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Clinical experience of trainee anaesthesiologists: logbook analysis

分析麻醉科醫學生的工作日誌了解其臨床經驗

Objective. To study the clinical experience acquired by trainee anaesthesiologists after 6 years of training in Hong Kong.
Design. Retrospective observational study.
Setting. Recognised anaesthesiology training posts in the Hong Kong Hospital Authority.
Participants. All anaesthesiology trainees who sat the Exit Assessment between January 2001 and June 2002 after completing more than 48 months of anaesthetic training.
Main outcome measures. Anaesthetic experience of trainees.
Results. All data provided by 25 trainees were computed for analysis. Each trainee administered a mean of 2668 anaesthetics over a 6-year period, including 57 anaesthetics for thoracic surgery, 15 for cardiac surgery, 213 for caesarian section (34% under general anaesthesia), and 100 for neurosurgical operations. The paediatric anaesthesia exposure involved a mean of 12 neonates and 180 children who were younger than 4 years. Apart from cardiac and thoracic anaesthesia, there was no statistical difference in subspecialty anaesthetic experience among trainees from different parent hospitals.
Conclusion. The current training system provides sufficient anaesthetic experience in terms of case variety and subspecialty case numbers. There was uneven exposure to cardiac, thoracic, and paediatric anaesthesia. An accurate logbook that is reviewed regularly by a supervisor will help ensure adequate subspecialty exposure. An electronic logbook will facilitate a more comprehensive reviewing process.

目的：研究香港的麻醉科醫學生在六年訓練後的臨床經驗。
設計：回顧式觀察研究。
安排：香港醫院管理局轄下認可的麻醉科醫學訓練單位。
參與者：在2001年1月至2002年6月期間接受離校評估的麻醉科醫學生，他們已完成為期48個月的麻醉科訓練。
主要結果測量：麻醉科醫學生的臨床經驗。
結果：利用電腦分析收集自25個麻醉科醫學生的數據。在六年內，每人平均進行了2668次麻醉工作，包括57次胸腔手術、15次心臟手術、213次剖腹生產（當中34%為全身麻醉）和100次神經外科手術。兒科麻醉方面，每人平均進行了12次新生嬰兒麻醉和180次四歲以下兒童的麻醉。除了心臟手術和胸腔手術外，不同醫院的醫學生在其他分科上的麻醉經驗，在統計學上沒有分別。
結論：現時的訓練制度為醫學生提供足夠不同種類和不同分科的麻醉經驗。他們在心臟手術、胸腔手術及兒科麻醉的次數，出現不平均的現象。醫學生準確撰寫工作日誌，並由其監督定期檢查，能確保醫學生涉獵各分科的經驗。將工作日誌電子化能協助加快檢查過程。

Key words:
Anesthesiology/education;
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Introduction

A specialist anaesthesiologist is often required to manage the anaesthetic of patients of different ages and with a variety of medical and surgical conditions. He/she may also be asked to provide anaesthetic services in an unfamiliar environment such as an interventional radiology suite or emergency room. While the Fellowship Examinations ensure that trainees possess the knowledge base required for safe practice, sufficient clinical experience in different anaesthetic subspecialties is equally important. Ensuring adequate exposure to different

Box 1. The American Society of Anesthesiologists status

It is a grading system to describe the physical state of a patient. The grading correlates with the risk of anaesthesia and surgery:
- Class I—A normally healthy individual
- Class II—A patient with mild systemic disease
- Class III—A patient with severe systemic disease that is not incapacitating
- Class IV—A patient with incapacitating systemic disease that is a constant threat to life
- Class V—A moribund patient who is not expected to survive 24 hours with or without operation
- Class E—Addition as a suffix for emergency operation

Box 2. The level of supervision

According to the educational guidelines of the Hong Kong College of Anaesthesiologists, supervision of trainee anaesthesiologists shall be undertaken by specialist anaesthesiologists who possess qualifications acceptable to the College. There are four categories of supervision:
- Category 1—A supervisor rostered solely to one theatre and available at all times during the rostered period
- Category 2—A supervisor rostered to two theatres which are in close proximity to each other
- Category 3—A supervisor who is available in the operating theatre complex but is not exclusively rostered to a trainee
- Category 4—A supervisor who is rostered on call, he/she is not in the hospital but lives within reasonable travel time from the hospital

The supervision level required varies with the training experience of the individual trainee.

anaesthetic subspecialties can be achieved through a mandatory hospital rotation programme. This is especially important when tertiary or quaternary services are restricted to a limited number of hospitals.

