey was limited to anesthesiologists in Ontario and may not necessarily translate to other geographical locations.

In conclusion, the use of U/S by academic and community anesthesiologists in Ontario is well established but not universal, and it is consistent with other developed countries. There appears to be significant interest amongst community anesthesiologists in expanding their use of U/S for CVC insertion and RA, but there may be difficulties with acquisition of equipment and training opportunities.

Conflicts of interest None declared.

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