Training in Minimal Access Surgery

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Preface

I readily accepted the task to write this Preface for several reasons, but primarily because it addresses a topic of seminal importance to the surgical profession. This book stresses concepts which I have always considered as conceptually valid and important throughout my career, such as minimal access surgery (MAS), that is 'surgery designed to reduce the trauma of access', rather that the semantically incorrect minimally invasive surgery . Likewise the use of learning curve is not appropriate to describe the complex process by which a trainee surgeon reaches the quasi-automatic stress-free stage, when he or she is able to perform a specific operation consistently well with good patient outcome. The proficiency-gain curve goes well beyond 'learning' and is at the heart of modern competence-based training and underpins the importance of this book. There is no doubt that the 13 chapters of Training in Minimal Access Surgery provide an excellent account of the advances that have been made in the subject since the advent of MAS in the mid-1980s; in this respect, this book contains a wealth of up-to-date information. Obviously, one expects to encounter some repetition with the involvement of so many authors, but I regard this in a positive

light as reinforcement. Important issues such as Training Curriculum in MAS, Simulation and Training in MAS, Training for Trainers in Endoscopy (Colonoscopy), and several others are addressed in a scholarly, objective and detailed manner. I found the chapter on Teletraining in MAS to be particularly stimulating as it heralds the inexorable trend towards globalisation of training, inevitable in the digital age. I complement the editors Dr. Francis, Dr. Fingerhut, Dr. Bergamaschi and Dr. Motson, all highly respected colleagues and indeed, all the authors for producing a much-needed account on training for MAS. I am sure it will be well received by the colleges and programme directors worldwide. Prof Sir Alfred Cuschieri, FRSE Chief Scientific Advisor, Institute for Medical Science and Technology, University of Dundee Contents

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1. Learning Environment and Setting Up a Training Unit in Minimal Access Surgery

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Introduction

Advanced Minimal Access Surgery (MAS) is technically challenging and within the context of its practice and training, the environment is often defiant. It can be marked by stress, responsibility and pressure that can negatively influence training and learning. As any surgery, MAS may sometimes be performed under suboptimal psychomotor conditions of sleep deprivation or following earlier, tiring operations. Additional pressures proper to MAS include financial targets and waiting lists. Yet public and professional expectations require that a surgeon is able to train junior colleagues, regardless of these difficulties. Managing the training environment requires the control of multiple inputs and demands during emergent situations. This chapter addresses all the attributes of the MAS training environment, how they could be optimised and how to set-up a training unit for MAS. Optimum Training

Environment A training environment can be defined as the external condition(s) that can provide acquisition of knowledge, skills and competencies as a result of teaching in this field without compromising patient care. An optimum training environment is the one that promotes learning; supporting the improvement of performance and increasing the efficiency of the whole training process. This depends on whether the training is aimed for cognitive, technical (in or outside Operating Room (OR)) or behavioural coaching. Before discussing the attributes of the optimum training environment, it is essential to first clarify the need for such a training environment in a complex and technically challenging intervention such as MAS. The simple answer is that a good training environment is likely to improve patient care. An optimum training environment is the setting that encourages optimum communication and team working between all the members of the OR team in order to facilitate learning, which promotes patient safety. A good educational case would also involve deconstructing the operation into tasks and subtasks where the teacher and the learner are aiming to optimamly performr each step of the operation- definitely this can only improve patients' outcome. An optimum training environment is therefore encouraged to promote safe operative performance, which ultimately improves patient care. Examining the attributes of training environment has been traditionally focused on the technical skills in the OR, but more recently, attention has been paid on coaching human factors, cognitive and technical skills outside the OR. For the purpose of discussion here, the training environment will be considered under physical environment and the educational environment in and outside OR. Training Environment in the OR/Endoscopic Suite Physical Environment MAS is technology dependent and its wide adoption across many fields has been matched, and perhaps driven, by the rapid evolution of technology in this field.