There is no universal agreement to quantify subspecialty training although number of cases/exposures can be specified. The Australian and New Zealand College of Anaesthetists (ANZCA) published a statement[1] on subspecialty training that listed the number of cases required in different subspecialties. The recommended numbers may be regarded as the minimum experience required by trainees. The Hong Kong College of Anaesthesiologists (HKCA) is in the process of defining the minimal experience required. A trainee's annual logbook, which is a compulsory requirement for all trainees, contains useful data on exposure, training, and experience. A study of logbooks from trainees who have completed the course provides an accurate overview of subspecialty exposure. This study was partly commissioned by the HKCA to determine the clinical experience of trainees after 6 years of training and to review and plan future training programmes.

Methods

The logbooks of trainees who had completed 6 years of training under the auspices of the HKCA served as the main source of data. All trainees who sat the Exit Assessment of the HKCA between January 2001 and June 2002 were included into the study. Verbal consent to extract information from the logbooks was obtained from all trainees. In addition, details of hospital rotation and vocational training were obtained. Incomplete logbooks were excluded from analysis. The details of each anaesthetic were entered into an Excel worksheet (Windows version Excel 97; Microsoft Corporation, Seattle, US) and included age, sex, American Society of Anesthesiologists (ASA) status of the patient; date, location, and subspecialty of the operation; level of supervision,[2] regional block, and airway management. A trainee may take more than 6 years to obtain Fellowship, thus only experience accreditated for the 6 years of vocational training were included.

A summary was compiled for each trainee and included the following information for each rotation:

(1) Total caseload—categorised according to ASA status (Box 1) and level of supervision (Box 2);
(2) Subspecialty caseload—thoracic surgery (TS), neurosurgery (NS), general surgery (GS), orthopaedics and traumatology (OT), gynaecology, obstetric analgesia and anaesthesia, otorhinolaryngology (ENT), oromaxillofacial surgery (OMF), electroconvulsive therapy, cardiac surgery (OHS), and anaesthesia for remote locations: computed tomographic scan, magnetic resonance imaging, interventional neuroradiology, and cardiac catheterization;
(3) Paediatric anaesthesia (Paed) caseload—categorised according to age (<1 month, 1 month-1 year, 1-4 years, 4-10 years[1]) and subspecialty (TS, OHS, NS, GS, OT, ENT, eye, OMF);
(4) Number of special airway manoeuvres performed such as double-lumen endobronchial tube (DLEBT) intubation, tubeless anaesthetic technique in upper airway surgery with or without laser, and anaesthesia for rigid bronchoscopy; and
(5) Number of different regional blocks performed.

The subsequent data analysis was divided into three parts as shown below.

Part 1: Corrected annual subspecialty exposure during each hospital rotation

This part assessed the annual exposure of trainees to anaesthesiology subspecialties and techniques during each hospital rotation. Because of the varying duration of each rotation, the caseload per subspecialty per trainee for each hospital rotation was corrected to a 12-month basis according to the following formula:

$$\text{Corrected annual subspecialty caseload (AnnSubSpLoad)} = \text{Subspecialty caseload} \times 12 / \text{duration of hospital rotation (months)}$$

The mean and standard error of the AnnSubSpLoad for each hospital rotation were calculated using data from trainees who had spent time in that hospital. Statistical Package for the Social Sciences (Windows version 10.0; SPSS Inc, Chicago [IL], US) was used for statistical

Box 3. The rotational system of the Hong Kong College of Anaesthesiologists

Individual hospitals were categorised according to their casemix and caseload provided—category A hospitals provide the largest casemix and caseload; category B hospitals provide cases of limited subspecialties; category C hospitals provide only cases from one particular subspecialty. For the purpose of accreditation of training, individual hospitals shall be accredited for training in clinical anaesthesia in the following categories by the Board of Accreditation of the College:

- Category A accredited anaesthetic training of more than 24 months but not more than 36 months
- Category B accredited anaesthetic training of not more than 24 months
- Category C accredited anaesthetic training of not more than 6 months

Vocational training in anaesthesiology shall consist of not less than 6 years after full registration with the medical registration authority.

The 6-year vocational training programme in anaesthesiology shall be full-time and shall consist of the following components:

- Non-anaesthetic clinical experience: 6 months
- Clinical anaesthesia: 48 months
- Intensive and critical care medicine: 3 months
- Elective options: 15 months

calculation. One-way analysis of variance (ANOVA) was used to look for significant statistical differences in the subspecialty caseload between hospitals, followed by Tukey Honestly Significant Difference (HSD) post-hoc test when appropriate. A P value of less than 0.05 was regarded as statistically significant.

