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Training Our Partners At Work

Bull HK Coll Anaesthesiol 2007; 16:4- 8

In the Hospital Authority operating theatres, anesthesiologists have been assisted by the Operating Theatre Assistants (OTAs) for over 40 years. In the sixties, ward stewards and porters were recruited to become OTAs as the required duties then were to transport patients from wards to the holding area and then onward to the operating theatres. They also helped with positioning of patients, applying tourniquet, and focusing the theatre light. Just before operation, they assisted with the induction of anesthesia by preparing the airway equipment which mainly consisted of oral airways, face masks, laryngoscopes and endotracheal tubes. They also helped to clean up the anesthetic equipment afterwards. In the 1990's, education of the general public had substantial improved. There were more secondary school graduates interested to work as the OTAs. The duties of the OTAs had also changed significantly in the recent years. Apart from the routine work of transporting and positioning patients, moving the theatre light, and some minor clinical duties such as applying ECG electrodes, blood pressure cuff, and priming intravenous fluid giving sets, some of them would be able prepare the transducer set for central venous and arterial pressure monitoring. In view of the development, many departments of anesthesia started to offer in-service training to their OTAs.[1] Most of the training consisted of lecturers and workshops. The results and feedbacks were encouraging in that the OTAs seemed to be more efficient at work and their attitudes were motivated and became more positive. As there were a lot of staff movements, it was not easy to provide structured training to all serving OTAs in a systematic manner. With the support from the Coordinating Committee in Anaesthesiology, Hospital Authority (HA), it was decided that a centrally coordinated course should be organized for all the OTAs working at the HA operating theatres. Also, it was the global trend to have organized training for anesthetic assistants. There are evidence to suggest that the incidences of anesthetic morbidity and mortality was decreased with the assistance of skillful anaesthetic technicians also appeared.[2] After overcoming some minor hurdles, the first Certificate Course in Anaesthesia Assistance (CCAA) was organized in year 2000. As a number of uncertain elements with the first pilot course were anticipated, the number of intake was limited to 30. The course was conducted in Cantonese. The aim of choosing Cantonese as the teaching language medium was to make it easier for the participants to understand the lectures, completing their assignments and passing the written examinations. The format of the course was designed to provide all full time OTAs an opportunity to complete the course in a year. All the lectures and workshops were arranged on Saturdays in order to facilitate the corresponding departments in releasing the participants from duty. As there were more than 300 OTAs in the HA hospitals, the priority was given to those who had at least 3 years experience. Although OTAs with higher education level was preferred, it was decided that a Form 3 graduate should be able to go through the course and complete the assessment at the end of the course.

Course Content and Assessment

The design of the CCAA met the educational requirements for assistants of the Hong Kong College of Anaesthesiologists.[3] The technical guidelines suggested that at a minimum, the course should consist of a number of criteria (Table 1). Although all participants were anesthetic assistants working in the operating theatres at the time of attending the course, they belonged to different ranks (Table 2) and they had diverse education and basic training background. Regardless of the ranks they belonged to, on completion of the course, participants should be able to:

(1) improve their skills in assisting anesthesia;

Table 1. Education requirement for assistants - Course and duration of instruction.

☑	A course of lecturers that will be provided either full-time or part-time. There will be continuous employment as an anesthetic assistant on probation during the course
☑	A course of lecturers of at least 50 hours in accordance with a curriculum into which anesthesiologists have a significant input
☑	Practical instruction supervised by anesthesiologists which should be documented in a log book as a record describing the type of instruction received and competencies demonstrated
☑	Completion of assignments appropriate to the curriculum which are suitable for presentation to supervisors
☑	Successful completion of internal assessments and designated examinations
☑	The duration of the course shall be during 6 months full-time employment
☑	The anesthetic assistant on probation should complete the course within 18 months
☑	Study may be undertaken in part-time courses or in full-time blocks

(2) understand the procedures and rationale of common types of anesthesia;
(3) assist an anesthesiologist and other professionals with appropriate skills, support and;
(4) assist an anesthesiologists effectively during crisis management and resuscitation.

These aims are consistent with HA's mission in providing patient-centered services. It was decided some basic science subjects would be taught to make ensure that a strong foundation before skills and knowledge on anesthesia was delivered to the participants. The basic science topics included physics, anatomy, physiology, and pharmacology. Information on important areas such as operating theatre management, operating theatre safety, central sterilization and infection control, anesthetic equipment, oxygen and other gas storage and supply were also systematically introduced to the participants aiming at a comprehensive training. In addition to didactic lectures, participants were required to perform practical tasks that were demonstrated by their mentors. Each successfully completed task required documentation in the logbooks. The various tasks required for successful completion covered most of the duties of the anesthetic assistants (Table 3). The course commenced in February just before the Chinese New Year. Second term started in July and graduation ceremony was held in November. The course lectures and workshops were delivered on the Saturday mornings from 0900 to 1230 hours. Workshops were conducted at various hospitals. Practicum was completed while the anesthetic assistants were at work. Tutorials to the participants were arranged between the

Table 2. Number of participants of Certificate Course in Anesthetic Assistants.

Rank	2000	2001	2002	2003/4	2005	2006	Total
Nursing Officer	0	2	1	1	0	1	5
Registered Nurse	2	10	5	2	0	0	19
Enrolled Nurse	4	6	15	8	7	6	46
Mid wife	0	1	0	0	0	0	1
Operating Theatre assistant (ORA/OTA)	27	40	38	48	21	3	177
Support Health Care Worker (HCA/GSA/TSA etc)	0	0	0	3	18	13	34
Non-HA Staff	0	0	0	0	0	34	34
Total	33	59	59	62	46	57	316

Table 3. Logbook contents

Main Areas:
1. Operating theatre floor plan and fire escape
2. Checking of anesthetic machine
3. Anesthetic and related gases storage and delivery
4. Difficult intubation trolley contents
5. Intra-operative ECG monitoring
6. Common anesthetic agents
7. Common intravenous fluids and transfusion procedures
8. Assisting in regional anesthesia
9. Recovery room anesthetic nursing
10. Acute pain management

participants and their mentors. Most of the tutorials were conducted during non-office hours to suit the participants and mentors. An average of 250 hours of practicum was required in order to complete the tasks set out in the logbook.

Assessment of the course consisted of assignments, logbook documentation of the required tasks and written examination. Participants were required to attend at least 80% of the classes and to achieve a total minimum score of 60% in assignments and examination. Certificates were issued to the successful participants at the end of the course. Although a few participants had to sit for the supplementary examination, most of the participants were able to pass the overall assessment.

Progress and Development

The course had undergone some modifications since the pilot scheme in 2000. Practical examination was used in the pilot course. The aim was to simulate working condition in the operating theatres. Although the aim was achieved, it was hard to arrange for the transport of anesthetic and surgical equipment to the examination venue. As the result, photographs showing the equipment were used in subsequent examinations. Although there was intention to organize the course yearly, in year 2003 it was suspended because of the SARS crisis. The course was resumed in 2004 combining participants in two years. From 2005, the course was arbitrarily divided into Module 1 and 2. The content of the new modular course was not different from the original one but participants were not allowed to proceed to Module 2 if they failed to achieve a pass in Module 1 assessment. If, for some reasons, the participants after going through Module 1 could not be released for the Module 2 component of the course in the same year, they could rejoin the training in subsequent years. The modular system also prepared the intake of second year health care associate degree students to the 2006 Module 1 of CCAA. An audit conducted in March 2006 revealed that almost all the workers in the rank of OTAs had attended the course (Table 4). The audit also showed that some newly recruited workers were waiting for their turn to join the course. As most of the OTAs had been trained, it was decided to lower the entry requirement and accept support workers of less than three years anesthetic assistant experience. Also, in year 2006, a total of 33 of year two students from the Polytechnic University Health Care Associate Degree were accepted into CCAA (Module 1). Three of them subsequently were employed as Anesthetic assistants and they proceeded to practical training in CCAA (Module 2).

As some of the nursing staff are required to assist anesthesia in education, administration and inventory management, it is envisaged that special skills are required in these areas. In addition to the CCAA, tailor made course was

Table 4. Number of workers that have been trained by the CCAA until 2006.

Cluster	Trained OTA	Not Trained OTA	Total number of OTA	Trained TSA	Not Trained TSA	Total number of TSA	Trained GSA	Not Trained GSA	Total number of GSA	Total number of Workers
NTEC	38	0	38	3	3	6	0	2	2	46
KCC	18	3	21	4	5	9	0	0	0	30
KWC	34	2	36	3	3	6	1	0	1	43
HKWC	15	0	15	7	3	10	1	1	2	27
HKEC	20	0	20	2	0	2	1	1	2	24
KEC	22	1	23	4	0	4	0	0	0	27
NTWC	19	1	20	0	2	2	0	0	0	22
Total	166	7	173	23	16	39	3	4	7	219

NTEC = New Territories East cluster; KCC = Kowloon Central cluster; KWC = Kowloon West cluster; HKWC = Hong Kong West cluster; HKEC = Hong Kong East cluster; KEC = Kowloon East cluster; NTWC = New Territories West cluster.

Table 5. Age profile of Anesthetic Assistants currently working in Hospital Authority.

Hospital	Years					Total
	21-30	31-40	40-50	51-55	55-60	
A	0	1	6	2	0	9
B	0	0	0	0	0	0
C	0	1	4	3	0	8
D	0	0	3	0	0	3
E	0	0	1	0	2	3
F	0	0	0	1	0	1
G	0	0	3	1	1	5
H	0	0	1	0	0	1
I	0	0	1	1	0	2
J	0	1	10	2	1	14
K	0	3	16	8	1	28
L	1	5	7	0	1	14
M	0	2	11	4	3	20
N	0	1	4	3	1	9
O	0	1	4	2	0	7
P	0	0	2	3	0	5
Q	0	1	10	6	3	20
R	0	0	0	0	0	0
S	0	0	2	0	1	3
T	3	9	4	1	0	17
U	0	0	4	2	1	7
Total	4	25	93	39	15	176

attained the requirement of the duty of Advanced Practice Nurse (APN) in Anesthesia. Some of them in fact took up the post of APN (Anesthesia) after training.

The way forward

A total of 192 out of 219 OTAs working in HA hospitals have attended the CCAA. Nonetheless, a small number of serving support workers currently working as anesthetic assistants were near retirement age and were not interested in pursuing further training (Table 5). There was also movement of employing assistants with an associate degree. Given that there are ongoing demands for anesthetic assistants, one of the options is to open the course to all students currently in their second year of a health care associate degree course. They may then take up their assistant role after the process of CCAA (Module 1) certificate.

Acknowledgement

Formal evaluation was performed by all the participants at the end of each course. All participants found the course very useful to understand their work duties. The also commented that the acquired skills and knowledge improved the standard of the services and patient safety. Most of them established very good working relationship with their mentors who put in a lot of time and efforts in training them and helping them with assessment. In addition to the mentors, lecturers who were mainly anesthesiologists, nursing officers and nurse specialists in anesthesia also contributed tremendously to make the program possible. All these were obviously driven by the noble desire of helping to advance the standard and making anesthesia safer for our patients. Without them, it would be impossible to start the course and keep it going.

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Class pictures on page 56.

A Randomized Comparison of Two Mobile Patient Controlled Analgesia Devices After Cesarean Section

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SUMMARY

We compared the analgesic efficacy and side effects of two disposable patient controlled analgesia (PCA) devices. One hundred and one patients following Cesarean section with general anesthesia were recruited randomly assigned to receive either Patient controlled injector PCI (Go Medical, West Australia) or an electronic patient controlled analgesia system (Graseby 9300, SIMS Graseby, UK). Oxygen saturation, heart rate, blood pressure, respiratory rate, sedation, nausea and vomiting and pain score were recorded every two hours. Patients were reviewed regularly for 24 hours after operation. We found the duration of PCA use, the time to mobilization, first oral intake, severity of pain and satisfaction score were similar in both groups. There were only few minor complications. We concluded that both devices performed equally well after Cesarean section.

Bull HK Coll Anaesthesiol 2007; 16:9-14

Patient controlled analgesia (PCA) was developed over twenty years ago. Initially, it was used as an experimental tool to measure pain in an objective manner.[1] Since then PCA, especially using intravenous drugs, has become a well-established technique for the provision of postoperative analgesia.[2] It is important to provide adequate pain relief not only for humanitarian reasons, but also because postoperative pain may increase morbidity and mortality after surgery. A meta-analysis of 15 randomized controlled trials confirmed the superior efficacy of PCA and strong patient preference for using it.[3] Similarly, report has indicated that PCA was associated with improved surgical outcome which could be related to early ambulation.[4] A number of PCA devices are now available for clinical use. Many of the devices are electronically driven. They are generally expensive and considerable investment is required if they are to be made available to patients after surgery. More recently, low cost disposable devices that are mechanically driven have been available and may be a reasonable alternative. The purpose of the present study was

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to compare the efficacy of a disposable PCA device, patient controlled injector (PCI) with a commonly used electronic PCA pump in patients undergoing Cesarean section with general anesthesia.

Methods

After approval from the local Clinical Research Authority, 101 American Society of Anesthesiologists physical status I-II patients presenting for Cesarean section during general anesthesia were recruited to the study. All patients gave informed consent. Patients were randomly allocated to receive either disposable patient controlled injector (PCI, Go Medical, Subiaco, West Australia) or electronic PCA (Graseby 9300, SIMS Graseby, UK). All patients were instructed on the use of either devices during the preoperative visits.

Ranitidine 150 mg was given orally the evening before and the morning of surgery, and 0.3 M sodium citrate 30 ml orally just before transfer to the operating room. After intravenous cannulation and routine monitors, such as electrocardiogram, noninvasive arterial pressure, and pulse oximetry were placed. All patients received pure oxygen for three minutes using a tight fitting mask. Anesthesia was then induced with rapid sequence technique with cricoid pressure applied by trained operating theatre assistants. All patients had thiopentone 4 mg/kg. Tracheal intubation was facilitated with succinylcholine 1.5 mg/kg. Additional muscle relaxation was provided with appropriate dose of atracurium and anesthesia was maintained with isoflurane 0.5 vol%. A bolus dose of morphine 0.1 mg/kg IVI was given for analgesia after delivery of fetus and syntocnion was given to augment uterine contraction. After the completion of surgery, neuromuscular block was reversed with neostigmine 40 μg/kg and atropine 20μg/kg.

In recovery room, morphine 1 mg IVI was was given to patient every five minutes until adequate pain relief was obtained. A PCA device (disposable PCI or electronic PCA) was connected to patient's IV cannula according the group allocation concealed in an opaque envelope. Further instructions were given to patients regarding the use of the PCA device. Both devices were loaded with 45 mg of morphine diluted with normal saline up to a concentration of 1 mg/ml. The settings of both devices were made to deliver a bolus of 0.5 ml with a lockout time of 5 minutes. One-hour maximum limit was not set.

Patients were then transferred to the postnatal ward after they have been stabilized in the recovery room for at least 20 mintues. We recorded a number of data every two hours in the ward:

(1) Pain was assessed at rest using an observer's initiated verbal numeric rating scale (VNRS) ranging from 0 to 10 (0 = no pain, 10 = the most severe pain that one ever had).
(2) Arterial pressure was measured noninvasivly using an automatic sphygmanometer. Hypotension was defined as a systolic arterial pressure < 90 mmHg or > 30% below the preoperative baseline value.
(3) Oxygen saturation were also recorded, and respiratory depression was defined as a respiratory rate of < 8 breaths/minute or an oxygen saturation < 90%.
(4) Sedation was rated using a 3-point scale (0 = awake, 1 = drowsy but rousable, 2 = unrousable).
(5) Nausea and vomiting was assessed using a 4-point scale (0 = no nausea or vomiting, 1 = mild nausea, 2 = vomiting once in the last hour, 3 = vomiting twice or more in the last 2 hours.

Once complications such as inadequate pain relief and pruritis were noted, the acute pain team would then be informed for prompt appropriate treatment.

The PCA device was connected to the patient for at least 24 hours and at 24 hours patient was asked regarding her satisfaction (good, fair or poor pain relief) and her comment on the ease of use of PCA device (easy / fair / hard to use) were recorded. In addition, the time to first oral

Table 1. Demographic data. Values are mean ± standard deviation or number.

	Disposable patient controlled injector	Electronic patient controlled analgesia pump
No. of patients	51	50
Age (years)	31.5 ± 5.5	30.3 ± 4.2
Parity (0 / 1 / 2 / >2)	15 / 17 / 16/ 2	15 / 19 / 10 / 3
Baby feeding (breast milk / formula / both)	20 / 25 / 6	24 / 20 / 6

intake and time to mobilization were charted. The PCA device was then disconnected or upon patient's request to encourage further mobilization and breast feeding. Subsequent analgesia was provided with oral analgesia.

