Society for Technology in Anesthesia • March 2012

INTERFACE

Annual Meeting A Success!

By Maxime Cannesson, MD, STA 2012 Annual Meeting Program Chair

Dear STA Members,

It was my pleasure and honor to Chair the 2012 STA Annual Meeting in West Palm Beach, Florida. The meeting this year focused on four major components of our specialty: patient safety, automation, monitoring, and environment. We had speakers coming from all over the world to share their knowledge and expertise and it was amazing to see how the STA is at the forefront of these topics. All presentations were excellent and attendees found the information valuable and rated all the lectures very highly.

Sunrise over the Atlantic Ocean from the Four Seasons in Palm Beach, Florida location of the 2012 Annual Meeting .

The joint FAER/STA session was a great success and all of us benefited from the inspiring lectures presented by the Panel. On a personal note, I truly feel this session will inspire younger anesthesiologists to develop new technologies and entrepreneurism skills.

I want to personally thank the Board of Directors of the STA for their help and support during this process and for giving me this unique opportunity, and FAER for putting together this joint session with the STA, our friends and supporters from the industry, as well as Jane and Annette for their invaluable help.

We look forward to seeing you next year.

All the Best,

Maxime Cannesson, MD

Annual Meeting Photos *on page 2*

In This Issue!

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STA 2012 Annual Meeting Photos

Kirk Shelly, MD, PhD, STA Immediate Past President presents Maxime Cannesson, MD, PhD a placque for his work as the STA 2012 Program Chair.

Kirk Shelley, MD, PhD of STA presents Kevin Tremper, MD with the Gravenstein Award at the STA Annual Meeting luncheon.

Chris Quartararo, MD (Left) & Joan Spiegel, MD (Right) at the STA Friday Night Dinner Event held on the pool deck of the Four Seasons.

Joseph Orr, MD (Left) and Mark Ansermino, MBBCh (Right) at the STA Annual Meeting Opening Reception.

Dwayne Westenskow, PhD (Left), Thomas Engel, MD (Center) and John Doyle, MD, PhD (Right) at the opening reception.

Members of the FAER Translational Medical Research Panel held at the 2012 Annual Meeting. From Left to Right: Ted Stanley, MD, Donn Dennis, MD, FAHA, Debra A Schwinn, MD, Denham S Ward, MD, Kirk Shelley, MD, Phd, Richard Melker, MD, PhD, and Bruce Gingles, Cook Critical Care

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STA President's Message

By George Blike, MD, STA President

As the first quarter of this New Year for STA concludes I am pleased to inform you, as president, that we are off to an incredibly great start. The January Annual Meeting was one of the best in STA's history, remaining true to the mission and vision of the founders some twenty years ago. The meeting is our primary vehicle to exist, to influence our own practice, practice among other anesthesiologists, and most broadly practice across the medical community. Thanks to all of those who contributed in any and all ways to achieve this result.

While STA has had some challenges over the recent years, steady leadership and management have put the society on a sound trajectory. New members have joined, participated and even helped lead the society to stability, in part because STA has a tradition of mentoring and support for each generation.

The goals for this year are straightforward and I believe will be achieved because of the participatory nature of our membership.

•Goal #1

Have a fantastic 2013 meeting that is even better than this years. Ingredients for success: a) The venue is excellent at the Royal Palm in Scottsdale; b) Jesse Ehrenfeld of Vanderbilt as program chair has the capability and resources AND help by those who executed on this year's meeting; and c) we have many problems that still need solving with innovative technologies.

•Goal #2

Build capacity to influence and inform the development and diffusion of innovative technology into anesthesiology practice. Ingredients for success: a) Mature collaborative relationship with FAER with continued co-sponsorship of a panel on entrepreneurship and translational medical research for the next 3yrs; b) Re-commit to robust industry collaboration AND participation in STA by acting on the Industry Roundtable initiatives identified at the 2012 meeting (led by Christina DeMur and Greg Spratt); c) Initiate planning to re-establish competitive grant program in 2013 or 2014 based on projected achievement of fiscal performance to fund.