Part 2: Comparison of subspecialty caseload of category A and category B hospitals

Hospitals accredited for anaesthesiology training in Hong Kong were categorised as A, B, or C according to the casemix, diversity, and volume of service as well as training provided (Box 3). Using the AnnSubSpLoad calculated in part 1 and coding the corresponding hospitals to different categories, the mean AnnSubSpLoad for categories A and B hospitals were calculated. Mann-Whitney *U* test was used to look for statistical differences between the two groups. Category C hospitals were not included in the statistical comparison because of the restricted casemix and low volume of service.

Part 3: Actual caseload administered by each trainee during 6 years of training

The actual caseload for each trainee, categorised into different subspecialties over the 6 years, was calculated. The HKCA requires each trainee to undertake at least 48 months of vocational anaesthesiology training within the 6 years of training. This part of analysis only included those trainees who had spent the 48 months of vocational anaesthesiology training in Hong Kong. Those who had some overseas training but had completed more than 48 months of anaesthesiology training in Hong Kong were also included. The subspecialty case numbers of the rotations of each individual trainee were added together to form the total number of subspecialty cases over 6 years. The mean actual subspecialty caseload was also calculated. Trainees were then grouped according to their parent hospital. The total average subspecialty caseload of trainees coming from the same parent hospital or category of hospital was then compared with that of trainees from other parent hospitals or category of hospital. One-way ANOVA followed by Tukey HSD post-hoc test, or Mann-Whitney *U* test where appropriate, were used to look for differences in the training experience of trainees originating from different parent hospitals or category of hospital.

Results

Approximately 200 logbooks from 36 trainees were obtained during the study period. Most (>90%) data were recorded by hand. There were 229 rotations: 148 category A (Hospitals I-IV), 76 category B (Hospitals V-XII), and 5 category C hospital rotations. A total of 25 trainees from seven parent hospitals received more than 48 months of anaesthesiology training in Hong Kong and were included in the part 3 calculation. Twenty trainees came from category A hospitals (five from Hospital I, six from Hospital II, seven from Hospital III, and two from Hospital IV) and five from category B hospitals (two from Hospital V, one from Hospital VI, and two from Hospital VIII).

Not all the required data elements were found in the logbooks. Level of supervision and ASA status were not commonly entered, and were thus not analysed. Subspecialty, mode of anaesthesia (eg general or regional anaesthesia) and nature of operation (such as laparotomy, craniotomy) were universally recorded. One trainee omitted the age of patients: these data were not used for analysing the paediatric anaesthesiology experience. The mode of airway control was usually not recorded except when special techniques were used. These included the use of a DLEBT and a ventilating bronchoscope for bronchoscopy.

The caseload of two anaesthesiology rotations of the same trainee were unusually small and data from these two rotations were excluded from further analysis.

Part 1

Tables 1 and 2 show the AnnSubSpLoad acquired during each hospital rotation. There was a diversity of subspecialty exposure in different hospitals in Hong Kong. Trainees in Hospital III administered significantly more anaesthetic for thoracic (>49.9% of total) and rigid bronchoscopic surgery (>50% of total) [$P<0.05$]. Trainees working in Hospitals IX to XII had no neonatal surgical exposure. Remote location and cardiac surgery anaesthesiology experience was available only in Hospitals II and III.

Part 2

Table 3 shows a comparison of the mean corrected annual caseload for hospitals categorised as A or B. Trainees working in category A hospitals had significantly more exposure to neurosurgery ($P=0.02$), thoracic surgery ($P=0.00$), and neonatal anaesthesia ($P=0.03$). Trainees in category B hospitals administered more general surgical

Table 1. Corrected annual subspecialty caseload per trainee against training institution