Statistics

Data were analyzed using student *t* test, χ^2 analysis, and Mann Whitley *U* test, where appropriate. A *P* value of less than 0.05 was taken as statistically significant.

Results

There were 51 patients in the disposable PCI group and 50 patients in the electronic PCA group. Demographic data did not differ between groups (Table 1). All patients had singleton pregnancies. Details of PCA usage are shown in Table 2. The mean (± standard deviation, SD) duration of PCA used in patients receiving disposable PCI, 26.5 ± 10.6 hours was similar to that with electronic PCA pump, 25.3 ± 9.5 hours, *P* = 0.52. One patient in the disposable PCI group demanded early termination of the device because of dizziness associated with its use. There were no technical problems. The time to first mobilization and the first oral intake were similar in both groups, *P* = 0.61. Complications from the PCA use are shown in Table 3. There were only few complications and minor in nature. No patient required specific treatment for the complications. One patient complained of pain at the cannula insertion site as the result of a blocked cannula. Most patients were satisfied with the PCA devices and found them very easy to use. There was no difference between group.

Discussion

The Cardiff Palliator was the first PCA pump available commercially in 1976.[5] Since then numerous types of PCA devices are in clinical use today. The choice of suitable PCA devices has increased over the last 10 years but many had no documentation of their safety and utility in the routine clinical situation.[6] Many PCA devices were tested in the laboratory only. Their accuracy

Table 2. Details of PCA usage. Values are mean ± standard deviation or number.

	Disposable patient controlled injector	Electronic patient controlled analgesia pump
No. of patients	51	50
Duration of use (hours)	26.5 ± 10.6	25.3 ± 9.5
Total volume used (ml)	29.5 ± 14.4	30.3 ± 18.8
Time to mobilization (hours)	19.8 ± 8.6	21.7 ± 6.1
Time to first oral intake (hours)	17.5 ± 7.9	17.5 ± 5.9
Pain score (0-10)	2.8 ± 2.0	2.5 ± 2.0
Satisfaction score (good / fair / poor)	38 / 13 / 0	33 / 16 / 1
Ease of use (easy / fair / hard)	45 / 3 / 0	42 / 8 / 0

Table 3. Incidences of side effects. Values are mean ± standard deviation or number.

	Disposable patient controlled injector	Electronic patient controlled analgesia pump	*P* Values
No. of patients	51	50	
Respiratory rate (beats/min)	19.3 ± 3.6	19.7 ± 3.6	NS
Sedation Scare (0 / 1 / 2)	50 / 1 / 0	49 / 1 / 0	NS
Nausea score (0 / 1 / 2 / 3)	47 / 2 / 2 / 0	49 / 1 / 0 / 0	NS
Hypotension (none / >30%)	50 / 1	50 / 0	NS
Desaturation (none / <90%)	51 / 0	50 / 0	NS
Pruritus (none / present)	47 / 4	50 / 0	<0.05
Rescue analgesia (none / required while on PCA)	49 / 2	49 / 1	NS

were usually assessed volumetrically or gravimetrically, from collection of the infusate delivered. In these studies the output was measured manually, and continuous infusion and bolus doses were tested separately that had no relevance to the clinical use.[7-9] Hawkins *et al* developed an *in vitro* system to test the accuracy of PCA devices in situation that resemble clinical use. Bolus requests are made automatically at predetermined intervals, and the infusate delivered is measured and recorded without the need for operator presence. The system provides a mean of testing PCA devices operating in any delivery mode.[10] Using this system an assessment was made to test the accuracy of 16 PCA devices (Graseby PCA pump, *n* = 12; Abbott provider pump, *n* = 3 and IVAC infuser, *n* = 1). All devices were found to deliver accurate amount of infusate over a 24 hour period.[8]

As PCA pumps are gaining popularity all over the world and more PCA devices are being used, serious adverse events related to device malfunction have been reported.[11-15] The PCA devices used were mainly electronic pumps. As electronic pumps generally are expensive and considerable investment is required if they are to be made available to all patients after surgery, several manufacturers have produced low cost disposable pump for alternative. In 1987 a disposable, non-electronic PCA device was developed to meet this need.[16] A number of studies have since been conducted to evaluate their performances, Robinson and co-workers compared the performance of the Baxter disposable with the Graseby electronic PCA system in 30 patients and concluded that there was no difference between groups with respect to postoperative pain relief or sedation. Requirements for antiemetic drugs and patient acceptability were also comparable.[17] The Baxter disposable PCA device was further evaluated in the pediatric population and found to have providing similar pain relief compared with Graseby PCA system The authors concluded that the disposable device is an alternative to electronic systems and may have advantages in term of cost.[18]

The mobile PCA devices we used in this study are lightweight even when loaded to 45 ml of solution (0.12 kg for disposable PCI and 0.50 kg for electronic PCA pump). The staff and patients found both devices easy to use. All patients graded the ease of use as easy or fair. The favorable response may be due to a preselection of highly motivated patients who were young and alert. The total volume used per patient in either group was similar and this finding was expected as the settings of the two devices were identically programmed. The pain scores were similar in both groups, confirming that the efficacy of PCA

morphine with the present dosing regime for our patients regardless the type of PCA devices used. We administered a IVI bolus of morphine in the recovery room and that is commonly adopted in the Western countries. However, the Chinese patients are of smaller build and are generally more sensitive to opioids and bolus of morphine 0.5 mg is considered to be adequate.[19] One out of 51 patients in the disposable PCI group and two out of the 50 patients in the electronic PCA group requested rescue analgesia while they were still connected to the PCA devices. One of the reason of inadequate analgesia was due to the traditional belief that intramuscular injection offers better relief and hence inadequate dosage of intravenous morphine was delivered. This was confirmed as the records from these three patients indicated that they had not made the maximum demands. The time to mobilization and the time to first oral intake were similar between groups. This reflects the importance in providing mobile devices to patients who should be encouraged to mobilize as early as possible for the care of themselves and their babies.

The incidence of complications was rare. Only five out of 101 patients complained of nausea. All patients refused rescue treatment. Four out of 101 patients complained of pruritis. The symptoms were mild and treatment was not given. Nausea, vomiting and pruritis are well known side effects of opioids and not related to the types of PCA device used.

In summary, we found that the performance of the disposable PCI performed was similar to the electronic PCA pumps in patients after Cesarean section. Both devices were easy to use and patients reported high satisfaction score. It is known that the electronic PCAS which require more capital outlay although it is potentially more flexible and versatile compared to the disposable devices. In order to use the electronic PCA pumps in a more cost effective manner, the number of electronic PCA pump acquired by the Acute Pain Service can be based on the average requirements. During the period of peak usage when the number of patients exceeds the number of electronic PCA pumps available, disposable devices can be used in appropriate patients to fill the gap.

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Anesthesia in High-Dose-Rate Brachytherapy for Cervical Carcinoma

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SUMMARY

High-dose-rate brachytherapy is increasingly used to treat patients with gynecologic neoplasms. However literature specific on anesthesia for high-dose-rate brachytherapy for cervical carcinoma in ambulatory settings is limited. Medical records of 801 treatment sessions were reviewed. Analysis on patient data, surgical procedures, mode and duration of anesthesia, quality of Phase I recovery and Post-Anesthetic Discharge Score (PADS) in Phase II recovery, incidence of adverse events and reasons for unplanned hospitalization were performed. A total of 206 patients who had received high-dose-rate brachytherapy between the period March 2004 and August 2006 were included in this analysis. Spinal anesthesia was used in 79 (9.9%) and general anesthesia in 722 (90.1%) of sessions. In 717 sessions, anesthesia was induced with intravenous agent, followed by maintenance with volatile agent and spontaneous breathing via a laryngeal mask airway. Aldrete score of 10 at 30 minutes in Phase I recovery was achieved in 588 (73.4%) sessions whereas in 186 (23.2%) sessions, patients were discharged in less than 30 minutes during Phase I recovery. Mean (± standard deviation) time to home-readiness (defined as PADS ≥9) was 118 ± 46 minutes after general anesthesia and 159 ± 50 minutes after spinal anesthesia. Anesthesia-related adverse events were reported in 55 (6.9%) sessions and patients in 7 sessions were admitted postoperatively, which accounted for 1% of unplanned hospitalization. No anesthesia-related events led to interruption during treatment session or postponement of brachytherapy treatment. Other options of anesthesia techniques were discussed.

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Brachytherapy is the placement of radioactive sources within the body cavities or within the tissues. Recent publications have given an overview on analgesia and anesthesia in brachytherapy for carcinomas at various anatomical sites.[1,2]

High-dose-rate (HDR) brachytherapy is being increasingly used to treat patients with gynecologic neoplasms.[3] The advantages of HDR brachytherapy include patient convenience and outpatient therapy. However literature specific on anesthesia in high-dose-rate brachytherapy for cervical carcinoma in ambulatory settings is limited.

In this report, we reviewed our records for 801 sessions of high-dose-rate brachytherapy for

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cervical carcinoma in an ambulatory setting over a period of 30 months. We reviewed the anesthetic techniques used and evaluated the incidences of adverse events and reasons of unplanned hospital admission.

Methods

Approval was obtained from the hospital Ethics Committee to conduct the study. All the patients who received high-dose-rate brachy-therapy for cervical carcinoma between the period March 2004 and August 2006 (30 months) were identified through the Clinical Management Information System.

In a typical procedure, following appropriate anesthesia, the patient was placed in lithotomy position. Urinary bladder was catheterized and the balloon of the urinary catheter was inflated with radio-contrast for brachytherapy planning. The cervical os was identified and endo-cervical canal was dilated if indicated. Radiotherapy applicators, in form of intra-uterine tube and vaginal ovoid or tandem, were then placed in position. Gauze was packed in vagina to displace the rectum and urinary bladder from the applicators. Intraoperative radiographs were taken and dosimetry was completed with computer program. All personnel then left the treatment room, the system was afterloaded and the patient was monitored through closed circuit television. At the end of treatment, the applicators and urinary catheters were removed. Anesthesia was reversed. Patients were transferred to Phase I recovery for close monitoring. Aldrete score was recorded. After being assessed by anesthetists, patients were transferred to Phase II recovery for observation before discharge home. Post- Anesthetic Discharge Score (PADS) was also noted. If the patients were inpatients before the treatment session, they would be transferred directly from Phase I recovery to ward, PADS was not recorded.

The medical records and anesthesia records were then retrieved. Data collected were divided into (1) patients' characteristics including age, body weight, American Society of Anesthesiologists (ASA) physical status and number of brachytherapy sessions received; (2) surgical details including whether the cervical dilation was needed, dimensions of the

Figure 1. Post-Anesthetic Discharge Scoring System (PADSS)

A. Vital signs
- 2 = within 20% of preoperative value
- 1 = 20% to 40% of preoperative value
- 0 = > 40% of preoperative value

B. Ambulation and mental status
- 2 = oriented to know his/ her name, his location and what time it is, AND has a steady gait
- 1 = oriented to know his/ her name, his location and what time it is OR has a steady gait
- 0 = neither

C. Pain or nausea and vomiting
- 2 = minimal
- 1 = moderate
- 0 = severe

D. Surgical bleeding
- 2 = minimal
- 1 = moderate
- 0 = severe

E. Intake and output
- 2 = has had oral fluids AND has voided
- 1 = has had oral fluids OR has voided
- 0 = neither

Table 1 Patients' particulars and detail of treatment sessions. Values are mean (± SD) or number (proportion).

	Overall	General anesthesia	Spinal anesthesia
Age (years)	61.6 ± 14.8	59.7 ± 14.0	75.8 ± 12.6
Weight (kg)	50.8 ± 8.8	51.0 ± 9.0	49.7 ± 7.7
ASA Grade;			
1	30 (14.6%)	30 (16.5%)	0
2	145 (70.4%)	133 (73.1%)	12 (50%)
3	31 (15.0%)	19 (10.4%)	12 (50%)
Number of treatment sessions	801	722	79
Duration of anesthesia (min)	66.2 ± 15.6	65.8 ± 15.6	70.8 ± 14.3)
Duration of procedures (min)	53.2 ± 14.4	53.0 ± 14.5	54.8 ± 13.1
Complications (episodes)			
Bradycardia	100	96 (13.3%)	4 (5.1%)
Hypotension	246	225 (31.2%)	21 (26.6%)
Change of anesthesia plan	1*	1 (0.1%)	-

ASA=American Society of Anesthesiologists

*The patient developed laryngospasm after insertion of laryngeal mask airway. Tracheal intubation was performed. The subsequent anesthesia and brachytherapy procedure was uneventful. The patient was discharged the same day after the session.

radiotherapy applicators in form of intra-uterine tube, ovoids or tandem used and duration of the surgical procedure. This was defined as the time from the first procedure undertaken by the oncologists to the complete removal of the applicators at the end of the treatment, and (3) anesthetic data including duration of anesthesia, measured from the first procedure undertaken by the anesthetist to the time patients were transferred off the operating table, mode of anesthesia, anesthetic agents used, intra-operative complications, such as bradycardia, defined as heart rate < 60 beats/ minute; hypotension, defined as blood pressure < 30% of pretreatment value; and change of anaesthesia plan. Aldrete score in Phase I recovery and time to home-readiness, defined as the time from end of anesthesia to time when PADS ≥ 9 (Figure 1) was attained, and reasons for hospitalization.[4]

Data were presented as mean ± standard deviation (SD), median (range) and number (proportion) as appropriate.

Results

During the 30 month-period, a total of 206 patients received high-dose-rate brachytherapy for cervical carcinoma. Nineteen of them were inpatients (9 patients due to pre-existing multiple

Table 2. Anesthetic agents used. Values are mean (± SD) or frequency, as appropriate.

Anesthetic agents	General anesthesia	Spinal anesthesia
Fentanyl (μg)	28.6 ± 21.6	---
Propofol (mg)	109.5 ± 36.8	---
Volatile agents (isoflurane / sevoflurane)		---
number of treatments	322 / 400	
maximum end-tidal concentration	1.0 ± 0.5 / 2.1 ± 1.0	
Bupivacaine; mg	---	7.5 ± 1.5
Ketorolac; frequency	48	-
Morphine; frequency	10	-
Anti-emetics- metoclopramide / ondansetron; frequency	19 / 9	-

Table 3 Adverse events that led to unplanned hospitalization. Values are number (proportion)

Reasons of unplanned hospitalization	Number of sessions
Social	125 (61.0%)
Medical*	34 (16.6%)
Surgical#	39 (19.0%)
Anesthesia-related	7 (3.4%)
Total	205 (100%)

*Medical reasons for unplanned hospitalization – 10 due to blood transfusion for anemia diagnosed before treatment, 8 due to fever, 4 for investigation of ischemic heart disease, diabetes and hypertension control, 12 wound care.
#Surgical reasons for unplanned hospitalization – 17 due to bleeding or observation for bleeding, 10 vaginal tear, 5 long list, 4 admitted for abdominal pain to rule out uterine perforation, 3 pain.

medical diseases, and 10 due to social reasons). The mean (± SD) age was 62 ± 15 (range: 15 - 92). Number of patients classified as ASA I, II and III were 30 (14.6%), 145 (70.4%) and 31 (15.0%), respectively. There were a total of 801 treatment sessions and all sessions were performed under the care of anesthetists.

Our data showed that endocervical dilation was required in 469 (58.5%) treatment sessions. The median (range) length of the intra-uterine tube applicators was 6 cm (3 -7 cm) whereas the median (range) size of the vaginal ovoids used was 3 cm (2.5-5 cm).

Spinal anesthesia was used in 79 (9.9%) treatments. General anesthesia was performed in 722 (90.1%) of the treatments. In 717 sessions (99.3% of general anesthesia), induction of anesthesia was achieved with bolus of propofol or

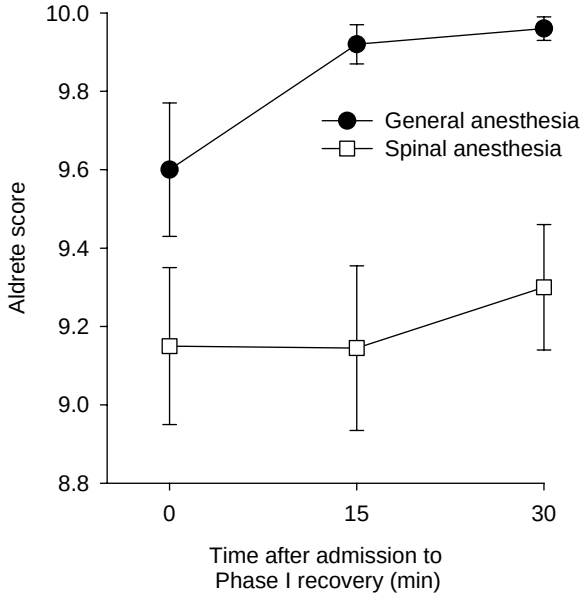

Figure 2. Aldrete Score at different time intervals. Values are mean with 95% confidence intervals.