Over the past few decades, MAS increasingly occurs in operating rooms equipped with advanced audio-visual technology, or what is referred to as "integrated operating rooms" (IOR), which include high-resolution video displays, touch-screen control, and digital information archiving, integrated into a purpose-built system that reduces dependence on mobile equipment. It is intended to increase efficiency in the OR and improve the ergonomics, communication and information systems for medical teams in any OR or endoscopy suite (Fig. 1.1).

Fig. 1.1 Integrated OR (The following text must be displayed alongside the image: © KARL STORZ – Endoskope, Germany)

Beyond facilitating the surgical procedure and improving efficiency, the integrated operating room facilitates live feeds to conference rooms and auditoriums for training and grand rounds. In addition, the integrated ORs have the potential to connect the surgeon for teaching and tele-monitoring at remote locations. The latter is discussed separately in Chap. 11, but briefly it involves remote coaching, whereby both the trainer and trainee are accessing live digital images of the operation, and the trainer can remotely coach surgeons through challenging parts of the surgery. However, technology needs to be matched at both sites to access the same quality of image with network cover of sufficient bandwidth to allow optimum audio and visual communication. Training Environment The primary focus of the OR team should always be patient safety and the effective performance of each procedure and these should also be the main objectives of both the trainer and trainee for a training case. However, training in the operating room should be conducted in an environment that is supportive to training and promote learning. Nevertheless, even with close supervision, inexperienced trainees will often take longer to perform a MAS procedure. This can create a conflict between the trainer, the trainee and the rest of the OR team. Dedicated operating training lists provide the best training environment in technically challenging surgery such as MAS. However, this warrants consideration of the financial pressures facing hospitals, with targets and the reduction of the training time (due to the adoption of European working time directive). Hence, these expectations and conflicts need to be addressed before, during and after the normal operating lists. Before an operating list, the trainer needs to ensure the list is appropriately scheduled for training purposes and that the OR team are aware that some parts or the entire list will be used for training. Opportunity now exists, with the widespread use the WHO checklists, to address these issues and come to a common agreement and understanding for the whole team. During an operating list,

the expectations and priorities of the trainee will need re-adjustment by the trainer if a case or cases have taken longer than expected. After completion of the case/ list, a sign out process can allow the team to draw together the useful learning points that make future training cases run smoothly. Attributes of an ideal training environment are summarised in Table 1.1. These may vary from the trainer, trainee and OR staff's point of view. The team brief is an ideal opportunity to discuss how the operating list should run for the mutual benefit of all and align all views of the entire team, in order to generate a safe environment for performance and training. Novices to MAS will be more susceptible to reduced performance in the presence of interference and the OR training environment should allow a trainee to focus on the task in hand with minimal interruptions. Table 1.1 Attributes of ideal training environment in the OR

1. Trainee-focused environment that supports learning
2. Unthreatening environment that allows the trainee and staff to ask questions and express opinion
3. Dedicated training list that allows time for training
4. Experienced professional staff who support training
5. Optimum selection of cases that suit the trainee's level
6. Supportive trainer who is a role model
7. Committed trainee who can make progress
8. Calm, quiet environment in theatre with minimal interruptions (phones, conversations, music etc.)
9. OR equipped with technology that facilitates feedback; such as video recording and image capture
10. Setting that allows confidential feedback after the training session when required

Training Environment Outside the OR A training environment outside the OR is designed to attain the attributes of ensuring a safe practice and optimum environment prior to undertaking surgery, usually through simulation techniques. One of the factors that underpin the success of a simulated training environment is the degree of realism where coaching is conducted. Technology is continually striving to provide an ever more realistic simulated environment for clinical training, which is resulting in very impressive systems. However, these systems are only available to a limited number of centres and thus to a limited number of learners. It will be necessary to be pragmatic about what facilities can be made available to the large numbers of surgical trainees who need to acquire MAS skills in a safe and effective manner. Very high fidelity learning environments will certainly have their place for the most advanced learners, multi-professional groups and perhaps for assessment and re-validation in the longer term. However, for the majority of learning episodes, it is unlikely to be possible to provide the highest level of realism. When considering MAS, one could question the need for some elements that are included in a high fidelity simulated OR. For example, the room lights are often only used during the initial access and final closing aspect of a case. However, essential elements include: 1. Imaging equipment – actual laparoscope or static camera depends on the nature of the task. The more complex the task, the more advanced equipment are required for simulated training.