Hospital No.	Total No. of caseloads per year Mean (95% CI)	No. of caseloads per year* Mean (95% CI)							
		NS	GS	OT	GYN	LSCS	TS	Paed (<1 m)	Paed (1 m-1 y)
I	505 (457-553)	29.7 (14.1-35)	183 (161-205)	98 (84-112)	91 (71.6-100.5)	51.3 (39.3-63.3)	0.51 (0.09-0.84)	3.8 (2.4-5.1)	13.8 (10.6-17)
II	503 (446-560)	15.8 (11.3-20.3)	133.6 (115.2-152)	135 (112-158)	173 (53-92.7)	43.4 (30.4-56.4)	11.6 (8-15.2)	1.9 (0.9-2.8)	12 (9-15)
III	573 (508-638)	21.6 (17-26.3)	227 (199-255)	113 (96-130)	92 (63-120.5)	35.9 (27.9-39.0)†	31 (21.8-40.2)‡	2.7 (1.9-3.5)	9.2 (7.7-10.7)
IV	681 (606-756)	27 (20.2-34)	215 (190.5-239.5)	204 (175-233)	106 (90-162)	41 (28.3-53.7)†	1.5 (0.5-2.5)	2 (0.7-3.3)	15.1 (10.7-19.5)
V	604 (507-701)	14 (8.7-19.3)	197 (166.6-227.4)	146 (119-173)	126 (90-162)	44 (25.2-62.8)	7.2 (4.9-9.5)	1.45 (0.5-2.4)	9.8 (5.9-13.7)
VI	776 (544-1008)	29 (19.5-39)	322 (210-434)	127 (66-188)	156 (105-207.5)	75 (53-97)†	3 (0-6)	1.27 (0-2.7)	8.9 (4.6-13.2)
VII	582 (404-760)	1.1 (0-2.2)	253 (181-325)	123 (80-166)	88 (40-136)	53.3 (19.7-86.9)	2.7 (0-6.2)	1.82 (0.1-3.6)	12.4 (7.4-17.4)
VIII	567 (460-674)	21 (13.2-29)	236 (191-281)	155 (118-192)	104 (73-134)	30 (21.8-38.2)†	5 (3-7)	1.14 (0-2.23)	11.4 (7.7-15.1)
IX	543 (414-672)	2 (0-5.9)	239.3 (105-373)	119 (67-171)	68.7 (35.6-102)	9.3 (0-22.3)	0.7 (0-2)	0	8.7 (0-23.7)
X	498	0	194	174	57	0	0	0	3
XI	727 (573-881)	0	388 (364-412)	218.7 (87.7-350)	0	0	5.3 (0.3-10.3)	0	13.3 (0-29.2)
XII	572	0	320	244	0	0	8	0	4

* If the duration of training in the hospital is less than 1 year, it is corrected to the annual figure; NS denotes neurosurgery, GS general surgery, OT orthopaedics and traumatology, GYN gynaecology, LSCS obstetric anaesthesia, TS thoracic surgery, and Paed paediatric anaesthesia
† Hospital VI had more obstetric anaesthesia than Hospitals III, IV, and VIII (P<0.05)
‡ Hospital III had the highest number of thoracic cases among the 12 training hospitals (P<0.05)

Table 2. Corrected annual subspecialty caseload per trainee in oromaxillofacial, otorhinolaryngology, airway surgery, and others against training institution

Hospital No.	No. of caseloads per year* Mean (95% CI)					
	Oromaxillofacial	Otorhinolaryngology	Upper airway surgery (tubeless technique)	Rigid bronchoscopy	Double-lumen endobronchial tube intubation	Anaesthesia for remote location
I	6.5 (3.8-9.2)	13.4 (9.4-17.4)	0.3 (0.1-0.6)†	1.7 (0.7-2.7)	3 (1.7-4.3)	0
II	6 (3.6-8.4)	34.2 (25.2-43.2)	2.9 (0-4.1)†	0.2 (0.1-0.3)	9.4 (6.3-12.6)	0.1 (0-1.3)
III	4.6 (2.8-6.4)	31.4 (21.8-41)	0.8 (0.4-1.3)†	3.1 (0.6-5.6)‡	21 (14.3-27.7)	0.3 (0-0.5)
IV	9 (5.3-12.7)	33.3 (24.3-42.3)	0.6 (0-1.3)†	0.2 (0-0.4)	2.5 (1.1-3.9)	0
V	11 (7.3-14.7)	25.4 (17.7-33.1)	1.7 (0.2-3.2)	0.7 (0.2-1.3)	6.9 (4.5-9.3)	0
VI	0.4 (0-0.8)	32.6 (17.4-47.8)	0†	0	3.4 (0.6-6.2)	0
VII	9.6 (2.2-17)	12.7 (2.7-22.7)	1.1 (0-2.2)	0.2 (0-0.5)	1.3 (0-2.8)	0
VIII	4.6 (2.2-6.9)	6.8 (0-19.3)	0.1 (0-0.2)†	0.3 (0-0.6)	4.6 (2.8-6.4)	0
IX	7.3 (0-17.7)	5.3 (0-11.8)	0	0	0.7 (0-2)	0
X	0	40	2	0	4	0
XI	1.3 (0-3.9)	114.7 (47.3-182.1)	2.7 (0.1-5.3)	0	8 (3.5-12.5)	0
XII	0	0	0	0	12	0

* If the duration of training in the hospital is less than 1 year, it is corrected to the annual figure
† Hospital II had more upper airway surgery done using tubeless technique than Hospital I, III, IV, VI, and VIII (P<0.05)
‡ Hospital III had the highest number of rigid bronchoscopic surgery (P<0.05)

(P=0.00) and gynaecological anaesthesia (P=0.01). In accordance with the more extensive thoracic anaesthesia exposure in category A hospitals, trainees likewise had significantly more exposure to DLEBT intubation and ventilating bronchoscopic surgery (P=0.00).