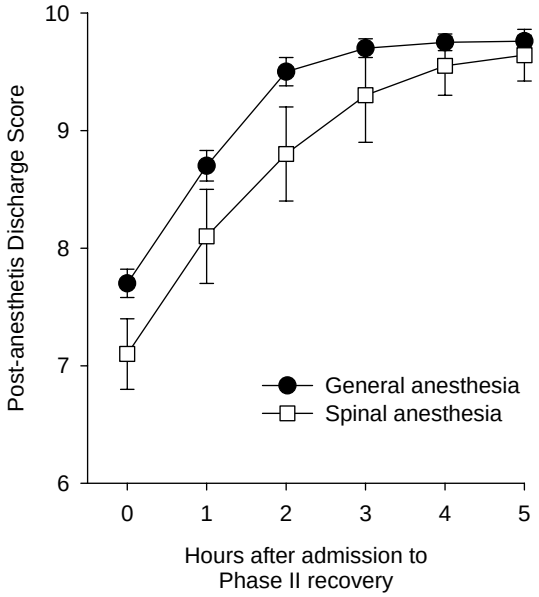

Figure 3. Post-Anesthetic Discharge Score (PADS) in Phase II recovery at different time interval after anesthesia.

Table 4 Anesthesia-related adverse events or effects (out of 801 sessions)

Number of sessions	Description of events	Number of subsequent hospitalization[#]
47	Post-operative nausea and vomiting	2
3*	Laryngeal mask induced laryngospasm	1
2	Lower limb weakness after spinal anaesthesia	2
1	Dental injury, dentist was consulted later	1
1	Dizziness	1
1	Brachytherapy under spinal anaesthesia, level of sensory block up to 10th thoracic dermatome, but patient complained of discomfort during vaginal gauze packing intra-operatively. Patient commented that the pain was tolerable and conversion to general anesthesia was not needed	0

*The same patient mentioned in Table 1.
[#]All patients were discharged home the next day

volatile agent and maintenance with volatile agent in nitrous oxide with 30-40% oxygen and spontaneous breathing via laryngeal mask airway. Balanced anesthesia with tracheal intubation was used in 5 sessions (0.7% of general anesthesia). No other modes of anesthesia were used (Tables 1 and 2).

A change of practice in Phase I recovery was noted during the study period. Vital signs of the patients were initially monitored in the Phase I recovery after anaesthesia but Aldrete Score was not assigned till 30 minutes after arrival. Since June 2005, this practice had changed and Aldrete score was given on arrival to Phase I recovery and subsequently at 15-minute interval. As a result, initial Aldrete Score was not available in 458 sessions. Of the 343 sessions with Aldrete Score available on arrival to Phase I recovery, a score of 10 was attained in 265 (77.3%) sessions. Aldrete score of 10 was attained at 30 minutes in Phase I recovery in 588 (73.4% out of 801) sessions, whereas in 186 (23.2% out of 801) sessions, patients were discharged to Phase II recovery in less than 30 minutes. For the remaining 27 (3.4%) sessions, Aldrete Score at 30 minutes of 8 and 9 was attained in 1 (after spinal anesthesia) and 26 sessions (7 after general anesthesia and 19 after spinal anesthesia) respectively.

Mean (± SD) time to home-readiness (PADS ≥ 9) was 118 ± 46 minutes after general anesthesia and 159 ± 50 minutes after spinal anesthesia (Figures 2 and 3).

Complications and reasons for hospitalization were summarized in Table 3. 61.0% of unplanned hospitalization was due to non-medical reason. Patients requested to stay overnight in hospital for observation and their request was honored.

Anesthesia-related adverse events were summarized in Table 4. Adverse events were reported in 55 (6.9%) out of 801 sessions.

There was no attendance to the Emergency Department or unplanned hospitalization after discharge. No anesthesia-related adverse events that led to interruption during treatment session or postponement of brachytherapy treatment were reported.

Discussion

High-dose-rate brachytherapy is now increasingly used to treat gynecologic carcinomas. Its advantages include reduction in radioactive exposure to staff, patient convenience and outpatient therapy.

The goals of anesthesia in high-dose–rate brachytherapy are therefore to provide analgesia, anxiolysis, patient immobilization during treatment and early home-readiness after each session of treatment. Avoidance of adverse events that lead to interruption during each treatment session or post-operative complications that lead to postponement of subsequent treatment sessions is another challenge to the anesthetists.

Based on a Medline Search using the keywords of "high-dose-rate brachytherapy", "cervical carcinoma" and "anesthesia", the current article is the first report from the anesthetic point of view. In the previous reports, the analgesic or anesthetic agents used and the dose requirement varied widely and the primary outcome assessment was derived from the perspectives of the disease. Therefore, the detail of the anesthetic management and steps of the surgical procedure were included in our analysis and report for discussion and reference.

In our institute, anesthetists were involved in all sessions of high-dose-rate brachytherapy for cervical carcinoma. Intravenous or inhalation induction of anesthesia followed by maintenance with volatile agent and spontaneous breathing via laryngeal mask airway appeared to be the preferred choice. During the initial part of the procedure, the surgical stimuli varied from minimal during urinary bladder catheterization to "discomforting", if not "distressing" pain during cervical dilation. A study in local patient population showed that the mean (± SD) pain score during cervical dilation for office hysteroscopy was 2.43 ± 0.96 on a 0-5 numeric scale (0= no pain, 1= mild pain, 2= discomforting pain, 3= distressing pain, 4= horrible pain, 5= intolerable pain with need to terminate the procedure).[5] During this period, anesthetist could titrate the depth of anesthesia with volatile agent and supplement of fentanyl accordingly. During the later part of the procedure, the discomfort was due to the presence of the applicators and vaginal gauze. However the level of stimulation was comparatively less variable. When the afterloading system started to deliver radiation, the patients were monitored by the anesthetists through the television panel located in another control room. We believed that the beauty of maintenance with inhalation anesthesia technique was that patients could titrate the depth of anaesthesia accordingly, though to a limited extent. If anesthesia was too deep, patients' minute ventilation would be suppressed, and uptake of volatile anaesthetic agent would be slowed down. On the other hand, if anaesthesia was too light, patients' minute ventilation would increase and the uptake of volatile anaesthetic agent would be faster.

The incidence of postoperative nausea and vomiting in the current study was 5.9% (47/801). There is no similar datum on this group of patients for comparison. However it compared favorably with the quoted incidence of 17% for nausea and 8% for vomiting in a systematic review for general surgical patients.[6] Risk factors amongst our patients included female gender, gynecologic procedure, and intraoperative use of volatile anesthetic agent in nitrous oxide. The use of propofol for induction and relatively short duration of the procedure might have counteracted their effects though.

Amongst our patients, the rate of unplanned hospital admission was high, 28.4% (205/721). But 61.0% of these admissions (125/205) were due to non-medical reasons. Incidence of anesthesia-related adverse events that led to unplanned admission amongst our patients was <1.0% (7/721). And more importantly, all these patients were discharged home the other day.

Total intravenous anesthesia (TIVA) with fentanyl and propofol has been evaluated in a recent study for prostate brachytherapy.[7] Anesthesia was induced with intravenous bolus

of fentanyl and propofol, followed by propofol infusion. However supplemental doses of fentanyl were needed during radiotherapy. It was not mentioned whether these doses were given before or during the radioactive source was being loaded. Moreover the time to discharge in this group of patients was 119 ± 42 minutes, which was similar to time to home-readiness of 117.7 ± 46.0 minutes amongst our patients after general anesthesia.

The mean (± SD) duration of treatment in our study was 53.2 ± 14.4 minutes. For patients with regional anesthesia, single shot spinal anesthesia was adequate. In contrast, spinal catheter was used in 53% of cases in another report where the mean (± SD) duration of anesthesia was 200 ± 100 minutes for high-dose-rate brachytherapy of female genital organ.[2] The difference in the duration of the procedure was not known. Therefore description of the procedure performed in our institute was included in the current article for comments. Patient's cooperation is also needed if regional anesthesia is used. In one study, three patients under spinal anesthesia moved interfering with radiotherapy procedure though they did not complain of pain.[7]

Other modes of anesthesia in high-dose-rate brachytherapy for cervical carcinoma have been reported.[1] Use of topical lignocaine for cervical brachytherapy has been studied. It resulted in pain reduction from 60.0 ± 24.8 mm to 49.9 ± 24.1 mm on visual analogue scale (0 = no pain, 100 = worst imaginable pain).[8] However another study showed that the local application of lignocaine gel was no more effective than the placebo.[4]

It was reported that osmotic dilators could be introduced to dilate the cervix 10-12 hours before insertion of applicators.[9] It may be useful in inpatients or in patients with poor pre-morbid state who are at high risk for general anesthesia. However it relies on the patient knowledge and compliance in ambulatory settings.

Sedation with fentanyl and midazolam for high-dose-rate brahcytherapy has been reported by Petereit *et al*.[3] The mean dose of fentanyl required was 207 μg, with a range of 50-800 μg, whereas the mean dose of midazolam was 8.8 mg with a range of 2-40 mg. Intraoperatively, three patients experienced oxygen desaturation which necessitated the administration of naloxone or oral airway placement and another two patients had hypertensive episodes. Apparently the "feedback mechanism" associated with maintenance of anesthesia with volatile agents discussed above was absent. These adverse events could have led to interruption of the brachytherapy procedure and recalculation of the radiation dose might be needed. Careful titration of the intravenous anesthetic agents was needed and a steady state achieved before treatment. We are not sure whether it could account for the difference between the mean duration of the procedures of 133 [range 28-309] minutes in their study and 66.2 ± 15.6 minutes in our study. Another point of interest was that "dilation of cervical canal was rarely required" amongst Petereit's patients whereas it was needed amongst our patients in 469 (58.5%) sessions. While there was no study on comparison of the incidence of cervical dilation needed during brachyhterapy treatment amongst different populations, a study in local population showed that cervical dilation was required in about 31% of their patients for office hysteroscopy.[5] As mentioned above, cervical dilation could result in severe pain in our population. We are not sure, if the above technique were adopted in our practice, whether a higher dose of fentanyl and midazolam is required in our patients on a body-weight basis and whether it would result in delay in home-readiness.

Lim *et al* found paracervical block efficacious for high-dose-rate brachytherapy for cervical cancer.[10] But its use in their institute was ceased after seizure developed in one out of 5 paracervical blocks performed in their review.

We do not suggest that one anesthesia technique is superior to another. It was also

supported by the evidence that there was no correlation between the type of anaesthesia and "acute complications" or perioperative morbidity.[11,12] But Lim *et al* believed that "better positioning and packing of vaginal gauze was possible with general anaesthesia, conscious sedation combined with topical anaesthesia was adequate and conscious sedation alone appeared inferior".[10]

There are limitations to our study. It is a retrospective survey. But the data collected for analysis are routinely recorded in the medical records and anaesthesia records. For example, postoperative nausea and vomiting, pain and lower limb weakness are parts of the assessment in the PADS system. Another limitation is that we did not carry out the post-discharge anaesthetic interview. The incidences of post-discharge nausea and vomiting and pain that did not lead to post-discharge hospitalization were not known.

In conclusion, we have reviewed the medical records of 801 anaesthetic procedures for high-dose-rate brachytherapy for cervical carcinoma, reported the adverse events and reasons for unplanned hospitalization. Options of anesthetic techniques were also discussed.

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Tracheal Rupture Complicated with Tension Pneumothorax During Transhiatal Oesophagectomy: A Case Report

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SUMMARY

We reported a case of tracheal rupture, complicated by a tension pneumothorax, during blunt cervical dissection in transhiatal oesophagectomy. We maintained oxygenation and ventilation by gauze packing the leakage site and jet ventilation until thoracotomy could be performed for repair the ruptured trachea. The operation and the repair of the trachea finished successfully and the patient was discharged home 3 weeks after the surgery. We discussed the causes, presentations, and investigations of tracheal rupture. The surgical and anesthetic management were also discussed.

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A 70-year-old man was scheduled for excision of the upper third carcinoma of oesophagus using a transhiatal approach. He was a chronic smoker. He had a right herniorrhaphy during spinal anesthesia in the past. His past health was otherwise unremarkable. Preoperative endoscopy showed an obstructive lesion at 22-23 cm from the incisors and a biopsy showed squamous cell carcinoma. There was no obvious tracheal invasion during bronchoscopy.

Anesthesia was induced with fentanyl 100 μg, propofol 100 mg. Atracurium 40 mg was given to facilitate tracheal intubation. A size 8 mm ID tracheal tube was inserted using a stylet. The tracheal tube was fixed at 23 cm at upper incisor. General anesthesia was maintained with nitrous oxide, oxygen, isoflurane and morphine. The lungs were ventilated using a Penlon Nuffield ventilator. Standard monitors, including electrocardiogram, invasive arterial and central venous pressure, pulse oximetry, anesthetic gas measurements and airway pressure, were applied.

During surgical dissection, the end-tidal carbon dioxide ($ETCO_2$) tracing suddenly found disappeared and the right chest expansion was poorer than the left. A longitudinal tear of the posterior membranous trachea was quickly recognized by the surgeon. Attempts to repair the ruptured trachea were abandoned because the surgeon realized that the lower end of the tear was too deep to be accessible. So the site of rupture was packed with gauze to minimize further leakage. It was still possible to ventilate the lungs manually with some leakage.

The surgeon continued with the resection of cardia, mobilized up the gastric tube into

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posterior mediastinum and performed gastroesophageal anastomosis. The abdominal wound was closed afterwards.

The patient was turned into left lateral decubitus position to prepare for right thoracotomy and repair of the ruptured trachea. Shortly after re-positioning, manual ventilation was found to be difficult and associated with elevated airway pressure, There was an associated decrease in oxygen saturation and $ETCO_2$. A tension pneumothorax was suspected. Right thoracotomy through a posterolateral incision was performed immediately. The airway pressure came down to normal and oxygenation returned to normal as pneumothorax was released. Intermittent manual jet ventilation using 100% O_2 with period of apnea was used to allow the surgeon to repair the trachea.

A 4-5cm longitudinal tear at the membranous trachea about 2 cm above the carina was noted. The tip of endotracheal tube was found just at the upper border of the tear. After the lower end of the tracheal tear was repaired, the thoracotomy wound was closed and the patient was turned back to supine position.

Neck wound was re-explored to complete the repair of the upper part of the tracheal tear. Air seal was confirmed. On completion of the surgery, patient was stable and transferred to intensive care unit for further management without extubation.

On day 13, the patient's trachea was successfully extubated. Bronchoscopy was performed and there was no stenosis detected at the site of repair and the mucosal healing was good. He was discharged to general ward on the same day. Gastrografin swallow study showed no anastomotic leakage on day 18 and oral feeding was resumed. He remained stable and was discharged home on day 24.

Discussion

Tracheal rupture is a rare but potentially life threatening event. Common causes of tension pneumothorax include trauma and iatrogenic. Other rarer causes, such as connection of the tracheal tube to a pressurized oxygen source.[6] Lobato *et al* reported a case of chemical perforation of the carina and left bronchus after ingesting hydrochloric acid during a suicidal attempt.[10] In trauma cases, a recent retrospective review of tracheabronchial injuries by showed that 41% of the injuries were due to blunt trauma and 59%, to penetrating trauma.[11]

Hofmann and co-workers performed a retrospective study on 19 patients with iatrogenic tracheobronchial rupture.[13] They found that 73% of the iatrogenic tracheobronchial rupture occurred after single-lumen tracheal tube intubations, 21% after double-lumen tube intubations, 10% of cases was related to tracheal cannula, and 10% was found after rigid bronchoscopy.