•Goal #3

Maintain trajectory to achieve financial stability. Ingredients for success: a) Plan to grow annual corporate support 5% led by management team Jane Svinicki and Annette Schott; b) Achieving small profit margin at annual meeting while maintaining low annual dues; c) Securing the second annual Corporate sponsor of the STA Innovation Endowment by the STA Board which will continue to establish an appropriate reserve fund.

It's going to be an exciting year. I am proud to be part of STA at this time and I have a deep respect for the hard work that positioned the society so well over the last few years. Please be a part of STA 2012 in any way that excites you. Myself and my colleagues, who are committed to helping STA finish the year as strong as we started it, welcome your help. Contact us by e-mail to share your ideas and how you wish to participate).

Sincerely,
George Blike, MD
STA President

President's Highlights & Upcoming Items

- **Our collaboration at the STA Annual Meeting with the Foundation for Anesthesia Education & Research (FAER) on Translational Medical Research**
- **Held an Industry Roundtable with STA Corporate Members at the Annual Meeting and the result of that meeting was the creation of a task force. That task force is going to work to bring amended pre-conference program to the 2013 STA Annual Meeting.**
- **Continue to advance support of the STA Innovation Endowment with the goal of re-introducing a competitive grant process.**

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Report from the Executive Director

By Jane A. Svinicki, CAE

Transparency and the Membership Organization

It is a challenging time for many non-profit organizations. There are more demands by members for value from their professional organizations at the same time there are less resources to meet those demands. In addition to delivering the nearly impossible, it is important for organizations to operate in an environment of transparency.

But what exactly is transparency and what does it mean for STA and other professional organizations?

Of course in the physical sense, transparency means something you can see through. But in the case of STA, IARS, and other membership organizations, it means transparency in the behavior of those that govern us.

Transparency is operating in such a way that it is easy for others to see and understand what actions are performed. For an organization to have a transparency culture, it must be aware of transparency and routinely incorporate it into how things are done by staff, Board members and volunteers.

For example, transparent organizations provide members access to board contact information, records of official meetings, financial information, and policy and procedure documents. The board members actions held to a standard of 'good for the organization' not 'good for me.'

Transparent organizations require the disclosure of conflicts of interest by Board members regarding the actions of the Board. A Board member may be owner of a company that wants to do business with the organization. This company may be the best provider of the service at a very fair price. The Board member can still propose such an arrangement, but they must disclose the value their company will receive from the decision AND not participate in the selection of their own company by the Board.

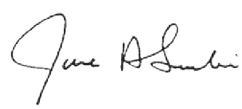
Here are two examples of the same situation, can you recognize which example is a transparent organization and which organization is headed for trouble with its members?

Example A: an organization is picking a location and hotel for its annual meeting. Two hotels are finalists for the meeting and one hotel offers the Board members a free weekend visit with families to experience the hotel. Everyone goes and has a great time and this hotel is selected.

Example B: The Board names members to a Search Committee to visit the two finalist hotels for its annual meeting. Each hotel is asked to provide the Search Committee members with two free nights and a hosted dinner to experience what it is like to stay at the hotel. The hotel selection criteria for the annual meeting is included in a written policy and procedure document. The Search Committee recommends a hotel to the Board based on its visits and the hotel is selected by a vote of the Board of Directors.

In the case of example A was the Board influenced by the 'gift' of a free weekend? What would a member think if they read about the free weekend in an medical meeting blog? How would the member perceive the Board actions in example B?

Transparency generally implies openness, communication, and accountability. Cultivating these values requires commitment and awareness on the part of any organization. At STA, we will continue to provide you, our members, with the transparency you deserve. We may not always be perfect, but we will always be working towards transparency.



Jane A. Svinicki, CAE
Executive Director

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Society for Technology in Anesthesia Upcoming Events

IARS 2012 Annual Meeting - STA Problem Based Learning Discussion & STA Breakfast Panel
Friday, May 18, 2012 - Monday, May 21, 2012
7:00am-8:00am
Marriott Hotel Copley Place
Boston, Massachusetts

American Society of Anesthesiologist Annual Meeting Events

STA Ty Smith Dinner
Sunday, October 14, 2012
Washington D.C.