Part 3

Tables 4 and 5 list the mean subspecialty exposure of each trainee over 6 years. The mean duration of training for anaesthesiology alone for the 25 trainees was 59.4 months (standard deviation [SD], 6.09 months). Every trainee administrated a mean of 2668 (95% confidence interval, 2234-3102) anaesthetics during their training.

There was no statistical difference in the subspecialty exposure among trainees coming from the seven parent hospitals except in thoracic and cardiac surgery (Table 4). While the mean number of thoracic anaesthetics administered by each trainee in 6 years was 57, it ranged from 0 to 138 for individual trainees, and from 5.5 to 102 for individual parent hospitals (Table 6). Trainees originating from Hospital V administered a mean of 57 cardiac anaesthetics, although 48% of trainees performed less than 10 cardiac anaesthetics in 6 years.

There was a large variation in experience of using a DLEBT in trainees originating from different parent hospi-

Table 3. Comparison of the corrected annual subspecialty caseload between trainees coming from categories A or B hospitals

Subspecialty	No. of caseloads per year* Mean (95% CI)		P value
	Category A hospitals	Category B hospitals	
Thoracic surgery	13.9 (10.3-17.4)	4.3 (3.1-5.5)	0.00
Neurosurgery	21.9 (19.1-24.6)	16.1 (12.3-19.9)	0.02
Gynaecology	85.2 (73.5-97.0)	111.3 (94.4-128.3)	0.01
Orthopaedics and traumatology	131.4 (119.2-143.6)	143.9 (126.5-161.2)	0.25
General surgery	182.0 (168.4-195.5)	246.1 (219.3-272.9)	0.00
Oromaxillofacial surgery	6.2 (4.9-7.5)	6.5 (4.6-8.5)	0.78
Electroconvulsive therapy	3.5 (1.8-5.2)	2.2 (0.8-3.7)	0.33
Anaesthesia for remote locations	0.1 (0-0.2)	0	0.21
Otorhinolaryngology	29 (26.7-31.5)	22.7 (15.8-29.7)	0.14
Laser	0.3 (0.1-0.5)	0	0.05
Obstetric anaesthesia	42 (35.8-48.1)	43.7 (34.2-53.5)	0.76
Paediatrics (age, <1 m)	2.5 (2.0-3.0)	1.5 (0.8-2.2)	0.03
Paediatrics (age, 1 m-1 y)	12.1 (10.5-13.6)	10.6 (8.6-12.5)	0.26
Tubeless technique in upper airway surgery	1.5 (1.0-1.9)	0.8 (0.3-1.3)	0.13
Rigid bronchoscopy	1.4 (0.9-1.7)	0.3 (0.1-0.5)	0.00
Double-lumen endobronchial tube intubation	10.6 (8.0-13.2)	4.4 (3.3-5.5)	0.00
Cardiac surgery	3.2 (1.7-4.6)	0 (0-0.20)	0.00
Total No. of caseloads per year	547.2 (513.8-580.7)	623 (564.9-681.5)	0.19

* If the duration of training in the hospital is less than 1 year, it is corrected to the annual figure

Table 4. The actual caseload of trainees in major subspecialty over the 6-year training period and the major subspecialty exposure of the trainees originating from categories A and B hospitals

Subspecialty	Actual No. of caseloads per year Mean (95% CI)	No. of caseloads per year Mean (95% CI)	
		Category A	Category B
Thoracic surgery*	57 (42-72)‡	55.9 (39.0-73.0)	64.5 (37-92)
Neurosurgery	100 (84-116)	102.7 (84.1-121.3)	85.3 (74.8-95.8)
Gynaecology	456 (381-531)	444.8 (360-535.6)	500 (404.5-595.5)
Orthopaedics and traumatology	611 (552-670)	630 (564-696)	512 (442.5-581.5)
General surgery	951 (848-1054)	941.2 (822.8-1059.6)	1001 (812-1190)
Oromaxillofacial surgery	32 (24.5-39.5)	33.9 (25.7-42.1)	22.3 (3.3-41.3)
Electroconvulsive therapy	14 (6.5-21.5)	15.5 (6.9-24.1)	3.3 (0-8.4)
Anaesthesia for remote locations	1.2 (0.3-2.1)	1.2 (0.2-2.2)	1.3 (0.0-2.5)
Otorhinolaryngology	122 (145-145)	129.5 (104.3-154.7)	79.5 (55.6-103.4)
Laser	1.0 (0.4-1.5)	1.1 (0.4-1.7)	0.5 (0-1.5)
Obstetric anaesthesia and analgesia	309 (259-359)	302.8 (242.4-363.2)	299 (206.5-391.5)
LSCS† (total)	213 (182-244)	211 (174.8-247.2)	224 (180.4-267.6)
LSCS by regional anaesthesia	140 (116-165)	142 (112.7-171.3)	130.5 (90.6-170.4)
LSCS by general anaesthesia	73 (57-89)	68.6 (51.6-85.6)	93.5 (44.5-142.5)
Analgesia for labour pain	85.4 (55-115)	87.3 (52.7-121.9)	75.3 (20.5-130.1)
% of LSCS by general anaesthesia*	35 (27.7-12.3)§	33.8 (25.0-41.7)	40.6 (20.8-60.4)
Upper airway surgery using tubeless technique*	5.5 (2.5-8.5)‖	6.2 (2.9-9.6)	1.8 (0.5-3.0)
Rigid bronchoscopy*	5.8 (2.8-8.8)¶	5.4 (3.1-7.7)	7.8 (4.4-11.1)
Double-lumen endobronchial tube intubation*	43.5 (34-53)**	42.2 (31.4-53.0)	50.3 (31.2-69.4)
Cardiac surgery*	15 (0-50.6)††	14.8 (7.5-22.1)	20 (0-45.7)