2. Surgical instruments – depends on the task; the whole range of instruments are required for instance to teach an advanced laparoscopic procedure, while a limited number is required to teach certain tasks such as laparoscopic suturing.
3. Simulations: this can involve a box trainer, virtual reality (VR) simulator synthetic or real animal parts, or human cadaver.

Training Environment in the Dry Lab An ideal training environment for dry lab training should have enough space to allow free movement of tutors and delegates, with sufficient lighting and equipment. One could also argue that the space should be designed with a flexible set up that supports seminars, hands-on skills with audio-visual facilities and video links to the OR.

The requirements for the laparoscopic work-stations depend on the nature of the tasks; full laparoscopic stacks are required for advanced MAS but a minimum of a camera, light source,

scope and training box are sufficient for more basic tasks. The simulated tasks can vary from a box with synthetic organs to ex-vivo animal tissue or hybrid simulations. There is wide use of VR simulators in the training of basic laparoscopic tasks of core procedures, but VR simulators with good validity for advanced laparoscopic surgery do not currently exist [1]. VR simulation still requires trainers to coach trainees on the simulated procedures and give constructive feedback [2]. Synthetic Simulations There is a growing number of synthetic preparations, which often have a realistic anatomical appearances. The benefits of using these models include reproducibility, less requirement for specialist technical support and preparation, simple to store, low odour and are easy to dispose of. However, dissection of synthetic tissue is not as realistic and the material is either much stiffer or softer than that corresponding to the real task. Few of these models support the use of energised tissue dissection. Ex-vivo Models A compromise between synthetic models and live animal tissue is to create a hybrid of excised animal tissue mounted in specially designed frames. The aim is to fix the tissues in a position as close as possible to human anatomy [3–5]. The benefits are to improve the degree of realism and allow the use of tissue energisers. If ex-vivo animal organs are used, the environment should be designed such that surfaces are washable; adequate space and facilities to store and prepare and dispose of the materials is also necessary. Wet Lab and Live Animal Lab In the USA and some European countries, training using live animals is permitted. Whilst this approach provides realistic control of bleeding and tissue elasticity, there are many disadvantages: it is relatively expensive, due to the specialist facilities, staff and anaesthesia, and animal anatomy often differs significantly from humans, so the types of procedures that can be taught are limited. In addition to the growing ethical concerns, the use live animals for training is prohibited in the UK. Cadaveric Training: Fresh Frozen and Thiel Embalmed Despite the demonstrable benefits of integrating cadaver dissection into a resident training program [6, 7], cadaver surgery is not yet utilised in most training programmes due to the financial constraints and limitation of supply [8]. Cadaver training, however, can be justified and be cost-effective in advanced laparoscopic training, as there is no better alternative for high fidelity simulation. Cadaver laboratories require very specialist skills among staff looking after the specimens and the environment. There are two cadaveric processing techniques: cryopreservation (fresh frozen) and embalming (Thiel method). The traditional formalin-fixed cadavers, are not suitable for simulated surgery. There is some evidence to indicate that fresh frozen cadavers are more favourable for laparoscopic dissection compared to classical cadaver embalming [9]. Traditionally formalin-fixed cadavers are less useful because the fixation causes tissue rigidity, loss of tissue texture, colour and consistency, limited preservation of surgical planes, and spaces, and difficulty in identifying small structures such as autonomic nerves [10]. The embalmed bodies retain more of the elastic tissue structure, which is completely different from the traditional formalin-fixed cadavers. This results in well- preserved organs and tissues with regard to colour, consistency, flexibility and plasticity [11, 12]. The environment for fresh frozen and embalmed cadavers involves storage in licenced premises and must fulfill the regulations of the Human Tissue Act in the UK [13]. This also involves proper care of donated cadavers for training, as well as security and confidentiality. Cadavers are frozen within a week of procurement and then thawed at room temperature approximately 3 days prior to use for a training session. The cadaver room can be set up as an OR, with laparoscopic stacks, monitors and surgical instruments provided. Disposal of the cadaveric tissues must also be in line with national regulations or the Human Tissue Act. Figure 1.2: Cadaver training model for laparoscopic surgery (with permission from the Vesalius Clinical Training Centre, Bristol)