Several predisposing mechanical and anatomical factors that lead to tracheal rupture after tracheal intubation have been proposed (Table 1).[7-9] The most common cause of tracheal rupture is excessive tracheal tube cuff pressure. Presumably, it is due to ischemic necrosis of the tracheal wall.[7] It is generally accepted that the cuff pressure should not exceed the 30 cm H_2O in order to provide a safe two-way seal against air leakage and aspiration and to prevent any tracheal cuff related tracheal damage.[12] In this regard, over-distention of the tracheal cuff can be a result of initial over-inflation or excessive diffusion of nitrous oxide into the air filled tracheal cuff. When nitrous oxide diffuses into the tracheal cuff over a prolonged period, volume and pressure of the cuff will increase.

Women are known to have a higher risk of tracheal rupture than men following intubation because of an increase weakness of the membranous portion of their trachea.[8] Inappropriate size of the tracheal tube is one of the important risk factors.[12]

Table 1. Factors related to post endotracheal intubation tracheal rupture.

Mechanical factors
Over-inflation of the endotracheal cuff
Multiple attempts at intubation
Reposition of the tube without deflating the cuff
Stylet protruding from the endotracheal tube
Patient coughing while intubated
Abrupt head and neck movement while intubated
Eccentric inflation of endotracheal tube cuff
Inadequate tube size
Anatomical factors
Congenital tracheal abnormalities, such as tracheomalacia
Weakness of the membranous trachea: women, elderly, oesophageal surgery
Chronic obstructive airway disease; inflammatory lesions of tracheabronchial tree
Chronic steroid use

The incidence of tracheal rupture during transhiatal oesophagectomy varies from 0-7%.[2] It can be a result of the intubation itself, surgical procedure, or a combination of the two factors. During surgery, the oesophagus is dissected from the posterior aspect of the trachea and this leaves the membranous part of the trachea completely unsupported.[1] The possibility of tracheal rupture will be higher with an over-distended tracheal cuff together with an aggressive dissection by the surgeon. In order to minimize this complication, the cuff pressure should be adjusted to a minimum, as necessary. Other authors suggested deflating the tracheal cuff during mediastinal manipulation.[3]

A few reports described tracheal rupture arising from over-distended tracheal cuff during oesophagectomy. Ayorinde *et al* reported a patient suffered tracheal rupture due to an over-inflated tracheal cuff of the double lumen tube.[5] The surgeon could directly palpate the distended cuff over the lacerated site and 30 ml of gas was aspirated from the cuff.

Smith and colleagues also described a case of tracheal rupture during oesophagectomy.[1] Herniation of the tracheal cuff through the tear was identified by the surgeon during the operation. The author suggested that the distending force of an eccentrically inflated cuff might be the cause.

Concerning our patient, the predisposing factor for tracheal rupture was mainly due to the fact that the tumour was adhering to the posterior wall of the tracheal. We believe cuff distension as a cause of tracheal rupture is unlikely because the laceration was distal to the tip of the tracheal tube. It is recognized that the most critical period of transhiatal oesophagectomy is during blunt resection where posterior membranous trachea may rupture if the tumor is adherent to it.[4]

Presentation

Tracheal rupture can occur during dissection of oesophagus either through the hiatus or through the cervical incision.[2,5] During surgery, the diagnosis of tracheal rupture is usually made when the surgeon detects a tear in trachea. If the tear occurs around the tracheal cuff, a herniated cuff may also be found. There may not be any gas leak if the tear is blocked by the tracheal cuff. More frequently a large air leak would develop if the tear is long and ventilation would become difficult. Expired tidal volume and airway

pressure would decrease. Diagnosis could also be made when frothy blood is noted in the mediastinum.[1] Pneumothorax may complicate the situation further. If there are any doubts about the diagnosis, intraoperative bronchoscopy can be performed to confirm the laceration.

Clinical presentations would be completely different if the tracheal rupture occurs as a result of intubation and trauma. Common signs would include subcutaneous emphysema and pneumomediastinum. The occurrence of a pneumothorax varies widely (0 - >60%) and only if the disruption communicates freely with the pleural space.[13] Other features include dyspnea, cough, hemoptysis, vocal changes and pneumoperitoneum.[9] If tracheal rupture is prolong and untreated, it can be complicated by mediastinitis. Long interval without any detectable symptoms has also been observed.[13]

Investigation

Chest X-ray and CT scan can assist in making the diagnosis in normal situation. Bronchoscopy is the mandatory investigation to establish the diagnosis, to identify the anatomy, and to decide on the most appropriate treatment.[14] However, bronchoscopy may be risky in an intubated patients requiring high ventilatory support. It may also miss the lesion completely if it is located in the upper portion of the trachea. Reconstructive 3D CT scan has been recommended as an alternative and safer modality with accurate diagnosis.[8]

Surgical management

Nonsurgical therapy may be considered in small (length < 2 cm) uncomplicated tears in stable patients, because under these conditions healing can be achieved with minimal risks and discomfort for the patient.[13,14] For patient in whom surgery carry an unacceptable risk, conservative management would also be an alternative.[5] Lesion larger than 2 cm, in the presence of extensive subcutaneous emphysema and/or respiratory distress, are best treated by early surgical repair if feasible.[15] Patients who have undrgone lung or mediastinal surgery should be treated surgically by any means.[13]

The surgical approach depends on the location of the tear. With mid and lower tracheal ruptures, repair is through a right thoracotomy, but higher lesion requires a left cervical incision.[9,14] Carbognani *et al* supports a transcervical approach for all lesions confined to trachea.[14] They performed a transverse anterior tracheotomy and repair the rupture through the narrow tracheal space. They concluded that the transcervical approach should be the procedure of choice in post-intubation lesions limited to the trachea because it is less invasive.

Basically primary repair of the injured tracheobronchial tree has been encouraged.[8,11,15] However, if primary repair of the trachea is going to narrow the lumen, or the sutures are under tension, then alternatives have to be considered. Gorenstein *et al* reported the use of a free pericardial sac to cover the defect.[2] Ruppen *et al* also reported the use of a doubled free pericardial flap to cover the tracheal tear.[16] Satyadas *et al* covered the cervical component of the laceration by suturing of the adjacent esophageal wall onto it.[6]

Concerning surgical approaches to the tracheal rupture during transhiatal oesophagectomy, repair through neck incision is preferable. This would avoid the addition operative time and morbidity of a thoracotomy.[2] Unfortunately, it was impossible in our patient to repair the tear through cervical incision alone, since the tear was too deep. Therefore a right thoracotomy was also performed.

Airway management

Airway management during tracheal rupture is a challenge to the anesthetist. The principle is to maintain ventilation and oxygen saturation. It is also important to avoid further tracheal damage. Management should be

individualized in accordance with different clinical situations such as the site of laceration, the etiology, surgical approach and patient condition. The strategies include: single lumen tube with the cuff distal to the lesion, bronchial intubation with single lumen tube, double lumen tube, manual jet ventilation, high frequency jet ventilation and using cardiopulmonary bypass.[9]

High frequency or manual jet ventilation is useful for ventilation during tracheal repair. It can also provide separate ventilation to either lung by inserting the cannula into one of the main bronchi. However aspiration of blood and debris may occur and it also increases the risk of mucosal damages due to prolonged exposure to the high pressure jet.

Double lumen tube permits separate lung ventilation. But the pressure exerted by the body of the tube on the trachea or proximal bronchial mucosa can worsen the injury and interfere with the surgical repair itself.[10] Moreover, in urgent situation of tracheal rupture in the midst of operation, replacing an existing tracheal tube with a double lumen tube would be challenging.

Lobato *et al* reported a bilateral bronchial intubation in patient with a ruptured trachea around the carina and extended into left main bronchus.[10] The author selectively intubated the right lung after induction of anesthesia with the aid of fibreoptic bronchoscopy. Then the left main bronchus was intubated with a reinforced tracheal tube introduced through the defect during direct vision. Once closure of the defect was nearly completed, the reinforced tube was removed.

When tracheal rupture occurs during transhiatal oesophagectomy, one of the popular maneuvers is to push down the tracheal tube to provide lung ventilation. It is realized that left main bronchus intubation is preferable.[3] It also facilitates surgeon's access during right thoracotomy. Oxygenation is better with ventilation of the dependent lung since a more favorable ventilation/perfusion ratio can be achieved. If pneumothorax occurs simultaneously which would be more likely in the right, left lung ventilation is safer.[4]

There are also other methods to maintain oxygenation if tracheal rupture occurs during transhiatal oesophagectomy. Sung described a progressive decline in oxygen saturation after inserting the tracheal tube into right main bronchus.[3] Subsequently, he passed a #14 catheter into left main bronchus through the posterior tracheal tear. A dramatic improvement in oxygen saturation was observed when CPAP of 6 cmH_2O was applied. Gorenstein *et al* reported a case of placing a flexible reinforced tracheal tube through the laceration into the left main bronchus.[2] The reason was that the original tracheal tube was cut and it was not long enough to pass beyond the laceration. To facilitate repair, the tracheal tube was removed intermittently until repair was finished.

Tension pneumothorax

Most of the authors pushed the tracheal tube blindly to accomplish bronchial intubation when they encountered tracheal rupture during transhiatal oesophagectomy.[4] This maneuver can sometimes maintain ventilation as the site of leakage was bypassed but they may aggravate ventilation if pneumothorax occurs simultaneously. Indeed pneumothorax is likely to occur in the right during oesophagectomy as the right mediastinal pleura and trachea are closely related anatomically.[4] Catastrophic situation may arise if a right side pneumothorax is associated with right lung intubation and ventilation.[4] The author depicted a patient continuing to deteriorate with oxygen desaturation, arrhythmia, profound hypotension and elevated airway pressure after pushing down the tracheal tube blindly. Oxygenation only improved after tracheal tube was withdrawn to original position and the surgeon was asked to obstruct the tracheal leakage by his finger. Right side tension pneumothorax was later confirmed during right thoracotomy with air leakage from the incision and a collapsed right lung.

In conclusion, we described a case of tracheal rupture during transhital oesophagectomy.

We used intermittent manual jet ventilation as an effective alternative method to maintain oxygenation.

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The EXIT Procedure for Tracheal Intubation in a Fetus with Cystic Hygroma

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SUMMARY

Advances in prenatal ultrasonography have improved the ability to detect fetal anomalies. The ex utero intrapartum treatment (EXIT) procedure allows the uteroplacental circulation to continue in fetuses with congenital airway abnormalities while an artificial airway can be established. We reported a case of multiloculated cystic lesion extended from neck to abdomen detected during routine antenatal ultrasound. An EXIT procedure was used to secure the airway of the neonate during Cesarean section. We also discussed the anaesthetic management with particular reference to the maternal, fetal and ethical considerations.

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A 37 year-old, para 2, woman who enjoyed good past health received routine antenatal follow up. Amniocentesis arranged at 18 weeks of gestation for advanced maternal age revealed normal karyotype. Ultrasound at the day of amniocentesis showed multiloculated cystic mass at the right side of body extending from neck to right abdominal wall, suggestive of cystic hygroma or lymphangioma. The couples were counseled about the prognosis, antenatal course and postnatal management. In view of normal fetal karyotype and no other fetal abnormalities detected, they decided to have continuation of pregnancy. Serial ultrasound showed progressive enlargement of the lesion as the fetus grew. The fetal growth was satisfactory and was well compensated with no feature of hydrops fetalis. At 35 weeks of gestation, the ultrasound showed a multiloculated, cystic, avascular lesion over right thorax with size 9.0 × 7.6 × 11.3 cm (Figure 1). In anticipation of potential airway obstruction at birth, a meeting involving neonatologist, otorhinolaryngologist and anaesthesiologtist was convened at 35 weeks of gestation. It was decided that Cesarean section should be performed before 37 weeks of gestation because her two previous spontaneous vaginal deliveries occurred at 37 weeks of gestation. Options of either performing tracheal intubation as an EXIT procedure or immediately after complete delivery were discussed. Other contingency plan for failed tracheal intubation during the EXIT procedure was also formulated.

Cesarean section under general anaesthesia was planned at 36 weeks 4 days gestation. Her

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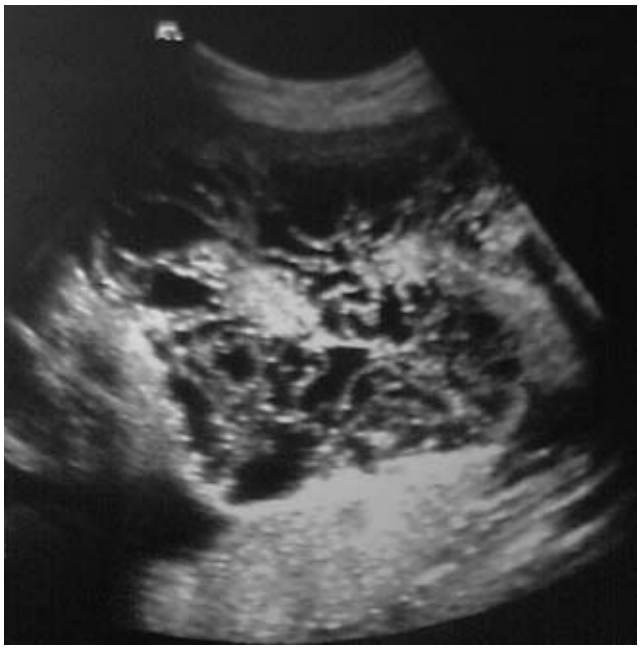
Figure 1. Ultrasound of fetus at 35 weeks of gestation showing cystic hygroma.



body weight was 58.9 kg. 150 mg ranitidine and 30 ml sodium citrate 0.3M were given orally as premedication. Invasive arterial pressure monitoring was established prior to induction. After preoxygenation, modified rapid sequence induction was performed with fentanyl 200 μg IVI, thiopentone 250 mg IVI. Succinylcholine 100 mg IVI was given to facilitate tracheal intuation. Anaesthesia was maintained with a nitrous oxide and oxygen mixture (inspired oxygen concentration was 50%) with end-tidal isoflurane maintained at a range of 1.2 to 2.0%. Muscle relaxation was maintained with atracurium infusion. Ephedrine 3 mg IVI was given once to maintain maternal systolic arterial pressure at around 100 mmHg. Tocolytic agent was not given.

Initially, the head and left hand was delivered. A neonatal pulse oximeter (Oxisensor II I-20, Nellcor, Pleasanton, CA) was attached to the left hand, wrapped with aluminium foil, to monitor oxygen saturation (SpO_2) and heart rate. Fetal heart rate was also monitored with transabdominal ultrasound. A 2.2 mm (outer diameter) flexible fibreoptic bronchoscope (Olympics LFG 2.2, Melville, NY), mounted with a 3 mm tracheal tube (Portex Medical, Hythe, UK) was inserted via the right nostril aided by suction of amniotic fluid and traction of the tongue. Normal airway anatomy was confirmed. Fetal vocal cords were however tightly adducted. The trachea was successfully intubated with the aid of a metal stylet while using the Benjamin slotted laryngoscope (Figures 2 and 3). Tracheal tube placement was confirmed with end-tidal capnography followed by complete delivery. The fetus was ventilated with sevoflurane 3-4% in 100% oxygen via a Jackson Rees' modification of the Ayre's T-piece (Figure 4). The placental bypass time was 24 minutes, fetal heart rate was between 130-160/min and SpO_2 50-70%. Umbilical arterial blood was collected after clamping of the umbilical cord. The umbilical arterial blood gas showed a pH of 7.26, oxygen and carbon dioxide tension was 35 and 48 mmHg, respectively. Intravenous access was established after complete delivery. After delivery, maternal end-tidal isoflurane was reduced to 0.5% and nitrous oxide

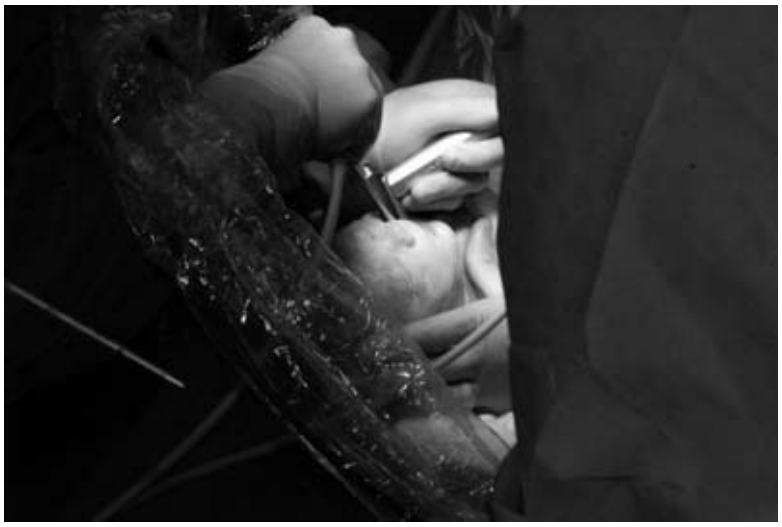


Figure 2. Larygoscopy of the fetus during the EXIT procedure.