STA Breakfast Panel
Tuesday, October 16, 2012
7:00am - 8:15am
Washington D.C.

STA 2013 Annual Meeting
January 9-12, 2013
Royal Palm Resort & Spa
Scottsdale, Arizona

STA 2014 Annual Meeting
January 15-18, 2014
Orlando, Florida

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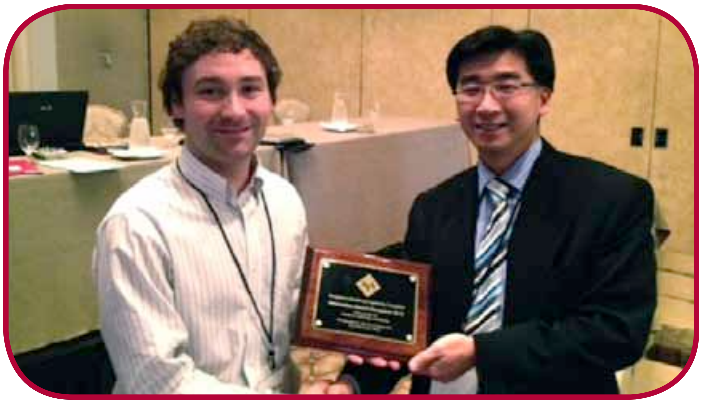
STA 2012 Engineering Challenge

By Jeff Mandel, MD, MBA

The goal of the STA Engineering Challenge was to pose a simple clinical problem that could be addressed by application of engineering. Past challenges have included design of a simple apnea detector and user interface technology. This year's challenge was chaired by Jeff E Mandel and Robert "Butch" Loeb. The problem was from a photoplethysmography signal. Kirk Shelley provided the signal sets, an initial set included the plethysomograph tracing with the accompanying respiratory waveform. These signals were made available in August 2011. The final data set was made available prior to the competition, with only the plethysomograph signal available.

Two entrants, both from University of British Columbia, presented their results. The first presentation was from Andy Tsai, who described MediWaveTM, a "desktop/mobile software application that is capable of analyzing sinusoidal waveform from an archive data set or a real time PPG source". The second presentation was made by Chris Brouse (on behalf of Srinivas Raman), which employed feature extraction to determine peak-to-peak interval and amplitude of heart beats and data fusion to derive respiratory rates.



Winners of the 2012 STA Engineering Challenge.

The final data set was comprised of four sequences of increasing complexity. Both teams performed well on the first three data sets, but on the fourth data set, Srinivas Raman's algorithm proved superior.

The session generated considerable interest, and we hope to continue this tradition at future STA Meetings.

Society for Technology in Anesthesia Upcoming Events

Ty Smith Dinner

Sunday, October 14, 2012

Charlie Palmer Steak

Located on Constitution Ave. NW Washington D.C. with views of the U.S Capitol Building

6:30pm Cocktails | **7:00pm** Dinner with presentation to follow

Registration Opens May 1, 2012

2012 STA Abstract Winners

By Thomas Hemmerling, MD

The winners of the 2012 Abstract Competition were:

- **A CO2 Waveform Generator Use in Evaluating Capnometer Performance Using Previously Recorded Clinical Data**
    - Presenting Author: Joseph Orr, MD

    Dr Orr presented a new CO2 waveform generator which can make the testing of new capnometers for precision easier; Dr. Orr's work is an example of STA members developing research tools for evaluating new medical devices.

- **Residents Helping in Navigating OR Scheduling (RHINOS): Facilitating Self Directed Learning**
    - Presenting Author: Jonathan Wanderer, MD

    Dr. Wanderer presented an OR scheduling program for residents. Assuring the quality and equality of resident education is one of the key aspects of anesthesia training. Dr. Wanderer's program helps keeping track of who does what and when and allows greater satisfaction of the residents by allowing them a more active role in OR assignment.

- **Automatic Ultrasound Nerve Detection**
    - Presenting Author: Thomas Hemmerling, MD

    Dr. Hemmerling's group presented software which allows automated detection of nerves on an ultrasound image. This program was tested in sciatic nerve images and showed very promising results in automatically detecting the nerve area.