* Statistically significant between different parent hospitals for the actual No. of caseloads per year

† LSCS denotes obstetric anaesthesia

‡ Trainees from Hospital III gave more thoracic anaesthesia (No. of caseloads: 102) than those of Hospitals I, II, and IV (No. of caseloads: 25.6, 40, and 5.5, respectively)

§ Trainees from Hospital III and VIII (47.5% and 55.6%) managed higher proportion of LSCS under general anaesthesia than trainees from Hospital II (16.1%; P<0.05)

‖ Trainees from Hospital II had managed 15.3 cases, much higher than trainees from other hospitals (Hospital I, 3 cases; Hospital III, 2.7 cases; Hospital IV, 2.5 cases; Hospital V, 1.5 cases; Hospital VI, 2 cases; and Hospital VIII, 1 case; P<0.05)

¶ No. of caseloads of rigid bronchoscopic surgery in Hospitals III, V, VIII (10.4, 10, 10, respectively) is higher than that of Hospitals II and IV (0.5 and 1.5, respectively)

** Trainees of Hospital III had more experience (No. of caseloads, 68) in managing double-lumen tube than trainees of Hospitals I, II, and IV (No. of caseloads: 28, 30.3, 13.5, respectively)

†† Trainees of Hospital V did more cardiac surgery (No. of caseloads, 57) than trainees of Hospitals II, III, IV, and VIII (No. of caseloads: 12.5, 8.4, 0, and 7, respectively)

tals (Table 4): a mean of 43.5 endobronchial intubations were performed by each trainee. Approximately 24% of trainees had no exposure to anaesthesia for rigid bronchoscopic surgery or upper airway surgery using a tubeless technique. The highest case number of anaesthesia for rigid bronchoscopic surgery was 10.4 and 15.3 for upper airway surgery using a tubeless technique (Table 4). The mean number of epidurals administered for analgesia by each trainee was 204.7 (SD, 119.81)—excluding caudal, combined spinal epidural technique and epidural for

Table 5. Comparison of actual paediatric exposure between trainees originating from categories A and B hospitals, and the actual mean paediatric exposure of our trainees over 6-year trainee period

Categories of paediatric experience	Actual No. of caseloads Mean (95% CI)	No. of caseloads Mean (95% CI)	
		Category A	Category B
Age			
<1 m	12 (8-16)	12.4 (7.7-17)	7.3 (4.6-7.0)
1 m-1 y	53.2 (47.2-59.2)	55.9 (49.3-62.5)‡	39.5 (32.8-46.2)‡
1-4 y	114.8 (102.8-126.8)	119.3 (105.4-133.3)	92.8 (84.8-100.8)
4-10 y	125 (114-136)	126.5 (114.6-138.4)	117.5 (88.4-146.6)
<4 y	180 (161-199)	187.5 (166.5-208.5)	139.5 (134.5-144.5)
<6 y	183 (165-201)	190.2 (170.2-210.2)	146.5 (130.1-163)
<10 y	250 (230-270)	257 (235.2-278.8)	217.5 (187-248)
Subspecialties*			
TS	0.9 (0.4-1.3)	0.8 (0.3-1.3)	1.3 (0-2.7)
NS	6.7 (4.8-8.6)	7.0 (4.8-9.1)	5.5 (2.3-8.8)
OT	43 (33.7-52.3)	46.2 (35.7-56.7)	29 (15-43)
GS	155.4 (140.4-170.4)	154.6 (137.2-172.0)	159.5 (135.2-183.8)
ENT†	22 (17.5-26.5)†	23.8 (19-28.5)‡	10.3 (3.3-14)‡
Eye†	12 (7.5-16.5)†	14 (9-19)	2.3 (0.1-4.4)
OMF†	4.3 (3-5.6)†	4.8 (3.3-6.2)	2.3 (0.6-3.9)
Heart†	5.8 (0-12.3)†	6.4 (0-14)	3.3 (0-9.0)