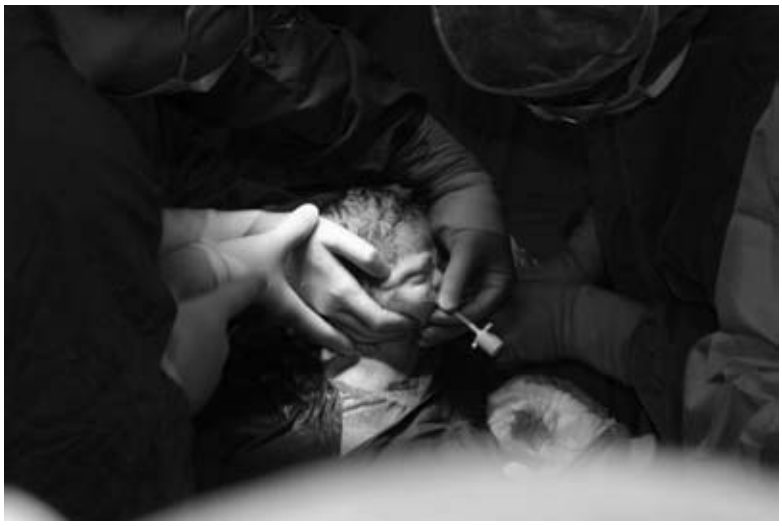


Figure 3. Completion of tracheal intubation after the EXIT procedure.

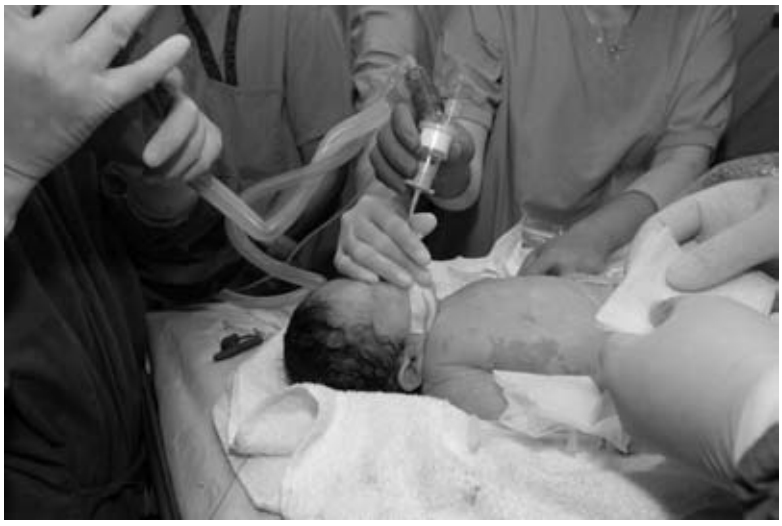


Figure 4. Ventilated via a Jackson Rees' modification of the Ayre's T-piece

70%, syntocinon 5 units was given as as a bolus followed by an infusion of 3-5 unit/h. Total estimated blood loss was 50 ml. Morphine IVI was given for maternal analgesia. The postpartum course was uneventful.

The trachea of the neonate was extubated 2 hours later in the neonatal intensive care unit after successful weaning from the ventilator. Excision of cystic hygroma was performed 3 months later. This is followed by ultrasound guided sclerotherapy with OK432.

Discussion

A search of the electronic databases PubMed and MEDLINE was performed to identify the relevant articles on the EXIT procedure and outcome. The term "ex utero intrapartum treatment" was used. Case reports, case series, cohort studies, reviews and articles from citation lists were analyzed.

With improvement in fetal ultrasound and ultrafast fetal magnetic resonance imaging,[1] diagnosis of fetal malformations have become more common. The EXIT procedure was first described in 1990.[2] Early descriptions involved complete delivery of infant from uterus with umbilical cord unclamped, and the placenta left *in utero*.[2,3] Later, the description is modified as performing a hysterotomy with only the fetal head and shoulders are delivered.[4] Such modification would leave the cord entirely in utero and allow longer procedure times, for up to one hour.[5] The EXIT procedure has been applied to conditions potentially causing neonatal airway obstruction. These conditions included teratoma, cystic hygroma, hemangioma, bronchial cyst remnants, congenital thyroid goiter, neuroblastoma, neural tube defects, hypoplastic craniofacial syndromes, hydrocephalus, vallecular cyst, airway atresias, fetal tracheal clip.[6-8] The EXIT procedure has been reported as a safe and efficacious way of securing neonatal airway in a controlled fashion as the placenta permits continued gas exchange during airway manipulation.[9,10]

Maternal considerations

The aim of anaesthesia during the EXIT procedure is to maintain uterine relaxation with hemodynamic stability and minimize bleeding. General anaesthesia with high concentration of inhalational agents is preferred as it provides surgical tocolysis and fetal anaesthesia.[11] Few reports advocated the use of epidural anaesthesia,[7,12] subarachnoid block,[13] or combined spinal-epidural anaesthesia.[14] Such alternatives are usually chosen because the mother was not adequately fasted or trying as an alternative to general anesthesia for the EXIT procedure. Additional uterine relaxants such as nitroglycerin[14] and magnesium sulphate[7]have been used when regional anaesthesia was contemplated. General anaesthesia usually includes rapid sequence induction and the administration of large doses of volatile anaesthetic agents, titrated to maintain uterine relaxation.[4] We gave fentanyl in our case because its onset is rapid, and its ability to cross the placenta. Fentanyl also does not affect uterine tone and maternal or fetal hemodynamics.[15]

Optimal uterine relaxation was essential to prevent premature placental separation prior to the establishment of airway.[16,17] We administered isoflurane for the maintenance of anaesthesia and uterine relaxation. After delivery of the neonate, oxytocin was administered, uterine contractility was promptly re-established and there were no signs of uterine atony in the postoperative period.[18] If uterine relaxation is inadequate, we were prepared to administer nitroglycerine for additional uterine relaxation. Nitroglycerine is useful for its rapid onset and titratibility, and can be used as an alternative to high dose volatile anaesthesia.[5,7]

We gave ephedrine to stabilize maternal arterial pressure. Although theoretically, α_1 agonist may cause vasoconstriction of uterine vessels, recent studies showed there was no

difference in fetal outcomes between phenylephrine and ephedrine for management of maternal hypotension during spinal anaesthesia for Caesarean section.[19] Successful use of angiotensin II has been described.[9] However, there are limited data supporting its use in Caesarean section.[20] The efficacy of ephedrine and phenylephrine is well established and hence angiotensin II was not considered.

Intraoperative uterine hemorrhage is a major consideration in EXIT procedure.[21] Bleeding from edges of uterine incision in this case was minimized by application of continuous sutures. A uterine incision stapling device has been advocated by others.[22]

Fetal Considerations

Mode and timing of delivery have an impact on the neonatal outcome. Studies have shown that a significant reduction in neonatal risk is attainable by waiting until 39 weeks of gestation before performing elective Caesarean section.[23] However, Caesarean section was performed at 36 weeks of gestation as this patient because she had two earlier pregnancies with onset of spontaneous labour at 37 weeks of gestation. Another reason was that fetal lymphangioma, are associated with high morbidity and mortality if airway compression occurs. Hence, affected infants need relief of airway compression immediately after birth,[24] which should be done in an elective setting under controlled fashion. A well planned elective Caesarean section was felt to provide the most optimal conditions of safety and easier access for securing the airway of the newborn.

We were concerned initially whether settings in the EXIT procedure would lead to adverse neonatal outcome. Neither prolonged deep anesthesia (approximately 2 MAC), uterine incision or manipulation of fetus has been shown to affect fetal gas exchange.[18,22] Fetal monitoring is important for the recognition, prediction and avoidance of fetal distress and hypoxia. These include blood gases, fetal heart rate, blood pressure and umbilical blood flow.[25] Ultrasonography is a useful tool to monitor fetal heart rate, ventricular volume, and contractility. Blood flow through the umbilical cord can be ascertained by Doppler assessment. Neonatal digital sensors wrapped around fetal arm or palmar arch prevent artifacts from ambient light and has been used for fetal pulse oximetry.[25,27] The fetal SpO_2 level greater than 30% in the 1st and 2nd stage of labor was associated with good neonatal outcome.[26] Fetal electrocardiogram using modified insulated atrial pacing wires to display the P and QRS complexes have also been described useful in measuring fetal well being.[27] To preserve the potential for spontaneous ventilation, the fetus was not paralysed,[28] as in our case. However, it posed a risk that the vocal cords might remain tightly adducted, hindering successful tracheal intubation. Strategies for fetal airway establishment were described. These include initial direct laryngoscopy, followed by rigid bronchoscopy with or without a bougie for tracheal intubation. The final maneuver is to proceed to tracheostomy in the EXIT position if above failed.[28] Some chose only routine rigid bronchoscopy to secure the airway without preliminary attempts at tracheal intubation.[29] Others have achieved fiberoptic intubation through a laryngeal mask airway.[30]
If placenta disruption or maternal bleeding is uncontrolled at any stage, the EXIT procedure should be abandoned with complete delivery in order to facilitate hemostasis. The neonate's airway would then be managed on a resuscitation trolley.[28]

Whether fetuses are capable of pain perception remains controversial,[4] though we are not sure whether tracheal intubation would cause pain in the fetus. It has been shown that painful stimuli produce an increment in cortisol and β endorphin levels, cause vigorous movement and breathing efforts.[31] It was reported isoflurane crosses the placenta rapidly and the umbilical to maternal partial pressures approached 0.7.[32] This suggests that volatile general anaesthesia is more advantageous than neuraxial anaesthesia because the former provides better fetal anaesthesia and

immobilization [33] as well as causing uterine relaxation.

Although EXIT procedures have been performed overseas since 1990s, this is a new procedure which had not been reported in Hong Kong. From the literature, the largest series of cases has been 52 cases performed in USA. A total of 51 (out of 52) patients were born alive and 27 patients (52%) are currently alive.[10]

In summary, with the ability to diagnose fetal anomalies by ultrasonography, a multidisciplinary approach for planning and establishment of the airway management in a controlled manner at birth is possible. The EXIT procedure only serves as a back up for securing the neonate's airway during uteroplacental perfusion. It has been performed with minimal maternal morbidity while showing variable fetal outcomes. It is a reasonable strategy for establishing an airway in a controlled manner, avoiding "crash" intubation or tracheostomy.[10] Our management plans were made by weighing maternal risks against potential fetal benefits.

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The readers should note that *surgical detail* of the same case has been published in the Hong Kong Medical Journal*

*Chu GM, Yue V, Addullah V, Chan HB, To WK, Chan MY, Kwan A. Ex-utero intrapartum treatment: a controlled approach to the management of anticipated airway problems in the newborn. Hong Kong Med J 2006; 12:381-4

New Applications of Remifentanil

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Remifentanil is an ultra-short acting, selective μ opioid receptor agonist. The 4-anilidopiperidine opioid is a synthetic analogue of fentanyl and is metabolized by nonspecific plasma and tissue esterases (Figure 1). The esterase linkage in remifentanil results in an unique and favorable pharmacokinetic profile. The rapid onset and offset of action, irrespective of duration of infusion, has made it a popular opioid during anesthesia.

The purpose of this review is to summarize the current knowledge on the clinical pharmacology of remifentanil and to provide an appraisal on the recent applications of the drug during the perioperative period.

Pharmacological Profile

Remifentanil has a strong affinity to the μ opioid receptor but less so for κ and δ opioid receptors. Its action is however, completely reversed by naloxone (Figure 1).[1] Following hydrolysis, the primary metabolite, GR90291, is a carboxylic acid derivative. In animal experiments, this metabolite is at least 2,330 times less active than the parent compound.[2-4] Although GR90291 is primarily excreted unchanged in the urine, it is unlikely that accumulation of metabolites during renal failure will contribute to altered drug response.

Table 1 summarizes the pharmacokinetic parameters of remifentanil in adult. There is no gender difference in the pharmacokinectic profile of the drug.[5] Similarly, renal[4] or hepatic impairment[6] does not affect drug elimination. However, the volume of distribution was increased by 80% after the initiation of cardiopulmonary bypass (CPB) and that clearance was reduced by 6.3% per degree Celsius decrease starting from 37°C. In total, clearance of remifentanil was reduced by 20% during the hypothermic phase of CPB.[7]

There are also age-related changes in remifentanil pharmacokinetics. Ross and colleagues studied 42 patients aged between 5 days to 17 years during isoflurane anesthesia.[8] Following a bolus dose of remifentanil 5 μg/kg, the volume of distribution in infants < 2 months (range: 191-610 ml/kg) was 50-100% higher compared with other age groups (range: 110-405 ml/kg).

Remifentanil produces typical opioid effects. Apart from analgesia, respiratory depression and hemodynamic changes, it has no clinically relevant effect on intraocular or intracranial pressure, cerebral blood flow, cerebrovascular cardon dioxide reactivity or cerebral capacity.[10-15]

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Figure 1. Remifentanil metabolism.

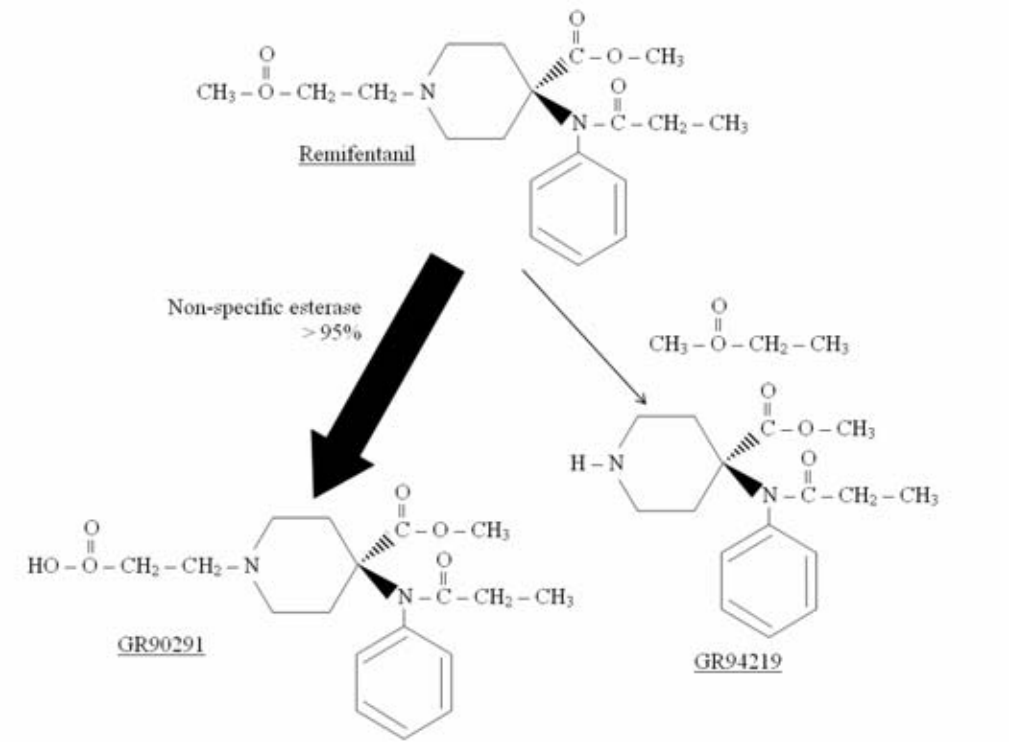

Table 1. Pharmacokinetic profile of remifentanil.

Author, Year (reference #)	Egan *et al* 1993[64]	Egan *et al* 1996[65]	Westmoreland *et al* 1993[66]	Glass *et al* 1998[67]	Minto CF *et al* 1997[68]
V_d steady-state (L/kg)				0.3-0.4	
V_d steady-state (L)	32.8	21.8	25-40	30	
V_1 central compartment				5-10	4.98*
V_2 peripheral compartment (L)					9.01
V_3 peripheral compartment (L)					6.54
Clearance (L/min)	2.8	2.9	4.2-5.0	4**	Cl_1 = 2.46 Cl_2 = 1.69 Cl_3 = 0.065
Terminal elimination half-time (min)	48	35.1	10-21	9	
$T_{1/2}$keo (min)				1-1.5	
pKa				7.26	
Non-ionized at pH 7.4 (%)				58	
Protein bound at physiological pH (%)				89-92	
Context sensitive half time (min)†				3	

*Age and lean body mass were significant covariates. From the ages of 20 to 85 years, V_1 decreased by approximately 25%.
**Age and lean body mass were significant covariates. From the ages of 20 to 85 years, Cl_1 decreased by 33%.
†After 3 hours of infusion.