- **Measuring Adequacy of Analgesia with Cardiorespiratory Coherence**
    - Presenting Author: Christopher Brouse, MASc

    Dr. Brouse presented a new score, called cardiorespiratory coherence, in the nerve ending quest for a valid intraoperative score for adequate analgesia. In the future, this score might be a valuable guidance for clinicians and a basis for closed loop administration of opioids during surgery.

- **The Magellan - First Robotic Ultrasound Guided Nerve Block in Humans**
    - Presenting Author: Thomas Hemmerling, MD

    Dr. Hemmerling's group presented the first robotic US guided nerve block system, called Magellan. An anesthesiologist can operate a robotic arm via a joystick to perform nerve blocks. Future studies will show the precision and safety of such a system.

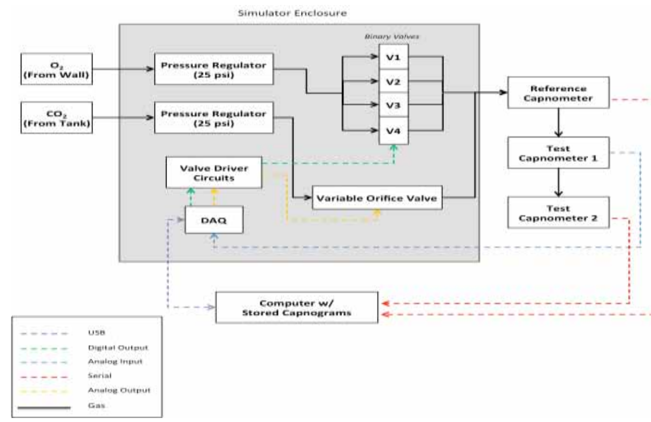
Congratulations to all,
Dr. Thomas Hemmerling
Research Committee Chair

Full Abstracts *appear on pages 9 - 13*

A CO2 WAVEFORM GENERATOR USE IN EVALUATING CAPNOMETER PERFORMANCE USING PREVIOUSLY RECORDED CLINICAL DATA

Joseph Orr, PhD, Christina Long, MS, Lara Brewer, PhD
University of Utah, Salt Lake City, UT

Introduction: Capnometry is becoming a standard for monitoring of spontaneously breathing patients during procedural sedation, during PCA and in the PACU. Because of the variable nature of spontaneous breathing in these conditions, identification of the start and end of each breath within the CO_2 signal can be difficult. Extraction of an accurate breath rate measurement from the capnogram signal becomes more difficult as the breathing becomes less mechanically controlled and as the sampling site moves away from the airway. Identifying breaths from the capnogram for a patient that is intubated and mechanically ventilated is trivial. On the other hand, if a patient is a sedated and breathing spontaneously and CO_2 is sampled via a split-lumen nasal cannula which is also being used to deliver oxygen, accurate detection of the start and end of each breath is much more difficult. Present performance standards for capnometers only require accurate measurement of the concentration of CO_2. There are no performance standards for the algorithms used tocalculate breath rate or end-tidal CO_2 from the CO_2 waveform. We have developed a system that physically re-creates clinically recorded CO_2 signals so that breath detection algorithms, as implemented in multiplecapnometers, can be compared using identical input data.



Methods: Our capnogram waveform generator consists of: 1) 100% CO_2 and O_2 gas sources, 2) a simulator enclosure, 3) a reference capnometer, and 4) a computer with stored capnograms. The concept of the simulator is to continuously change the flow rate of CO_2 being injected into a constant flow of O_2, in order to create varying CO_2 partial pressures over time that mimic capnograms. The CO_2 flow rate is computer controlled through a variable orifice solenoid valve that outputs higher flow rates or higher solenoid currents. Its response is non-linear and requires calibration before use. Once the CO_2 is injected into the O_2 stream, the mixed gas is diverted to the reference capnometer, which is used to calibrate the CO_2 valve and measure the performance of the simulator. The reference capnometer used in this study was the on-airway Capnostat analyzer (Phillips Respironics, Wallingford, CT). Five capnogram data files were used to simulate different CO_2 levels, respiratory rates, and waveform shapes and trends. These files include waveforms from intensive care unit (ICU), operating room (OR), new born, pediatric, and sedated adult patients.