* TS denotes thoracic surgery, NS neurosurgery, OT orthopaedics and traumatology, GS general surgery, ENT otorhinolaryngology, and OMF oromaxillofacial surgery
† Statistically significant between different parent hospitals (P<0.05)
‡ Statistically significant between parent hospitals of different categories (P<0.05)

Table 6. Total number of thoracic and cardiac surgeries administered over 6 years against parent hospitals

Parent hospital	No. of trainees	Thoracic caseload* Mean (SD)	Open heart surgery caseload† Mean (SD)
I	5	25.6 (16.5)	24.2 (24)
II	6	40 (7.3)	12.5 (9.8)
III	7	102 (25)	8.4 (5.3)
IV	2	5.5 (2.1)	0
V	2	67 (19.7)	57 (2.8)
VI	1	55	7
VIII	2	75 (43.8)	7 (5.7)

* The thoracic caseloads of trainees of Hospital III was higher than those of Hospitals I, II and IV (P<0.05)
† The cardiac surgical exposure of trainees of Hospital V was higher than those of Hospitals II, III, IV, and VIII (P< 0.05)

labour analgesia—and that for brachial plexus block (BPB) in 6 years was 32.6 (SD, 18.34).

In terms of paediatric exposure, there was no difference in most of the subspecialties between trainees originating from categories A and B hospitals (Table 5). The only exception was that trainees originating from category A parent hospitals administered more anaesthetics to paediatric ENT cases and to children aged between 1 month and 1 year.

Discussion

Learning is a complex process governed by a host of factors such as individual variation, institutional preferences, the learning and teaching situation, level of supervision, the number of cases over time,[3] the amount of knowledge to be learned, and the ease of learning.[4] This makes it difficult to define the minimal experience required by a trainee to master the skill for case management.

For tasks involving manual skill, more experience equates with better performance. A positive volume outcome relationship has been proven for some surgical procedures.[5,6] A high volume is associated with better outcomes across a wide range of procedures and conditions in health care,[7] although the magnitude of the association varies greatly. Anaesthesia fellows who perform fewer than 100 paediatric anaesthetic procedures a year have a significantly increased complication rate compared with those who perform more than 200 procedures.[8] The volume effect may also be true for learning.

Data on the acquisition of manual proficiency in anaesthesia are scarce.[9] The learning curve for a number of anaesthetic procedures has been generated.[3,9-12] Konrad et al[3] studied the acquisition of a number of anaesthetic manual skills and found that trainees needed to perform 57 orotracheal intubations before they could achieve a 90% success rate. Similarly 90 epidurals and 62 BPB were required before 80% and 87% success rates, respectively, could be achieved. The number reflects the difficulty of the technique.

In this study, our trainees performed 85.4 epidural procedures for labour pain, and 204.7 epidurals for analgesia during a surgical procedure. The number of epidural procedures performed was much more than that recommended for learning. The learning curve generated by Konrad et al[3] made use of the learning progress of new residents over a 1-year period. Our trainees performed more than 290 epidural procedures over 6 years (including epidural anaesthesia for labour pain, surgical procedures, and obstetrics anaesthesia [LSCS]), but this does not necessarily mean they reached the plateau of the learning curve during the early days of training. The number of

cases over time is also an important factor that determines rate of learning. After achieving a high success rate, continuous practice is necessary to maintain the skill. The annual number of cases required to achieve this is unknown.

A DLEBT is only one of the methods available to provide one lung ventilation (OLV). More than 99% of OLV techniques recorded in the logbooks were achieved by DLEBT intubation. Therefore the number of cases with OLV was almost equal to the number of DLEBTs inserted. The learning curve of DLEBT intubation has not been constructed and the minimal number required to perform for learning is unknown. In general, endobronchial intubation is more difficult to learn as a novice than orotracheal intubation. This is especially true when a right-sided endobronchial tube is used. As a result, it is usually performed by trainees who have acquired a basic skill in orotracheal intubation and fibreoptic bronchoscopy. The mean number of DLEBT intubations performed by each of our trainees was 43.5; this was limited by exposure to thoracic cases. Further study is needed before we can draw any conclusion about the adequacy of acquiring the technique of OLV by our trainees.

The total number of BPB performed by each trainee was 32.6, much lower than the recommended number. This may be related to the individual and institutional preference.