Patient Controlled Delivery of Remifentanil

Patient controlled analgesia for postoperative pain and acute pain

Given the favorable pharmacokinetic profile, an infusion of remifentanil has been advocated for providing postoperative analgesia. The major concern is however respiratory depression. In this regard, Bowdle and colleagues found a high incidence of respiratory adverse events (29%) and apnea (7%) in patients receiving high doses of remifentanil.[16] Alternatively, remifentanil can be delivered according to patient's demand by a patient controlled analgesia (PCA) device. A typical PCA regimen is to deliver an intravenous bolus of remifentanil 0.2-0.4 μg/kg. This can be supplemented by a basal continuous infusion running at 0.02-0.04 μg/kg/min. The regimen have been successfully used in patients with multiple fracture ribs,[17] following major abdominal or cardiac surgery,[18-20] and in a child following neurosurgical procedure.[21] While all the aforementioned reports suggested that PCA remifentanil provides effective analgesia, potentially serious respiratory depression may still happen. It is therefore recommended that patients using this technique should also receive supplemental oxygen and respiratory monitoring.

Patient controlled analgesia for labor pain

Based on the same principle, remifentanil has been used as an alternative for labor analgesia. This is particularly important when epidural analgesia is contraindicated.[9,22-24] Given that the rapid onset and offset of action, an appropriate PCA setting would be the key to success. In addition, the mother using PCA remifentanil must be aware of the forthcoming uterine contraction. Therefore, she can activate the demand bolus at the earliest warning in order to achieve the maximum analgesia during the peak of contraction, but to avoid excessive sedation between painful contractions. In this regard, a previously PCA setting designed to infuse the bolus (0.2-0.5 μg/kg) over 1 minute has resulted in disastrous results. Volmanen and colleagues reported that 10 out of 17 women develop hypoxi a in between uterine contractions and supplemental oxygen is required in three women.[25] In a dose finding study the median effective bolus dose was 0.4 μg/kg, but there were wide variations in individual doses required. Most studies limited the PCA demand dose to < 0.5 μg/kg. [22,24,27,26] A typical PCA regimen is shown in Table 2. At this dosage, PCA remifentanil has been compared favorably with meperidine infusion,[28] PCA meperidine,[26] intramuscular meperidine[29] and nitrous oxide.[27] It should be noted that a direct comparison with PCA remifentanil with epidural using local anesthetics and opioid has not been done.

Apart from maternal respiratory depression, a major main drawback of using opioid IVI or IMI for labor analgesia is the risk of neonatal apnea. Such side effect on the newborn can be prolonged

Table 2. Remifentanil PCA regimes for labor pain

- Remifentanil diluted to 25 μg/ml
- Bolus dose: 0.2-0.5 μg/kg
- Lockout time: 1-3 min
- No limit for the total dose
- No background infusion
- Watch for sign of respiratory depression (respiratory rate < 8 per min) and oxygen desaturation (< 93%)
- Supplemental oxygen therapy as indicated

after meperidine.[30] Nonetheless, all opioids cross the placental barrier to a certain extent. As a lipophilic molecule, remifentanil crosses placenta barrier readily. However, the newborns are capable to metabolize and redistribute remifentanil as efficient as the adult.[31] Consequently, there is no report on remifentanil related adverse event in the neonates.

Systemic opioid also reduces fetal heart rate variability. This is thought to be related to a direct effect on the fetus and does not necessarily imply fetal asphyxia. But this phenomenon can be confusing to the obstetrician and may result in unnecessary intervention. Fortunately, because of the rapid offset of action, one strategy is to stop the remifentanil administration for short period of time when the fetal heart rate variability should return to normal in the absence of fetal asphyxia.[25] This is an unique advantage for remifentanil.

Patient controlled sedation

Remifentanil has also been used to provide conscious sedation during colonoscopy,[32-34] minor oral surgery or extracorporeal shockwave lithotripsy (ESWL).[35-38] However, the respiratory depressive effect of remifentnail limits its usefulness. Earlier studies reported an incidence of apnea (> 20 seconds) and oxygen desaturation in over 50% and 14% of patients, respectively.[39-41] Furthermore, there were more patients complaining of nausea and vomiting after remifentanil (background infusion = 0.08 μg/kg/min, demand bolus = 25 μg, lockout = 5 min) than propofol (background infusion = 2 mg/kg/hour, demand bolus = 0.5 mg/kg, lockout = 10 min).[39]

The failure of remifentanil for patient controlled sedation (PCS) during surgery may be related to the dose administered. Medina and coworkers evaluated different doses of remifentanil (background infusion 0.05 *versus* 0.1 μg/kg/min and demand bolus of 10 μg) for ESWL treatment.[42] Although all patients achieved effective sedation and analgesia during the procedure, there were higher incidence of vomiting, dizziness and pruritus in the larger dose group.[42] There are also other intrinsic problems with PCS. In this regard, up to 35% of patients refused the technique, because they were not willing to accept the responsibility of titrating their own sedative drugs.[43] Another disadvantage of PCS is that patients can only react to painful or unpleasant sensation, whilst in anesthesiologist titrated sedation, sedatives can be administered in anticipation to forthcoming painful stimuli.

Target Controlled Infusion of Remifentanil

Apart from adjusting infusion rate manually, an alternative method of administering remifentanil is by a target controlled infusion (TCI) device. The TCI systems deliver variable infusion schemes based on a pharmacokinetic model. TCI uses a microprocessor that calculates and constantly updates (usually every 5-15 s) the infusion rate in order to maintain the desired target plasma concentration.[44,45] The predicted plasma and effect site concentrations of the drug can be changed rapidly in as simple a manner as that for volatile agents to suit varying levels of surgical stimulation and individual patient requirements. The perceived advantages of remifentanil TCI include an improved hemodynamic profile and reduced drug consumption.[46] Although TCI produce a more precise control in drug delivery in clinical simulation (Figure 2), there is currently no report demonstrating a superior clinical utility for TCI. Nevertheless, a self-contained TCI system for remifentanil – "Remifusor" has been developed and is commercially available.

Høymork and colleagues studied the performance error of Remifusor in 21 patients undergoing laparoscopic cholecystectomy. Propofol and remifentanil were infused using TCI systems, Diprifusor and Remifusor, respectively.[47,48] There was large variation of measured actual concentrations, with median performance error of at least 25%. Previous studies on Diprifusor also demonstrated similar variation in performance error (about 30%).[49-51] Further research has currently concentrated on targeting the effect-site concentration and may improve the performance TCI.

Clinical experience of TCI remifentanil is still limited but emerging. Currently there were encouraging reports on using TCI remifentanil for intraoperative analgesia in patients whom were breathing spontaneously,[52] being paralyzed[48] or during conscious sedation.[53,54] A study has also been done to evaluate the utility of TCI remifentanil for tracheal intubation in the absence of neuromuscular block.[26]

Despite the success of remifentanil TCI in few reports, its role in daily clinical practice is still unclear. Given that the onset and offset of remifentanil is fast and the concentration-effect relationship is predicatble, it would be simple to adjust the drug infusion according to the desired effect manually. Some examples of recommended target concentration for remifentanil are summarized in Table 3.

Is there acute tolerance to remifentanil?

A major concern of prolonged and intense μ opioid receptor stimulation is the development of acute opioid tolerance. This is a phenomenon characterized by a decrease in analgesic effects with the same dose of opioids after its repeated use.[55,56] Several studies have attempted to demonstrate acute tolerance of remifentanil in clinical situations. Crawford and coworkers studied 30 healthy children, aged between 12 and 17 years, scheduled for correction of idiopathic scoliosis.[57] Patients were randomly assigned to receive intraoperative bolus doses of morphine or remifentanil infusion at 0.05-0.25 μg/kg/min. Postoperative analgesia was provided with patient controlled analgesia (PCA) with morphine. The authors found that the cumulative morphine consumption in patients receiving remifentanil was significantly more than the morphine group during the 24 h after surgery. The difference is most obvious during the first 4 hours. Similarly, in adult patients undergoing major abdominal surgery, the daily morphine requirement in patients receiving remifentanil 0.3 μg/kg/min was higher than those after 0.1μg/kg/min (59 *versus* 32 mg per day).[58] Similarly, in volunteers

Figure 2. Predicted plasma and effect concentration after remifentanil infusion (A) at a constant rate (0.05 μg/kg/min); (B) targeting at a plasma concentration of 5 ng/ml, using the Remifusor; (C) targeting at an effect site concentration of 5 ng/ml using a tailor made target controlled infusion system (Computer controlled infusion program, CCIP version 2, available at www.aic.cuhk.edu.hk). It should be noted that the plasma and effect concentration continue to increase after 4 min of remifentnail infusion running at 0.05 μg/kg/min.

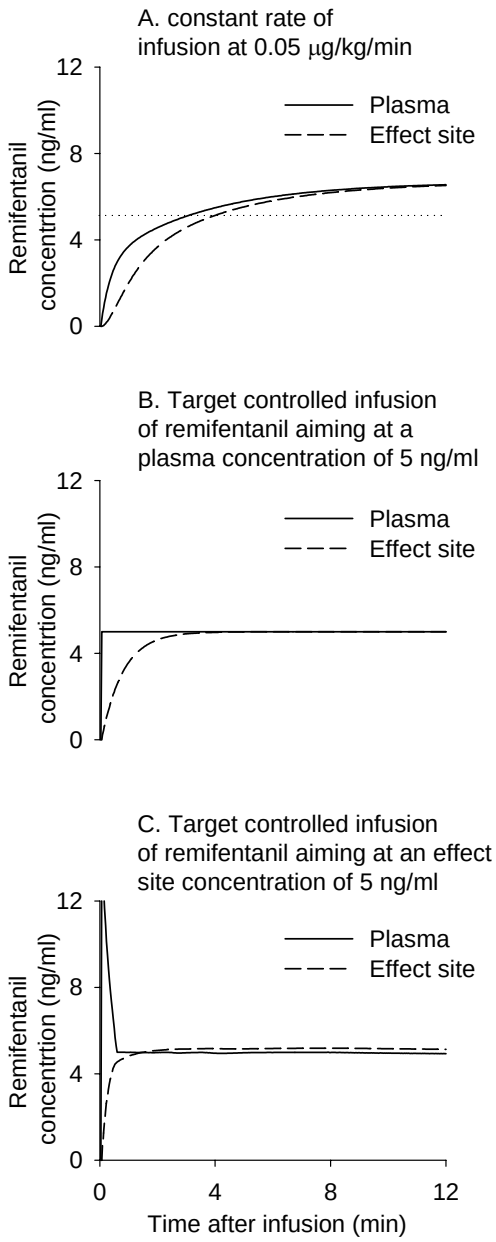

Table 3. Examples of recommended target concentration when using remifentanil TCI

Procedure	Remifentanil concentration (ng/ml)
Tracheal intubation[48] (with neuromuscular block)	7.5
Tracheal intubation (without neuromuscular block)[63]	10-15
Intraoperative analgesia (mechanical ventilation)[48]	5-7.5
Intraoperative analgesia (spontaneous breathing)[47]	0.6-2.8
Conscious sedation[62]	1.8-3.7

receiving a constant rate of remifentanil infusion 0.1μg/kg/min, it was shown that analgesia against thermal and mechanical stimuli was reduced by 75% after three hours of drug infusion.[59] The most striking illustration of acute opioid tolerance after remifentanil infusion was shown in three patients who had remifentanil (0.1-0.8 μg/kg/min) for sedation in the intensive care unit. Each of these patients showed classical signs of withdrawal, including included myoclonus, agitation, sweating, hypertension, tachycardia and mydriasis, soon after termination of remifentanil infusion. The signs were not changed with morphine, clonidine or ketamine but resolved rapidly when remifentanil infusion was resumed.

While all these findings suggested the presence of acute tolerance, several recent studies failed to demonstrate a difference in opioid requirement with or without intraoperative remifentanil infusion.[53,60,61] Nevertheless, the sample size in all the aforementioned studies were small, and it is difficult to draw any conclusion from the existing data.

In conclusion, remifentanil is a pure μ opioid receptor agonist that has fast onset and offset of action. Future research should be conducted to evaluate the optimal technique and dosage to deliver remifentanil for both intraoperative and postoperative analgesia.

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Corrections:

In the December issue of *Bulletin*, the article entitled "Magnetic Resonance Imaging of the Airway"* contains several typographical mistakes:

In Figure 2 and 3, the legends should read:

Figure 2. A deflated classic LMA ready for insertion. $\angle \gamma$ = angle of the bowl to the tube. $\angle\varepsilon$ = wedge angle of the deflated tip.

Figure 3. The upper airway geometric model with a LMA in the pharynx. $\angle\gamma$ = angle of the bowl to the tube = 28°, $\angle\varepsilon$ = wedge angle of the tip when deflated = 36.5°

The Editors apologize for the mistakes.

*Sit RYK. Magnetic Resonance Imaging of the Airway: Implications on the Design of Laryngeal Mask Airway for the Chinese. Bull HK Coll Anaesthesiol 2006; 15:184-8.

Board of Pain Medicine

The Hong Kong College of Anaesthesiologists conducted an inspection of the New Territory East Cluster and Hong Kong West Cluster Hospitals for renewal of accreditation of training towards the Diploma of Pain Management on 16th and 19th April 2007. Results of the inspection process will be reported in the next Bulletin following endorsement of the inspection report by Council.

In preparation of the change in format of examination that includes the introduction of Oral examination in 2008 (see previous issue of Bulletin October 2006 or HKCA website for detail), the Board of Pain Medicine has nominated additional examiners to the Court of Examiners. These examiners participated in the recent Examiners' Workshop conducted by HKCA and will participate in the coming HKCA Anaesthesiology Final examinations. The current Dip Pain Mgt examiners are; Dr TW Lee (Chairman), Drs Anne Kwan, Steven Wong, PP Chen, MC Chu, Theresa Li, SL Tsui. The criteria required to qualify as an Examiner in pain medicine is set by the HKCA Board of Examination, and is similar to that of the HKCA Anaesthesiology Examination.

Over the last year, the Dip Pain Mgt Formal Project Committee has assessed eight projects and approved six, towards Diploma of Pain Mgt. The Board of Pain Medicine is grateful to all assessors who have participated in the review of the project reports. Each submitted manuscripts was assessed independently by two assessors and the Project Officer. The current project assessors are; Dr PP Chen (Project Officer), Drs TW Lee, CT Hung, Anne Kwan, Steven Wong, KK Lam, MC Chu, SL Tsui, Anne Chan, Jacqueline Yap, Theresa Li, Simon Chan and MS Law.

PP Chen
Chairman
Board of Pain Medicine

Institute of Clinical Simulation

The North District Hospital (NDH) in collaboration with the Hong Kong College of Anaethesiologist (HKCA) set up the Institute of Clinical Simulation (ICS) at North District Hospital in August 2001 for the training of anaesthesiologists and health care professionals. The ICS is governed by a Committee comprising of representatives from NDH and HKCA. Previous Directors of ICS included Dr TS Sze (2001/02, 2002/03), Dr KK Lai (2003/04), Dr TW Lee (2004/05) and Dr KM Ho (2005/06).

We have a state-of-the-art METI human patient simulator, SIMMAN simulator and an advanced audiovisual system located in simulated real-life environment where clinical scenarios are played out. The ICS is also equipped with airway training equipment including a virtual bronchoscopy model and latest airway management accessories.

Since last October, HKCA has funded a part-time manager (Ms Josephine Wong Pui Ying) at the ICS to assist in coordinating the different courses and to manage the facility. This year we have increased the number of courses conducted at the ICS and also introduced generic courses on medical intervention of clinical emergencies for different medical specialties. Currently we run several courses including the Anaesthesia Crisis Resource Management (ACRM), Effective Management of Anaesthetic Crises (EMAC), Nursing Intervention of Clinical Emergencies (NICE), Medical Intervention of Clinical Emergencies (MICE) for doctors from different specialties, Advanced Difficult Airway Management Workshop for Doctors (ADAM-D) and Advanced Difficult Airway Management Workshop for Nurses (ADAM-N). Apart from these courses we also accommodate requests for specially tailored courses for different target groups at the ICS. You can find the ICS course programme for 2007 attached below, or you can refer to the HKCA website.