Results: The average statistics for five minute simulations were root mean squared error (RMSE) = 1.99 mmHg, normalized root mean squared error (NRMSE) = 3.77%, mean absolute error (MAE) = 1.40 mmHg, and R^2 = 0.989.

Discussion: Using a CO2 waveform generator, it is possible to directly evaluate the performance of capnometer algorithms using a library of clinical data. This waveform generator facilitates the standardization of capnometry algorithm performance so that clinicians can be assured that the parameters reported by their capnometers are consistent for a given type of CO2 waveform regardless of the make or manufacturer of monitor. Furthermore, use of a physical simulation ensures that the capnometer algorithm accounts for the limitations of the analyzer and sampling system.

Sample CO_2 waveforms. Black line represents clinically collected capnogram waveform, red line represents output of waveform simulator

RESIDENTS HELPING IN NAVIGATING OR SCHEDULING (RHINOS): FACILITATING SELF-DIRECTED LEARNING

Jonathan Wanderer, MD, MPhil, Stuart Forman, MD, PhD, Keith Baker, MD, PhD

Massachusetts General Hospital, Boston, MA

Introduction: Few mechanisms exist for matching available clinical opportunities to trainee's individual interests. We created and deployed Rhinos, a web-based tool that facilitates self-directed learning by permitting residents to rank order preferences for specific assignments. The application was piloted on two core anesthesia residency rotations over six weeks. The impact on the residency experience was assessed with an ad hoc survey.

Methods: Success was determined by comparing the frequency with which resident requests matched the actual cases done. Residents were asked to complete an on-line survey which included the System Usability Scale to assess usability.

Results: 165 requests were entered. Residents received a requested assignment 76% of the time (1st choice 54%, 2nd choice 17%, 3rd choice 5%, no match 24%). 21 of the 26 residents who used Rhinos completed the survey (80% response rate). On a Likert scale (1="Much improved", 7="Much worse"), Rhinos improved satisfaction with the case assignment process (2.05 ± 0.97), increased feeling of case ownership (2.05 ± 1.20), improved daily satisfaction (2.29 ± 1.15), improved overall satisfaction (2.29 ± 1.23), self-assessed learning (2.38 ± 1.16) and morale (2.1 ± 1.13). Usability ratings were high (91.15 ± 12.04; maximum score 100).

Discussion: Rhinos integrates multiple peri-operative information systems with resident input to create a highly usable scheduling tool that improves the resident experience. Resident preferences varied sufficiently on a day-to-day basis to permit the majority of 1st choice assignment requests to be met. Scheduling workflow can be improved by replacing manual processes with drag-and-drop solutions.

AUTOMATIC ULTRASOUND NERVE DETECTION

M. Wehbe, J. Morse C. Zaouter, S. Cyr, Thomas Hemmerling, MD

McGill University, Montreal, Canada

Introduction: The purpose of this project is to derive an optimal algorithm to allow for automatic ultrasound (US) detection of the sciatic nerve at the popliteal fossa.

Methods: The software was written in MATLAB® R2011b (MathWorks®, Natick, MA, USA). The first step was to apply a Wiener filter on the US image, in order to reduce noise. Next, K-means clustering was used to divide the US image into three clusters, one of which contains the nerve. The appropriate cluster was the one containing the brightest pixels as these tissues appear as the brightest regions in an US image. Muscle fascia was then eliminated by discarding objects having a width greater than two times the length. The largest remaining object was then assumed to be the popliteal nerve. The study consisted of two parts; in part 1, 20 US images were obtained (TH) from both sciatic nerves in 5 authors. To evaluate the algorithm, two US-experienced anesthesiologists were asked to manually locate the nerve in the US images. Both anesthesiologists detected the same regions on all of the US images as being the sciatic nerve. The manual nerve locations were then compared with those detected automatically using two levels of comparison: first, whether the center of the automatically identified nerve lies within the area of the manually identified nerve; and second, the percentage of overlap of areas created around the nerve centre by drawing circles ranging in diameter from 1 mm to 1 cm around the centers of the automatically identified nerves and the manually drawn area (Figure 1). In part 2 of the study, 100 US images of the sciatic nerve (5 per side and author) were taken in 5 authors. The algorithm was applied with the objective to determine the percent of the images where the automatically defined nerve centre was within the manually detected nerve area and to determine whether the maximum area drawn around this centre to allow for a minimum of 95% overlap between manually identified nerve area and automatically drawn area around the nerve centre – as determined in part 1 of the study – could be confirmed in this larger number of US images.