The logbooks collected for data analysis belonged to trainees who sat the Exit Assessment of the HKCA in 2001 and 2002. The training recommendation of ANZCA during that period was used for comparison. The ANZCA recommended that the minimal number of both neurosurgical and thoracic anaesthetics performed should be 25 and that for cardiac surgery should be 10. Every trainee was advised to be involved in the management of anaesthesia in at least 100 children aged younger than 4 years and with 200 children aged between 4 and 10 years. Each trainee should also be involved with the management of at least 150 obstetric patients. Our results showed that in 6 years, a trainee would have administrated a mean of 2668 anaesthetics including 57 thoracic, 100 neurosurgical, 213 LSCS, and 12 neonatal. The mean actual subspecialty caseload of our trainees fulfilled most of the ANZCA's training recommendations. Apart from paediatric patients aged between 4 and 10 years (Table 5), the subspecialty exposure of our trainees was in line with ANZCA's recommendations. The small number of paediatric cases may be related to a smaller population size for that particular age range. In addition, an ageing population and a progressive reduction in birth rate,[13,14] combined with widespread use of early prenatal screening and medical abortion for a grossly abnormal foetus mean there are relatively fewer children undergoing surgery. If the paediatric population further decreases, additional measures may be required to ensure the future paediatric anaesthetic training of our trainees.

There was a large difference in the corrected annual subspecialty exposure between categories A and B hospitals (Table 3) which indirectly reflects the casemix and caseload of hospitals in different categories. Nonetheless when clinical experience of the whole 6 years of our trainees was counted (Tables 4 and 5), the only differences were in the paediatric anaesthetic exposure in children aged between 1 month and 1 year and paediatric ENT cases. This confirms the effectiveness of our rotational programme to ensure even distribution of cases between trainees from categories A and B hospitals. Our programme nonetheless remains deficient in some aspects: three trainees who came from two different parent hospitals were deficient in cardiac and thoracic anaesthetic experience because they did not have the chance to work in hospitals that provided thoracic and cardiac surgery. Contrary to this, trainees originating from Hospital V had significantly more exposure to cardiac surgery anaesthesia (Table 6). Duong and Havel[15] estimated the minimum number of cases for anaesthesiology residents to master the clinical skills required in cardiac anaesthesia. The minimum number ranged from 10 cases for preoperative assessment to 20-30 cases for haemodynamic and coagulation management. There are only three hospitals in Hong Kong that perform cardiac surgery (two category A and one category C hospitals). Most of our trainees did less than 20 cardiac surgeries during their training (Table 6). According to the recommendation by Duong and Havel,[15] 72% of our trainees may not be able to acquire the requisite level of skill for haemodynamic and coagulation management.

The exposure to different subspecialty cases between trainees from categories A and B hospitals was different (Table 4). The HKCA has set criteria for rotational training. Trainees can have accredited training in category A hospitals for at least 24 months but not more than 36 months (Box 3). As a result, a trainee from a category A hospital can spend up to 36 months in such hospitals while trainees from category B hospitals may spend only 24 months in category A hospitals. The case exposure of these two groups of trainees may differ and will depend on the length of stay in category A hospitals, which normally have a larger and more varied caseload.

Our trainees are requested to keep logbooks to document their experience and training in clinical anaesthesia. Most logbooks provide a paper-based record that is cumbersome. It does not easily lend itself to analysis or synthesis with other records and is subject to arithmetic errors, compromising the integrity of the information. It does not permit longitudinal evaluation of the progress of an individual trainee or comparison of different anaesthetic units.[16] If logbooks are kept in an electronic format, it will provide trainees with a convenient and versatile record of their experience[16] and enable careful analysis of the individual workload of each trainee in the department.[17] With frequent reviewing of such electronic data, the problem of subspecialty case maldistribution

may be able to be addressed before planning for the next training rotation.

One of the major limitations of the study is the reliability of the reported data. During data entry, the caseload of two rotations was found to be unusually small and corresponding data were therefore deleted. It is likely that there was other less obvious underreporting that may have gone undetected. Training rotation blocks might be present in some hospitals. A trainee might be engaged in three to four rotations in a year and cannot be fully exposed to all the subspecialties in that hospital. For this reason there may be bias in the corrected AnnSubSpLoad.

In Hong Kong, with clustering of hospitals and budgetary constraints, some highly specialised operations will in future be centralised to a few major hospitals. Hence the results in this study only reflect the current situation. Differences between categories A and B hospitals may increase in the future.

Conclusions

Our training centres provided sufficient subspecialty caseloads to support anaesthetic training in Hong Kong at the present level of trainee numbers. There was uneven exposure to cardiac, thoracic, and paediatric anaesthesia. Frequent reviewing of the logbook data, and moving to an electronic means of recording data, if possible, before planning for trainee rotation may be necessary to ensure adequate subspecialty exposure.

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