Fig. 1.2 Cadaver training model for laparoscopic surgery (with permission from the Vesalius Clinical Training Centre, Bristol)

Setting Up a Training Centre It is important not to underestimate the planning required to set up a new training centre. Many readers may be familiar with situations where a MAS training facility has been set up by a lone enthusiast, only to founder when this individual moves on to new projects. In a recent survey to obtain a consensus from 57 international experts on the attributes of a training

centre in advanced MAS; the following attributes were agreed on the order of importance [14]: (Fig. 1.3) Fig. 1.3 Desirable attributes for a training centre in MAS The expert group agreed that a minimum number of MAS courses (between 2 and 5 per year) should be delivered and that the unit should be actively training residents in MAS (with a minimum 2–5 trainees per year). There was a majority consensus (over 80 %) on the need for quality assurance of both training centres and of the courses provided. There are many excellent guides for setting up a new business and project management, but here are the authors' recommendations with regard to setting up a training centre in MAS: Ten Top Tips 1. Set up a coalition of keen surgical / clinical educators from a number of specialties.

2. Think carefully about who will need to use the centre – consider their job roles, specialties, geographical location and funding streams.

3. Look at the competition – are there any other training centres in your region/ within 50 miles? If other centres already exist, is there a way to collaborate and ensure that your own centre 'fills the gaps' in provision? 4. Which are the successful centres that you would like to emulate? – Arrange to visit them and, if possible discuss your ideas. 5. Create a business plan and get expert financial help to make sure that everything is covered.

6. Consider how you can fund the different aspects of the project: your employer, healthcare companies, grants and fundraising: it will probably have to be a combination of all of these aspects. Think about what each group will want in return for their investment and how this will impact on what you want to achieve.

7. Still want to go ahead? Employ (or second) a good project manager to oversee the implementation of first stage of the plan – this could involve building work or re-development to create the space, procurement of equipment and hiring of staff.

8. Have a number of training activities agreed and set up to run as soon as the facility is ready – this will result in some funds coming in to the business and reassure your investors. Do not wait for the building to be completed before starting to design your training programmes. 9. Remember that each new training programme could take 6–9 months to design and could take up to 18 months to run effectively. 10. The most fantastic training centre will fail without a good team of staff to support the activities. Depending on the activity that you have planned, you will certainly need administrative and technical staff and may also want to consider academic staff or teaching fellows, together with a centre manager.

Practical Issues with Setting Up a Mas Training Centre

There are clearly some particular issues around setting up a MAS training centre [15], specifically on equipment and learning environment. Rogers et al., have summed up the requirements of a training centre focusing on the learners' need stating that " There should be adequate facilities to accommodate the learning needs of all participants, allowing them to practice until they can demonstrate the desired level of performance…" [16]. MAS Equipment and Industrial Support Establishing a good relationship with industry is vital in supporting the set up and sustaining any training centre in MAS. Technology is evolving and training centres need to keep up to date with new laparoscopic equipment; such as high definition cameras and stacks, staplers and energy sources. Industry may be willing to contribute to the teaching of optimum use of their products and good liaison with them is recommended prior to delivering any educational activities. The level of support/ sponsorship from commercial companies should be discussed in the initial stages of course development to clarify their input and match the expectations. Industry can also be very useful in marketing educational events, which they sponsor through their wide network of contacts (both with surgeons and allied health care professionals). Eastablishing relationships with multiple sponsors for the educational activites is generally recommended. Any equipment purchased must be flexible enough to meet the needs of a number of specialties and be reasonably future proof. In addition, it is vital to have the costs of maintenance contracts and depreciation of equipment included in the business plan to