Results: In part 1, the automatic nerve centre was within the manual nerve area in 96% of the US images. Percentages of overlap ranged between 92% (1 mm diameter) decreasing to an overlap of 63% (1 cm diameter). The maximum diameter for at least 95% overlap was determined as 0.5 cm. In part 2, the automatically detected nerve centre was within the manually detected nerve area in 99% of the images. Overlap ranged between 100% (1 mm diameter) and 69% (1 cm diameter) Figure 2. Percentage of overlap at a diameter of 0.5 cm was 95% and at 0.4 cm 98%, respectively.

Conclusion: The automatic ultrasound nerve detection system proved to be reliable in detecting the sciatic nerve in the popliteal fossa. Using this system, drawing a circle of 0.4 cm around an automatically detected nerve centre produces an overlap of almost 100% with a manually detected nerve area. A target area of a circle with 0.4 cm diameter seems a clinically sufficiently large target area for nerve block needle placement. This system will pave the way for the development of a completely automated robotic nerve block system.

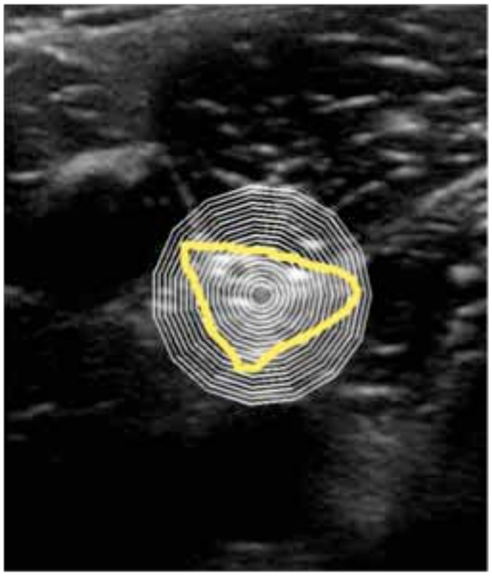


Figure 1: Automatic detection areas (white), and manual detection (yellow)

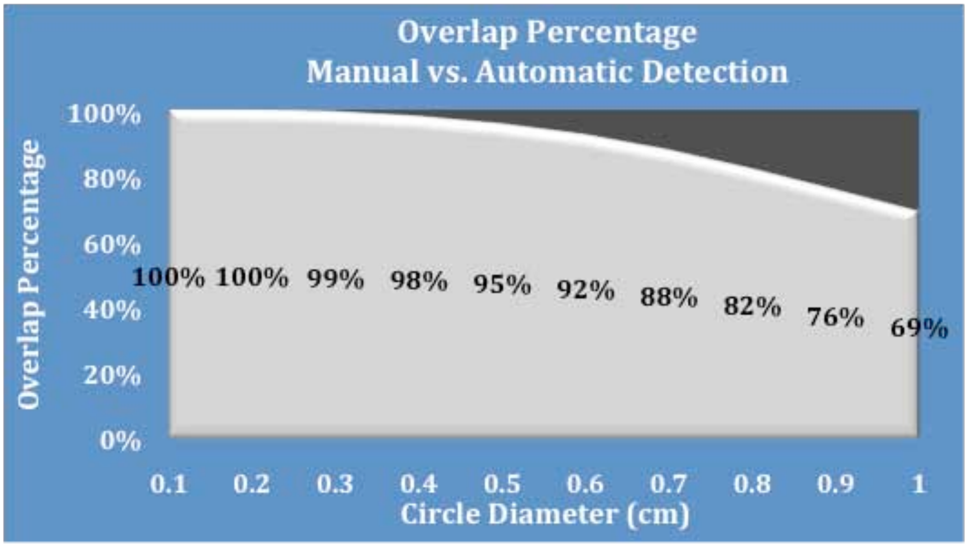


Figure 2: Percentage of Overlap between the automatic and the manual detections

MEASURING ADEQUACY OF ANALGESIA WITH CARDIORESPIRATORY COHERENCE

Chris Brouse, Walter Karlen, Guy Dumont, Dorothy Myers, Erin Cooke, Jonathan Stinson, Joanne Lim, J. Mark Ansermino