Our instructors for different courses have been trained and credentialed by relevant authorities. Most of our instructors are anaesthesiologists and nurses working in operating theatres. This year we shall be recruiting more instructors from these disciplines and other medical specialties and disciplines to cater for the expanding role of ICS in training healthcare professionals in the pursuit of patient safety and quality healthcare. If you are interested or know someone who is interested in becoming an instructor to one of the course, please email office@hkca.edu.hk and let us know. Your interest and participation will be most appreciated by HKCA. We shall be organizing some instructor courses this year.

Finally on behalf of ICS, I would like to thank all our instructors who have assisted in the various courses over the years. Your past contributions are very much appreciated and I look forward to your continued participation and involvement in the activities at ICS in the years ahead.

PP Chen
Director

2007 ICS Schedule

Date	Events
14-04-2007	Anaesthesia Crisis Resource Management (ACRM)
05-05-2007	Advanced Difficult Airway Management Workshop for Nurses (ADAM-N)
19-05-2007	Instructor Course for Advanced Difficult Airway Management for Nurses (I-ADAM-N)
09-06-2007 to 11-06-2007	Effective Management of Anaesthetic Crises (EMAC)
23-06-2007	Advanced Difficult Airway Management Workshop for Doctors (ADAM-D)
30-06-2007	Instructor course for Medical Intervention of Clinical Emergencies Workshop (I-MICE)
07-07-2007	Advanced Difficult Airway Management Workshop for Nurses (ADAM-N)
21-07-2007	Instructor Course for Nursing Intervention of Clinical Emergencies (I-NICE)
28-07-2007	Nursing Intervention of Clinical Emergencies Workshop (NICE)
04-08-2007	Instructor Course for Advanced Difficult Airway Management for Doctors (I-ADAM-D)
18-08-2007	Advanced Difficult Airway Management Workshop for Doctors (ADAM-D)
01-09-2007	Advanced Difficult Airway Management Workshop for Nurses (ADAM-N)
15-09-2007	Medical Intervention of Clinical Emergencies Workshop (MICE)
06-10-2007	Medical Intervention of Clinical Emergencies Workshop (MICE)
20-10-2007	Nursing Intervention of Clinical Emergencies Workshop (NICE)
03-11-2007 to 05-11-2007	Effective Management of Anaesthetic Crises (EMAC)
17-11-2007 to 18-11-2007	HKCA Annual Scientific Meeting Crisis Management Workshop
01-12-2007	Medical Intervention of Clinical Emergencies Workshop (MICE)
22-12-2007	Nursing Intervention of Clinical Emergencies Workshop (NICE)

Board of Intensive Care Medicine

THE HONG KONG COLLEGE OF ANAESTHESIOLOGISTS
ADMINISTRATIVE INSTRUCTIONS: TRAINING AND EXAMINATION

1. REGISTRATION AND MEMBERSHIP SUBSCRIPTION

To be awarded Fellowship of the Hong Kong College of Anaesthesiologists (Intensive Care), a registered medical practitioner must be a trainee of the College, pass or be exempted from the Intermediate Examination, pass the Fellowship Examination, satisfactorily complete an approved Formal Project, complete other training requirements of the College and successfully complete the Exit Assessment.

1.1. To be registered as a trainee, a medical practitioner must have completed postgraduate training acceptable to the College, which necessitates having held general hospital internship appointments for 12 months.

1.2. Trainees must register with the College and must pay the Membership fee before being eligible to present for a College examination.

1.3. For training to be recognised in an approved post in Hong Kong, trainees must comply with requests from the College for information relating to their training including the annual approved vocational training forms and surveys of training.

2. TRAINING PROGRAMME IN INTENSIVE CARE (See also section 6)

2.1. Basic Vocational Training

2.1.1. The first three years of training shall be basic training in Anaesthesiology and other specialties of acute medicine such as Intensive Care Medicine, Internal Medicine, Paediatrics, Surgery and Emergency Medicine, and other disciplines related to Intensive Care Medicine as approved by the College.

2.1.2. Trainees have to pass the Intermediate examination of the Hong Kong College of Anaesthesiologists, or equivalent by the end of their Basic Vocational Training before they are eligible for Higher Vocational Training.

2.1.3. During Basic Vocational Training, a minimum of **6** months of Anaesthesia in an approved Anaesthesia training post is required.

2.1.4. Trainees registering for Higher Vocational Training in Intensive Care who have completed partial training in other programs acceptable to the College may, at the discretion of the College, be deemed to have completed Basic Vocational Training. A detailed program for such a trainee must be submitted for approval.

2.2. Higher Vocational Training

The next three years of training shall be Higher Vocational Training which shall consist of:

2.2.1. Two years of training in an accredited Intensive Care Training post.

2.2.2. One optional year as specified in section 6.3.2.

2.3. At least 6 months of accredited training in either Internal Medicine or Paediatrics must be completed during either Basic or Higher Vocational Training.

2.4. The total duration of Anaesthesia training, in a recognised anaesthesia training post, during Basic or Higher Vocational Training must be a minimum of **12** months.

2.5. An approved Formal Project must be satisfactorily completed in accordance with IC-13, before presenting for the Exit Assessment.

2.6. The duration of vocational training shall be a total of six years to comply with the requirements of the Hong Kong Academy of Medicine.

2.7. All training must be assessed and approved by the Board of Censors.

3. SPECIAL SITUATIONS

3.1. FELLOWS OF HONG KONG COLLEGE OF ANAESTHESIOLOGISTS

3.1.1. The Fellowship of the Hong Kong College of Anaesthesiologists (Intensive Care) cannot be obtained within twelve months of having completed the requirements for the Fellowship of the Hong Kong College of Anaesthesiologists (Anaesthesiology).

3.1.2. At least twenty-four months of accredited training in Intensive Care must be completed after the first 3 years of Basic Vocational Training to satisfy the requirements for the Fellowship of the Hong Kong College of Anaesthesiologists (Intensive Care).

a. A minimum of twelve months of accredited training in Intensive Care must be completed after satisfying the requirements for the Fellowship of the Hong Kong College of Anaesthesiologists (Anaesthesiology).

3.1.3. At least 6 months of accredited training in either Internal Medicine or Paediatrics must be completed during training.

4. THE INTERMEDIATE EXAMINATION (ANAESTHESIA AND INTENSIVE CARE)

4.1. Intermediate Examinations will be held at times that are determined by the College Council.

4.2. The subjects for the Intermediate Examination, which include written and oral sections, are:

a. Physiology and the principles of measurement.

b. Pharmacology and the principles of statistics.

5. FELLOWSHIP EXAMINATION

5.1. Fellowship Examinations will be held at times that are determined by the College Council.

5.2. The subjects for the Fellowship Examination will be the theory and practice of Intensive Care, including relevant aspects of the basic sciences, anaesthesia and clinical medicine.

5.3. The examination will comprise written, oral and clinical sections.

5.3.1 The written examination will be taken at centers in Hong Kong at the discretion of the College Council.

5.3.2 The oral/clinical examination will be held at centers in Hong Kong at the discretion of the College Council.

5.4 Candidates may apply for admission to the Fellowship Examination who comply with Administration Instruction 1.1 and who have:

a passed the Intermediate Examination of the College; or

b passed an Intermediate Examination recognised by the College Council as of comparable standard, or

c been granted exemption from the Intermediate Examination by the College Council.

In addition, the trainee must comply with training requirements as follows:

5.4.1 Candidates may present for the Fellowship Examination in Intensive Care after having completed a minimum of one year of intensive care training as part of the Higher Vocational Training.

6. TRAINING PERIOD (INTENSIVE CARE) (See also section 5).

6.1. All trainees will be required to be assessed by their training departments. These assessments will use the criteria and form laid down in Policy Document IC-11, "In-training Assessment of Trainees in Intensive Care". The Censor must certify that in-training assessment is satisfactory according to this Policy Document before Fellowship of the College can be awarded.

6.2. Vocational training commences from the date that the trainee:

a occupies an approved training post in Anaesthesia or Intensive Care, or

b occupies another post recognised towards training when it is part of a formally organised training programme.

Retrospective recognition may be given for other training which complies with the College Administrative Instructions: e.g. internal medicine, surgery, paediatrics, emergency medicine, research etc., but this retrospective recognition will not alter the official date of commencement of Approved Vocational Training.

6.3. The Higher Vocational Training period in intensive care specified in Administrative Instruction 2.2 **MUST** include:

6.3.1. Two years in an accredited Intensive Care. Twelve months must be continuous and undertaken in one unit.

6.3.2. Twelve months may be spent in any combination of internal medicine, emergency medicine, surgery, research, anaesthesia, intensive care, paediatrics, or other disciplines related to intensive care as approved by the College Council.

6.4. Trainees should seek from the Intensive Care Board prior approval of terms in medicine, research or other discipline related to Intensive Care.

6.5. Prior approval of a research programme must be followed by documentation, which authenticates completion of the period for which approval was sought.

6.6. Holders of a higher qualification in anaesthesia for which there is a basic science examination equivalent to the Hong Kong College Intermediate Examination must produce evidence of training acceptable to the College Council before presenting for the Fellowship Examination.

6.7. Interrupted Training

6.7.1. Higher Vocational Training must include two uninterrupted years.

6.7.2. Following an interruption of more than one year but less than three years a minimum of one uninterrupted year is required to complete training.

6.7.3. Following an interruption of more than three years a minimum of two uninterrupted years is required to complete training, one of which must be an uninterrupted year in Intensive Care.

Note1: An uninterrupted year is a year of training which is broken only by normal recreation and/or study leave.

Note2: Two uninterrupted years consist of two years each of which is spent in accordance with Note 1 and the interval between them is no more than three months.

6.8. Part Time Training

6.8.1. May be accepted for training in Hong Kong subject to prior approval of the College Council.

6.8.2. Cannot commence until two years of Basic Vocational Training as delineated under Administrative Instruction 2.1 has been completed in a full time capacity and the Intermediate Examination has been passed

6.8.3. Must be in approved training posts.

6.8.4. Must have the same content of training and total training time as for full time trainees. Vocational Training must be completed within ten years.

6.8.5. Must have a commitment within any block of training which is at least 50% of that of a full time trainee and including pro rata involvement in out of hours work.

6.8.6. Must involve participation in Hospital Intensive Care teaching programmes.

6.8.7. Requires registration with the College and payment of the annual training fee each year.

6.8.8. Requires that applications to the College Council must be accompanied by supporting documentation from the Hospital administration and Head of the Intensive Care Department.

7. APPROVED POSTS FOR TRAINING

7.1. The College Council will approve Intensive Care Units for training in Intensive Care. A limitation may be imposed on the number of posts and/or the duration of training recognised.

7.2. Posts for the anaesthesia component of Intensive Care training must be in hospitals approved for training by the Hong Kong College of Anaesthesiologists.

7.3. Posts in medicine related to Intensive Care must be in hospitals with training posts approved for training by the Hong Kong College of Physicians.

7.4. Posts in Paediatrics must be in hospitals with training posts approved for training by the Hong Kong College of Paediatricians.

7.5. Posts in surgery related to Intensive Care must be in hospitals with training posts approved for training by the Hong Kong College of Surgeons.

7.6. Posts in emergency medicine must be in hospitals with training posts approved for training by the Hong Kong College for Emergency Medicine.

7.7. Posts in other disciplines related to Intensive Care must have the approval of College Council.

7.8. Research programmes must have the approval of the College Council.

7.9. Candidates should seek from the Censor prior approval of such programmes. Prior approval of a research programme must be followed by documentation which authenticates completion of the period for which approval was sought.

8. EXAMINATION APPLICATIONS

8.1. The form of application to present for examination must be accompanied by a certificate of training from the candidate PIs Supervisor(s) of Training, or Director of the Department.

8.2. Where the training required to sit the examination has not been completed by the closing date for application, but will be completed by the date of the written section of the examination, a written statement will be required from the candidate PIs Supervisor of Training or Director of the Department certifying that training will continue up until the examination date.

9. NOTIFICATION OF RESULTS

The Chairman of the Committee of Examiners or Deputy shall, at the conclusion of the Examiners Meeting, sign letters to each candidate indicating acceptance or rejection by the Committee. These letters will be handed directly to the candidates by the Invigilator at a specified time and place. In the event that a candidate does not appear to receive this notification, the letter will be posted to the candidate by the first available mail.

10. CERTIFICATE OF EXAMINATION

Upon successful completion of the College Examination candidates will be issued with the following certificate:

This is to certify that ..... has satisfied all the examination requirements of the Hong Kong College of Anaesthesiologists.

Award of Fellowship of the College is dependent on candidates fulfilling both examination and training requirements.

Eligibility for Admission to the Fellowship of the Hong Kong College of Anaesthesiologists is dependent upon successful completion of the prescribed period of training.

11. THE MEDAL

The Medal will be awarded by the Hong Kong College of Anaesthesiologists.

11.1. All candidates who present for the Fellowship Examination will be considered for this Award.

11.2. The Medal is awarded by the College Council on the recommendation of the Chairman of the Fellowship Examination Committee.

11.3. The Medal may be awarded to the candidate who achieves the highest mark in the Fellowship Examination in that calendar year provided that the candidatePIs performance is of outstanding merit.

11.4. If two or more candidates are found to have reached the required standard and to have achieved the same number of marks, the Chairman of the Fellowship Examination Committee will adjudicate. Special note will be taken of the performance of the candidates in the Clinical Section of the Examination.

11.5. The winner of the Medal is advised of the Award by the President following a College Council Meeting. The Medal is presented at the subsequent Congregation of the College.

Promulgated: June 2004
Revised: December 2006

Centrally Organized Training Program for HKCA (IC) trainees

In order to strengthen the training for intensive care trainees, the ICU Board had coordinated a Centrally Organized Training Programs targeted for trainees undergoing **Higher Vocational training.**

With the help of 30 tutors from all the 7 hospitals providing HKCA (IC) training, namely NDH, PMH/YCH, PWH, PYNEH, QEH, QMH and TMH, we have devised a two-year training program. We are honored to invite Dr HY So to give the first tutorial on 21st March 2007 at PWH. This tutorial is not limited for HKCA (IC) trainees, all the anaesthetics trainees as well as CCM trainees are welcomed to join.

Aim and logistic of running this Central Organized Training Program

1. To expose trainees to different specialists with different style of teaching and different units with different case mix or practice.
2. To ensure a structured, guaranteed 2- hours teaching every week
3. All the seven training units in Hong Kong will participate in this program.(NDH, PMH/YCH, PWH, PYNEH, QEH, QMH, TMH).
4. The training program consists of a mixture of core ICU topics and bedside teaching over the time span of 2 years. This training program will be distributed to all the SOTs/ICU trainees as well as published in the HKCA Bulletins.
5. After the trainee receives the training program, he/she will go to the corresponding hospital to have the 2- hours coaching as scheduled. COS and SOT of each unit had been informed to relieve the trainee to attend this course as much as possible.
6. The tutor will be responsible to take attendance and send it back to Prof G Joynt via his secretary for record. A **minimum of 60%** attendance rate is counted as satisfactory in the HKCA(IC) trainee's Annual In-Training Assessment.