avoid unpleasant surprises in the future. If you decide that VR simulations are essential, special considerations must be given to the cost of the simulators, as well as the ongoing maintenance costs. An educational curriculum needs to be in place prior to purchasing the simulators to clarify how VR will be used to assist in teaching; who will be taught on them and ensure that all learners have equal access [17]. Selection of the type of VR is based on several factors. First, VR simulation needs to fit within the training vision and the learning that the unit is providing. Secondly, if the simulation will be used as part of national courses, including assessment, it is important to align this with the local/ national regulations. Practical Issues with Running a MAS Educational Event Planning for Educational Events Think about the learners – how will they get to the training centre? Are there good public transport links? What is the parking like? If they come from a long distance, where can they stay overnight? Do you have a list of accommodation nearby? Plan other logistical issues of catering and transport from the accommodation to the training centre Plan course hand-outs and other educational materials to be provided to the participant, either before or when they attend the learning event. Consider why a potential participant will choose to come to your training centre. Consider your reputation, location, quality of facilities and how closely these meet their needs and value for money. One of the most common barriers for surgeons being able to attend a training course is arranging time away from their own clinical practice, however individuals will be willing to organise this leave if the course is deemed to be of sufficient value [18]. Conducting the Educational Event There are generic educational resources that need to be available in any training centre: audiovisual teaching resources Wi-Fi and web resources video production capabilities and video recording of participant activity For the practical skills in MAS centre: adequate equipment; number of stacks per number of delegates camera holders or the delegates will be assisting each other adequate technical support during the course for trouble shooting and assisting the delegates when required consider the working hours of the technical support team who will need to be there early to prepare for the course and to stay late to clear up. allow extra time for those delegates who wish additional practice Finally, ensure that you have the right faculty Other major barriers to delivering a sustainable training programme are the availability of faculty and finances, which was highlighted in a survey of training centre managers by Kapadia et al. [19]. The financial pressures have only increased since that time, together with the increased clinical commitments on expert faculty members. Thus it is essential to build a database of enthusiastic faculty, rotate them across the training programme to prevent burn-out, and also to involve them in the development of the training programme. Networking with Faculty of Other Training Centres Increasingly, it may be more sensible to set up a collaborative network rather than a single training centre. Rogers et al. recognised that linking experts in different centres can provide a much more successful way to ensure that the needs of learners are met: As technologic innovations continue to occur, the feasibility of establishing a network of training centres should be explored. Creating this network in academic medical centres would create and excellent opportunity to study the evolving learning needs of practicing surgeons [16]. Given that most surgeons value a combination of short, intensive courses together with clinical mentorship [19], it would seem that a network of experts is best placed to provide a broad training programme. This method has been used to good effect during the National Training Programme for Laparoscopic Colorectal Surgery (LAPCO) [20], where seminars, short practical courses and long running mentorship was employed to facilitate training in laparoscopic colorectal surgery across England between 2008 and 2013. Assessment of Educational Activities Assessment during any educational activity is essential in training and education as it can promote learning and focus learning objectives. Assessment of