The University of British Columbia, Vancouver, Canada

Introduction: An automated nociception monitor would be very useful in general anesthesia, providing anesthesiologists with real-time feedback about the adequacy of analgesia. We have developed an algorithm to measure nociception using respiratory sinus arrhythmia (RSA) in heart rate variability (HRV). We have previously shown that this algorithm can detect patient movement (strongly nociceptive events) during general anesthesia [1]. We will now attempt to determine if the algorithm responds to boluses of anesthetic drugs (strongly anti-nociceptive events).

Method: *Algorithm:* The algorithm estimates cardiorespiratory coherence, which is the strength of linear coupling between HR and respiration (one measure of RSA). It measures and combines the spectral power in both signals using wavelet analysis. Coherence is dimensionless, and ranges from 0 (no coherence, strong nociception) to 1 (perfect coherence, no nociception).

Data Analysis: Following ethics approval and informed consent, 60 drug bolus events (excluding induction of anesthesia) were recorded in 47 pediatric patients receiving general anesthesia during dental surgery. In post hoc analysis, coherence was averaged over the 60s immediately preceding the bolus dose of drug (nociceptive period). The bolus was given 30s to take effect, after which the coherence was averaged over the following 60s (anti-nociceptive period). The change in average coherence between the two periods was calculated. The change in average HR was also calculated, for comparison.

Results: Coherence increased by an average of 0.14 (32%) in response to the bolus dose of anesthetic drug. HR decreased by an average of 4.1 beats/min (3.9%).

Discussion: Cardiorespiratory coherence responded much more strongly to the anesthetic boluses than did HR alone. This result, combined with previous work showing that coherence is low during periods of nociception [1], demonstrates that cardiorespiratory coherence can be used to measure the adequacy of analgesia during general anesthesia. We are currently adapting the algorithm so that it can be used in real-time.

References

1. Brouse CJ et al., Conference Proceedings of the IEEE EMBS, 2011, pp. 6114-7.

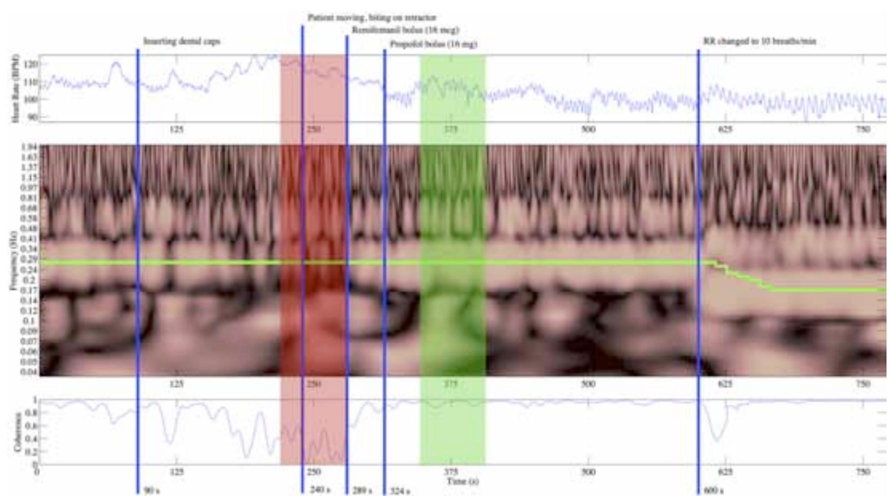


Figure 1: Example coherence analysis. Top plot: heart rate. Middle plot: coherence map in time/frequency. Bright areas indicate high coherence. Horizontal green line indicates the respiratory frequency. Bottom plot: coherence at the respiratory frequency. Vertical blue lines denote clinical events. Red box denotes nociceptive period, green box denotes anti-nociceptive period.