Format, time and venue of teaching/Tutorial

1. **Time**: Every Wednesday from 18:00 to 20:00 except Statutory holiday or Public Holiday
2. **Venue of each hospital**:

Hospitals	Venue	SOT/ Chief contact persons
NDH	2/F ICU conf. room	Dr CM Chau
PMH	G1	Dr KW Chan
PWH	C3 ICU	Dr Charles Gomersall
PYNEH	D10 ICU	Dr Anne Leung
QEH	D6 ICU	Dr KW Au Yeung
QMH	C4 Seminar room	Dr K M Kwok
TMH	D8	Dr Judith Shen

Date	Hospital	Tutor	Topics
6/6/2007	PWH	Dr Gavin Joynt	Weaning of mechanical ventilation
6/13/2007	PYNEH	Dr CW Lau	Management of pneumothorax, pleural effusion and chest drain in ICU
6/20/2007	QMH	Dr KM Kwok	Shock
6/27/2007	PWH	Dr Anna Lee	Cardiovascualar monitoring
7/4/2007	TMH	Dr Judith Shen	Treatment of Septic shock
7/11/2007	NDH	Dr W Wong	Myocardial ischaemia
7/18/2007	QEH	Dr KW Lam	Management of heart failure
7/25/2007	PMH	Dr KW Chan	Management of arrhythmia and Cardiac pacing
8/1/2007	QMH	Dr KM Kwok	Pulmonary thromboembolism/fat embolism/amniotic fluid embolism
8/8/2007	PYNEH	Dr Anne Leung	Management of community acquired infections - CAP/Meningitis/Viral infections/sepsis of unknown origin
8/15/2007	PMH	Dr Dominic So	Nosocomial infections infections including VAP/line sepsis/Catheter related UTI/Wound sepsis etc.
8/22/2007	NDH	Dr Claudia Cheng	Infection in immunocompromised patient
8/27/2007	JFICM written		
8/29/2007	QMH	Dr Alexander Chiu	Approach to fever in ICU
9/5/2007	TMH	Dr CK Koo	Viva
9/12/2007	NDH	Dr CM Chau	Bedside teaching
9/19/2007	PWH	Dr Gavin Joynt	X-ray interpretation
10/3/2007	PWH	Dr Charles Gomersall	Bedside teaching
10/10/2007	PWH	Dr Thomas Li	ECG/Biochem interpretaton
10/17/2007	TMH	Dr Judith Shen	Infection control in ICU--MDROs and staff infection control
17-19/10/2007	JFICM oral		
10/24/2007	PYNEH	Dr KC Chan	Management of status epilepticus
10/31/2007	QEH	Dr KY Lai	Neuromuscular disease causing acute respiratory failure: GBS, MG, Critical illness polyneuropathy, tetanus
11/7/2007	PMH	Dr Dominic So	Bedside teaching
11/14/2007	QMH	Dr Karl Young	Bedside teaching
11/21/2007	PYNEH	Dr KC Chan	Viva
11/28/2007	QEH	Dr F Cheng	Bedside teaching
12/5/2007	QMH	Dr Karl Young	Viva
12/12/2007	NDH	Dr CM Chau	Management of cerebral vascular disease
12/19/2007	TMH	Dr CK Koo	Management of delirium in ICU

Board of Examination

Intermediate Fellowship Examination

The following candidate was successful in the Intermediate Fellowship examination February/April 2007:

Alex Chalk Ming WAN

The College is grateful to Dr. Peter Roessler of ANZCA for their assistance as External Examiner in Physiology during the examination.

Final Fellowship Examination (Anaesthesiology)

The following candidates were successful in the Final Fellowship Examination (Anaesthesiology) March/ May 2007

Timmy Chi Wing CHAN
Sandy Kit Ying LAM
Ernest Tat Shing LAM
Chung Wai LAU
Yuen Leung Elina MA
Anthony Kui Hung NJO
Alpha Mang Sze SO
Belinda Lai Yee WONG

The College is grateful to Dr Jeremy Langton of RCA for his assistance as External Examiner during the examination.

Fellowship Examinations 2007

Intermediate Fellowship Examinations
Examination Fee: $ 6,000

June / August	**Date**
Written	22 June 2007 (Fri)
Oral	10/11 Aug 2007 (Fri/Sat)
Closing Date	11 May 2007 (Fri)

Final Fellowship Examination in Anaesthesiology
Examination Fee: $ 9,500

July / September	**Date**
Written	20 July 2007 (Fri)
Oral/OSCE	7-9 Sept 2007 (Fri-Sun)
Closing Date	8 June 2007 (Fri)

Application forms are available from Supervisors of Training and HKCA Office.

Future Meetings:

HONG KONG
23 June 2007
14:45 – 18:00 hours

DEVELOPMENT AND FINANCING OF HONG KONG'S FUTURE HEALTH CARE
Venue: Lim Por Yen Lecture Theatre, Hong Kong Academy of Medicine
Contact: Jason Chan, Manager (Research), Bauhinia Foundation Research Centre,
Tel.: (852) 3182 1128; Fax: (852) 3101 2890

Queenstown
NEW ZEALAND
23 - 26 August, 2007

NEUROANAESTHESIA SPECIAL INTEREST GROUP CONTINUING EDUCATION MEETING
Theme: Hypothermia
Venue: Millennium Hotel
Contact: Ms Juliette Mullumby, ANZCA, 630 St Kilda Road, Melbourne VIC 3004
Tel: 03 9510 6299; Fax:03 9510 6786
Email: jmullumby@anzca.edu.au; Website:http://www.neurosig.com

Perth
AUSTRALIA
14 - 18 Sept.,2007

ASA 66TH NATIONAL SCIENTIFIC CONGRESS AND AOSRA-PM 9TH BIENNIAL CONGRESS
Theme: A Regional Focus.
Venue: Burswood Entertainment Complex
Contact: NSC Secretariat: Congress West, PO Box 1248 West Perth WA 6872.
Tel: 08 9322 6662; Fax: 08 9322 1734
Website: http://www.asa2007.org.au

HONG KONG
29 Sept., 2007

HEALTH RESEARCH SYMPOSIUM 2007
Theme: "*Building bridges between research, practice & policy*"
Venue: Hong Kong Academy of Medicine
Contact: Symposium Secretariat, Tel: 2871 8787; Fax: 2871 8898
Email: HRS@hkam.org.hk

Venice
ITALY
27-29 Sept., 2007

FIRST WORLD CONGRESS OF TOTAL INTRAVENOUS ANAESTHESIA – TCI
Contact: Kenes International, 17 Rue du Cendrier, CH-1211 Geneva 1, Switzerland.
Tel: +41 22 908 0488, Fax: +41 22 732 2850, E-mail: tivatci@kenes.com
Website: http://www.kenes.com/intravenous-anaesthesia

San Francisco
USA
13-17 October, 2007

AMERICAN SOCIETY OF ANESTHESIOLOGISTS ANNUAL MEETING
Venue: San Francisco
Contact: ASA, 520 N. Northwest Highway, Park Ridge, IL 60068-2573.
Tel: 1 847 825 5586; Fax: 1 847 825 1692
Email: mail@ASAhq.org; Website: www.asahq.org

Auckland
New Zealand
7-10 November, 2007

NZ ANAESTHESIA ASM 2007
Theme: Facts, Fads and Folklore
Venue: Sky City Convention Centre, Auckland, New Zealand
Contact: Dr Helen Frith, Convenor. Middlemore Hospital, Private Bag 93311,
Otahuhu, Auckland, New Zealand, Tel: 09 2760 000; Fax: 09 2704 702
Email: hfrith@middlemore.co.nz
Website: www.asm2007.co.nz

Perth
AUSTRALIA
2-4 November, 2007

9TH ANNUAL SCIENTIFIC MEETING OF THE SOCIETY FOR PAEDIATRIC ANAESTHESIA IN NEW ZEALAND AND AUSTRALIA
Venue:Fremantle Maritime Museum, Perth, Western Australia
Contact: Motive Conventions, Tel: 0408 905 099; Fax: 08 9322 1417
Email: jennydyer@motiveconventions.com
Website: www.spanza.org.au

Management of Anaesthetic Crisis (EMAC) course

(Censored by the Australian and New Zealand College of Anaesthetists)

EMAC is a simulator-based course catered to management of anaesthetic crises developed by Australian and New Zealand College of Anaesthetists. It is comprised of 5 half-day modules, namely Human Performance, Cardiovascular Emergencies, Airway, Anaesthetic Emergencies and Trauma.

Venue: **Institute of Clinical Simulation**
North District Hospital
9 Po Kin Road, Sheung Shui

Date: **9-11 June, 2007 Course A**
35 November, 2007 Course B
(Tentative date only, please visit the college website for possible changes)

CME points: **HKCA 20 points**

Max participants: **8**

Fee: **HK$4,000 per head**

Format: **Each registrant will participate in:**

(1) Lectures
(2) Skills stations
(3) An introduction on the METI Simulator the anesthetic machine for use in the workshop and the theories of crisis management
(4) Allocated time for handson crisis scenario management on the METI Simulator, rotating through different roles and handling different scenarios

Trainees starting training program on or after 1st January 2005 are required to complete the EMAC course or its equivalent.

CCAA 2002

CCAA 2001

CCAA 2003 / 4

CCAA 2005

CCAA 2000

Annual Scientific Meeting in Anaesthesiology

17 – 18 November 2007

Programme Outline*

16 November (Pre-meeting Workshop)

- Off-site Workshop on Transthoracic Echocardiography

17 November

- Off-site Simulator Workshop
- Advanced Airway Workshop
- Refresher Courses
- Plenary Lectures
- Symposia in Anaesthesia
- Nursing Seminar - Updates in Recovery Room Care
- HKCA Trainee Project Presentations
- HKCA Congregation and Dinner

18 November

- Plenary Lectures
- Symposia in Anaesthesia
- Symposia in Pain Management
- Symposia in Intensive Care
- Debate Session
- Medico-legal Session
- Free Paper Presentations

* Programme and invited faculty are indicative only and are subject to change

International Faculty*

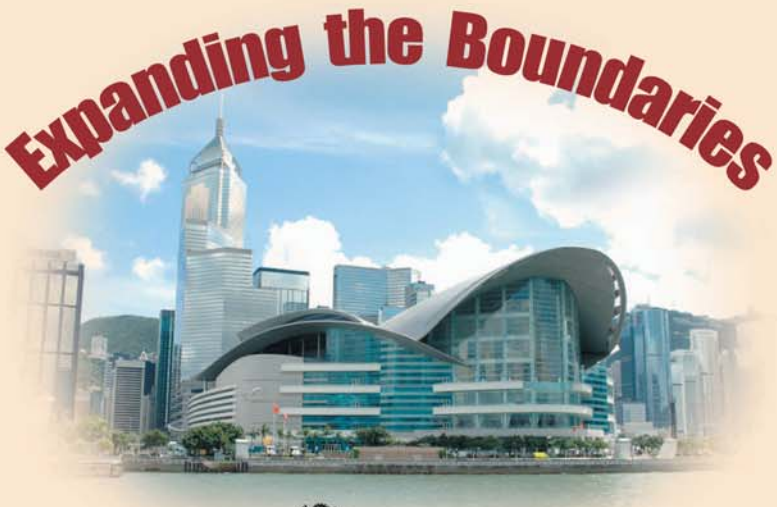
- **Professor Simon Finfer**
  Senior Staff Specialist in Intensive Care at Royal North Shore Hospital, Clinical Associate Professor in Intensive Care at University of Sydney and Director of the Critical Care & Trauma Division at The George Institute for International Health, Australia
- **Professor Pamela Flood**
  Associate Professor of Anesthesiology, Department of Anesthesiology, Columbia University, USA
- **Professor Peter Kam**
  Nuffield Professor of Anaesthetics, Royal Prince Alfred Hospital, Australia
- **Professor Kate Leslie**
  Associate Professor, Department of Anaesthesia & Pain Management, Royal Melbourne Hospital, Australia
- **Professor Alan Merry**
  Head of Department, Department of Anaesthesiology, University of Auckland, New Zealand
- **Professor Stephan Schug**
  Chair of Anaesthesiology & Director of Pain Medicine, University of Western Australia, Royal Perth Hospital, Australia
- **Dr. Tim Semple**
  Senior Consultant Anaesthetist, Department of Anaesthesia and Intensive Care, The University of Adelaide, Royal Adelaide Hospital, Australia
- **Professor Steven Shafer**
  Professor of Anaesthesiology, Department of Anaesthesia, Stanford School of Medicine, USA
- **Professor Martin Tobin**
  Professor of Medicine, Pulmonary and Critical Care Medicine, Department of Medicine, Loyola University Hospital, USA

Venue

Room 301, New Wing, Hong Kong Convention and Exhibition Centre
Wanchai, Hong Kong

Enquiries

CMPMedica Pacific Limited
Tel: (852) 2559 5888 Fax: (852) 2559 6910
E-mail: meeting.hk@asia.cmpmedica.com
Web-sites: www.hkca.edu.hk/asm2007.htm
www.sahk.hk/upcomingevents.html



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The Society of Anaesthetists of Hong Kong

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- SEVOrane® does not predispose the heart to arrhythmias when catecholamines are administered for control of surgical bleeding[2]
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References: 1. Puckett SD, et al. Sevoflurane use in Veterans Affairs medical centers: Utility, safety, and cost-effectiveness. AANA 1997.; 65 (2): 136 -141. **2.** Larson CP Jr. Sevoflurane. The best volatile anesthetic ever developed. Curr Rev Nurs Anesth 2005; 27(25): 293-304. **3.** Ebert TJ, et al. Cardiovascular response to sevoflurane: a review. Anesth Analg 1995; 81: S11-22.

SEVOrane® Quiz 2 (Tick the correct answer and fax to 2219 8066)

What kind of stability offered by SEVOrane® does Bottle 2 represent?

☐ Pulmonary stability ☐ Cardiac stability ☐ Neural stability ☐ Hepatic stability

Doctor's name: _____ Tel: _____

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The **first twenty respondents** who return the Quiz with correct answer will be entitled to a HK$200 medical bookshop voucher. Abbott Laboratories Limited reserves the right to make final decision in relation to the SEVOrane Quiz.

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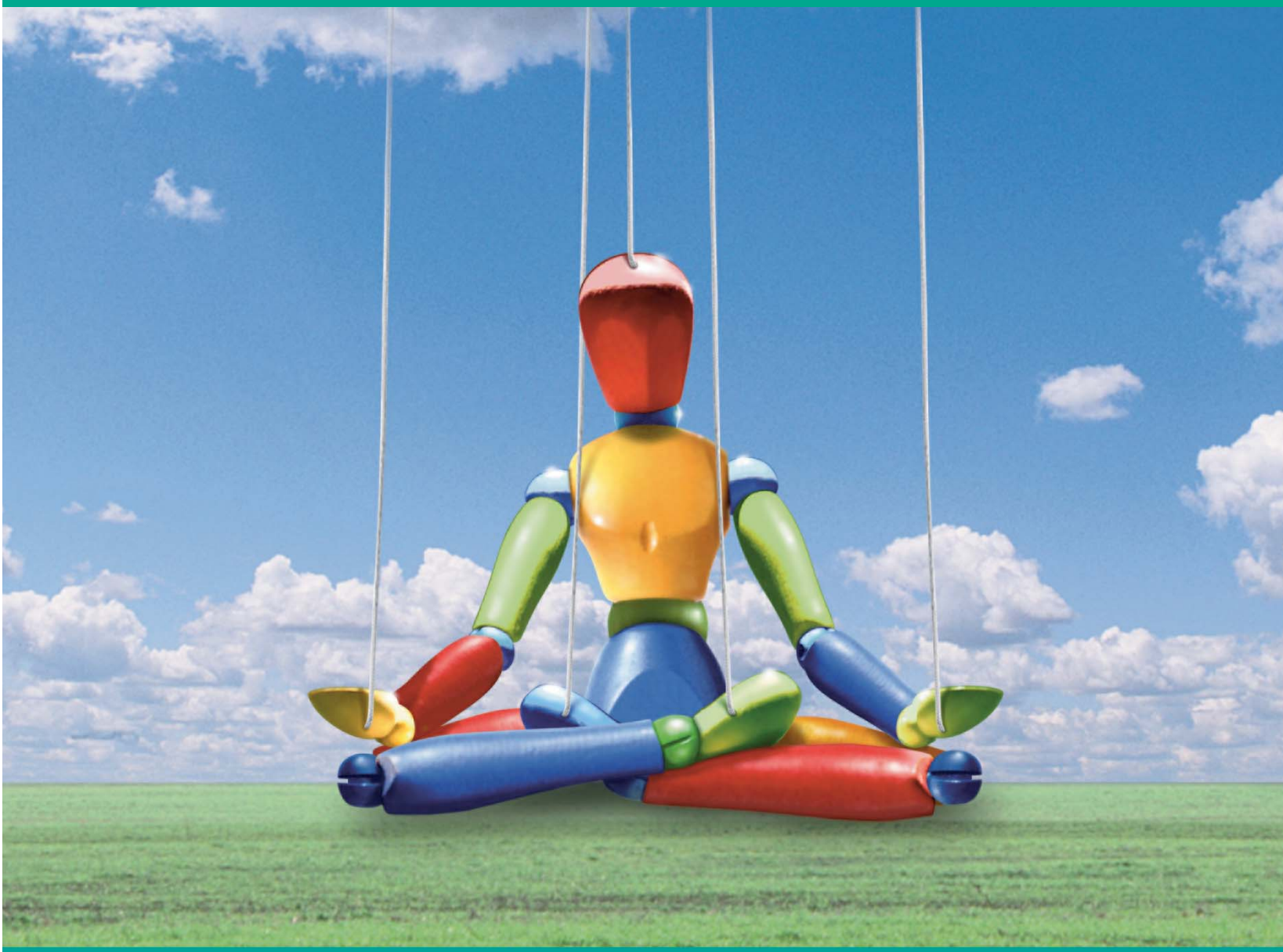

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Phone: (852) 2871 8833. Fax: (852) 2814 1029, Email: office@hkca.edu.hk, website: www.hkca.edu.hk

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