the effectiveness of the education activity is also encouraged to improve the quality of the courses and to ensure the learners' needs are always met [21]. Traditionally, assessment of educational activities is performed using delegate feedback. This, however, is of limited value in refining the curriculum and ensuring the aims of the educational activities are focused. A widely-accepted model for a more structured and detailed evaluation is that of Kirkpatrick [22], who describes four levels: initial reaction of the learners' (level 1); evidence of learning as knowledge, skills or attitudes (level 2); changes in behaviour (level 3); and results in terms of structural changes undertaken by the course delegates at their home environment (level 4); or in a later refinement, evidence from trainees or course participants that their training has improved since completing the course (level 4B). A recent national training curriculum has been assessed using Kirkpatrick models to evaluate the impact of training the trainer in laparoscopic colorectal surgery and showed that the course has a direct impact on all levels, demonstrating a measurable improvement of training effectiveness [23]. Summary The physical training environment in MAS is technology dependent and the educational environment should be a non-threatening and learner-focused to promote learning, which ultimately ensures patient's safety. Training outside the OR is influenced by the availability of simulations and their degrees of realism. VR simulations provide good training for basic MAS and cadaver training provides the optimum training for advanced MAS. There are several issues that must be considered prior to setting up a training centre, but an optimum training centre needs to provide adequate facilities to accommodate the learning needs and allow learners to practice until they can demonstrate the desired level of performance. References 1. Larsen CR, Oestergaard J, Ottesen BS, Soerensen JL. The efficacy of virtual reality simulation training in laparoscopy: a systematic review of randomized trials. Acta Obstet Gynecol Scand. 2012;91(9):1015–28. CrossRefPubMed 2. Carter F, Schijven M, Aggarwal R, Grantcharov T, Francis NK, Hanna G, Jakimowicz J. Consensus guidelines for validation of virtual reality surgical simulators: EAES Work Group for Evaluation and Implementation of Simulators and Skills Training Programmes. Surg Endosc. 2005;19(12):1523–32. CrossRefPubMed 3. Carter F, Russell E, Dunkley P, Cuschieri A. Restructured animal tissue model for training in laparoscopic anti-reflux surgery. Minim Invasive Ther. 1994;3:77–80. CrossRef 4. Ross GA, Christie L, McNeill A, Carter F. Novel training phantom for skills acquisition in laparoscopic nephrectomy'. Surg Endosc. 2007 (21):S148. 5. Christie L, Francis NK, Carter FJ. Tissue training model for skills acquisition for gastric bypass. Surg Endosc. 2008 (22):S36. 6. Levine RL, Kives S, Cathey G, et al. The use of lightly embalmed (fresh tissue) cadavers for resident laparoscopic training. J Minim Invasive Gynecol. 2006;13:451–6. 7. Foster JD, Gash KJ, Carter F, Longman R, Acheson A, Horgan A, Moran B, West N, Francis NK. Development and evaluation of a training curriculum for Extra-levator Abdomino Perineal Excision (ELAPE); within the LOREC National Development Programme for low rectal cancer. Colorectal dis. 2014;16(9):O308–19. 8. Corton MM, Wai CY, Babak V, et al. A compre-hensive pelvic dissection course improves obstetrics and gynecology resident proficiency in surgical anatomy. Am J Obstet Gynecol. 2003;189:647–51. CrossRefPubMed 9. Tjalma WAA, Degueldre M, Van Herendael B, D'Herde K, Weyers S. Postgraduate cadaver surgery: an educational course which aims at improving surgical skills. Facts Veiw Vis ObGyn. 2013;5(1):61–5. 10. Barton DPJ, Davies DC, Mahadevan V, et al. Dissection of soft preserved cadavers in the training of gynaecological oncologists: report of the first UK workshop. Gynaecol Oncol. 2009;113:352–6. CrossRef 11. Thiel W. Die Konservierung ganzer Leichen in natu¨rlichen Farben [The preservation of the whole corpse with natural color]. Ann Anat. 1992;174:185–95. CrossRef PubMed 12. Thiel W. Supplement to the conservation of an entire cadaver according to W. Thiel. Ann Anat. 2002;184:267–9. CrossRefPubMed 13. Human Tissue Authority. The regulator for human tissue and organs. 2004;

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ThisÂ bookÂ provides a broad overview on training in Minimal Access Surgery, with expert opinions from leaders in the field clarifying the definitions and terminology related to competence and accreditation. It also provides expert advice on how to set up a training unit and explores the role and impact of all types of simulations on training including virtual reality simulation. How to design a competency-based training curriculum in advanced laparoscopic surgery is also explored along with in depth examination of the role of assessment and competency based accreditation.Â *Training in Minimal Access Surgery*Â is a valuable resource for all health care professionals who are involved in training and education in Minimal Access Surgery including trainers and supervisors.

There is well established and robust evidence to support the benefits of laparoscopic surgery in terms of better pain control, fewer complications and shorter length of stay with an earlier return to work. Hence, there is now widespread adoption of laparoscopic techniques in many surgical specialties including colorectal and morbid obesity surgery across the world.

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