THE MAGELLAN™ – FIRST ROBOTIC ULTRASOUND-GUIDED NERVE BLOCK IN HUMANS

M. Wehbe, J. Morse C. Zaouter, S. Cyr, Thomas Hemmerling, MD

McGill University, Montreal, Canada

Background: Ultrasound(US)-guided nerve blocks are very popular in modern anesthesia. The aim of the present study was to develop a robotic US-guided system (The Magellan™) to perform nerve blocks in humans using a remote control centre and to determine its feasibility defined as success rate.

Methods: In this pilot study, 13 patients were enrolled after approval of the local Ethics board and written informed consent..The Magellan™ (Fig. 1) consists of three main components: a ThrustMaster T.Flight Hotas X joystick (Guillemot Inc., New York, NY, USA), a JACO robotic arm (Kinova Rehab, Montreal, QC, Canada), and a software control system. The Magellan™ consists of a remote control centre (joystick and nerve block cockpit) linked to both a webcam and a US machine for image transmission (Fig. 2). The joystick allows simulation of wrist or arm movements of a human operator. After manual localization of the sciatic nerve, 35 ml of bupivacaine 0.25% were injected. Success rate of popliteal nerve blocks and block performance times (performance time = interval of time from the start of the ultrasound search for the nerve to the end of the injection of the drug; robotic time = interval of time from the detection of the nerve to the end of the injection of the drug) were measured. Data are shown as median (interquartiles; min, max) and categorical data. Trend was analyzed using linear regression.

Results: Seven men and 8 women aged 37 yrs were included in this study. Three out of 16 patients received a bilateral block. Nerve blocks were successful in all patients. Nerve performance time was 189 s (150, 233; 90, 305), robotic time was 164 s (121, 210; 73, 271). The linear regression of the mean nerve performance time showed a negative slope, denoting that each successive trial required less time (Fig. 3). The negative regression coefficient of the slope was more distant from 0 when the patients receiving bilateral blocks were excluded (Fig. 4).

Conclusions: We present the first human testing of a robotic US-guided nerve block system. The success rate was 100%. The total robotic block performance time ranged from 3 to 4 min.

Figure 1

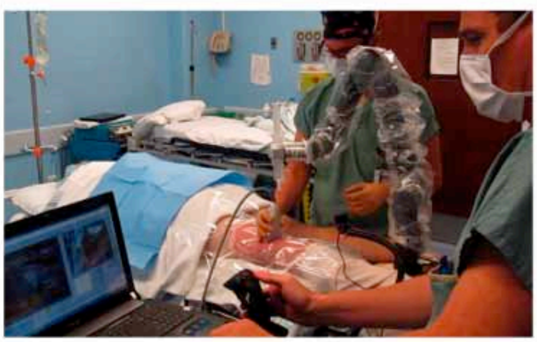


Figure 3

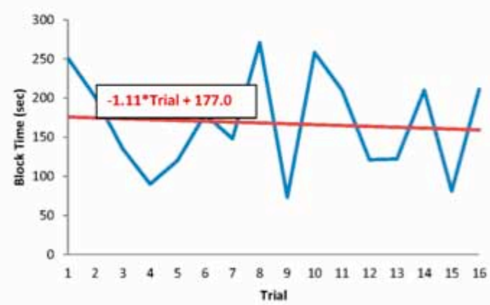


Figure 2

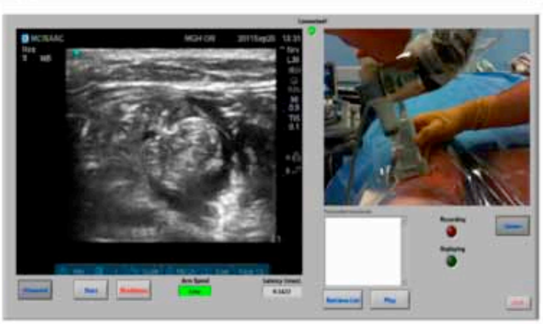


Figure 4