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Robotic Surgery

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The Cover Shot

This photo, which depicts pink cherry blossom flowers in full bloom, was taken at Shinjuku Gyoen in Tokyo in late March 2023. The Shinjuku Gyoen is one of Tokyo's largest and most popular parks, and one of the best places in the city to view cherry blossoms. In Japan, cherry blossoms are typically blooming around the same time when children start school. Therefore, cherry blossom blooms are thought to symbolise fresh starts and optimism for the future. We are also optimistic that robotic technology will continue to evolve and improve, and will benefit more patients and surgeons in the future.

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Recent Advances in Robotic Surgery

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One of the most significant technical advances in the field of minimally invasive surgery (MIS) in the recent two decades is the introduction of robotic surgery. The robotic surgical system provides a stable camera platform with a magnified 3D view. It intuitively transfers movements from the master handle at the console to the tip of the wristed instrument with tremor filtering. Robotic surgery can essentially overcome the technical disadvantages of conventional laparoscopic or thoracoscopic surgery in terms of visualisation and manoeuverability, which may enable surgeons to perform precise surgical dissection easily, even within confined spaces.

Robotic surgery era in Hong Kong began with the installation of the first generation of the da Vinci Surgical System at Prince of Wales Hospital in 2005. In the past two decades, new generations of da Vinci robots have been produced and installed in different hospitals worldwide. As of April 2023, there are 11 da Vinci Surgical Systems in 10 surgical units (seven public and three private) in Hong Kong. The annual throughput of robotic surgery in Hong Kong has gradually increased from less than 1,000 cases in 2014 to nearly 2,000 cases in 2022. Besides the increase in case volume, the surgical indications of robotic surgery have also expanded over the years. In this month's issue of the Hong Kong Medical Diary, we shall provide an update on recent advances and research development in robotic surgery in four areas: colorectal surgery, thoracic surgery, endoscopic/endoluminal surgery, and urology.

Colorectal surgeons in Hong Kong have been actively involved in developing and evaluating emerging robotic platforms such as flexible endoscopic robots and single port robots. These novel platforms have facilitated endoluminal surgery for early colorectal cancer and single port/transanal surgery and maximised the benefits of MIS to patients by further reducing surgical scars and wound trauma. With better robotic platforms and greater experience in robotic surgery, colorectal surgeons in Hong Kong have also applied the robotic approach to perform complex procedures such as pelvic exenteration for locally advanced or recurrent rectal cancer in a safe and minimally invasive manner.

Robotic surgery has been adopted by thoracic surgeons to treat anterior mediastinal diseases and lung pathologies since 2001. Recent meta-analyses comparing robotic-assisted and conventional video-assisted transthoracic surgery for thymic disease and lung cancer have demonstrated better clinical outcomes in the robotic group in terms of less blood loss and shorter hospital stay. With the increasing prevalence of small ground-glass opacities in lung, thoracic surgeons have applied robotic-assisted bronchoscopy (RAB) to facilitate pre-operative localisation and even endobronchial ablative therapy. Notably, thoracic surgeons at The Chinese University of Hong Kong (CUHK) have recently conducted the world's first RAB microwave ablation for multiple lung metastases.

Gastrointestinal (GI) tract-related lesions such as stomach and colorectal cancer are prevalent worldwide. The evidence clearly demonstrates that early screening and intervention with endoscopy are essential in

reducing the incidence and mortality rates of GI tract-related cancer. However, conventional endoscopy has possible limitations, including low patient tolerance, risk of perforation, and high skill requirements for endoscopists. GI surgeons and engineers at CUHK are undertaking collaborative research on developing novel robotic-assisted endoscopic systems (robotic capsule endoscope, soft-tethered endoscope, and dual-arm robotic endoscope) to provide alternative solutions for conducting GI tract screening and intervention in a more patient-friendly and surgeon-friendly manner.

Urology is one of the first surgical specialties that has widely adopted robotic surgery in their daily practice. Robotic prostatectomy is now regarded as the gold-standard treatment for clinically localised prostate cancer. Recent evidence suggested that robotic prostatectomy is associated with better oncological and functional outcomes when compared with laparoscopic prostatectomy. Using robotic platforms, urologists can now perform complex procedures such as radical cystectomy with intracorporeal urinary diversion and partial nephrectomy, that may be technically difficult with the laparoscopic approach.

The Emerging Role of Robotics in Colorectal Surgery: From Endoluminal, Single Port, to Exenterative Surgery

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This article has been selected by the Editorial Board of the Hong Kong Medical Diary for participants in the CME programme of the Medical Council of Hong Kong (MCHK) to complete the following self-assessment questions in order to be awarded 1 CME credit under the programme upon returning the completed answer sheet to the Federation Secretariat on or before 31 May 2023.

INTRODUCTION

Over the last two decades, robotic technology has led to substantial advancements in minimally invasive surgery (MIS) for both early and advanced colorectal cancer. Hong Kong has been actively involved in the development and evaluation of emerging robotic platforms such as flexible endoscopic robots (EndoMaster EASE System) and single port robots (da Vinci SP Surgical System). These new platforms have facilitated endoluminal surgery for early colorectal cancer and single port/transanal surgery and maximised the benefits of MIS to patients by further reducing surgical scars and wound trauma. The robotic approach can also allow colorectal surgeons to perform complex procedures such as pelvic exenteration for locally advanced or recurrent rectal cancer in a safe and minimally invasive manner. This approach has great potential to benefit patients undergoing this highly complex and morbid procedure. This review article will discuss the emerging role of robotics in colorectal surgery: from endoluminal, single port to exenterative surgery.

ENDOLUMINAL SURGERY

The recent progress in endoscopic technologies and interest in colorectal cancer screening have enabled the diagnosis of a larger number of early colorectal neoplasms, which include benign polyps and early T1 cancers. Most of these lesions are treated by colorectal surgeons with laparoscopic resection. An alternative minimally invasive therapeutic option for these early lesions is endoscopic submucosal dissection (ESD).[1] However, ESD is technically very challenging.[2] As surgeons, we are trained to operate using two hands during open or laparoscopic surgery for dissection and traction, but ESD requires a surgeon to operate using only one hand or one endoscopic knife without any assistance or countertraction. Therefore, the procedure usually takes a long time to complete, and procedure-related complications such as bleeding and perforation can occur. Furthermore, ESD has a very long learning curve, and a surgeon has to perform at least 80 cases in order to become proficient and to minimise complications.[3]

To overcome these technical problems associated with advanced endoscopic procedures, operators have thought about the application of robotic technology. In order to perform endoluminal surgery, such as colorectal ESD, the development of a flexible endoscopic robot that can travel along the colon is essential. Thanks to the innovative and collaborative efforts of Prof Lawrence Ho and Prof Louis Phee from Singapore and Prof Sydney Chung from Hong Kong, a prototype endoscopic robot known as the Master And Slave Transluminal Endoscopic Robot (MASTER) was designed and built in 2006.[4,5] In a preclinical study using ex vivo porcine stomach model, even non-clinician novices were able to successfully perform ESD using the prototype MASTER system, without any perforation.[6] Endoscopy experts and non-experts could perform ESD much faster with the MASTER system.

The original prototype MASTER system was quite crude and bulky, with wires or exoskeleton mounted on a standard double-channel endoscope. A second-generation endoscopic robot, the EndoMaster EASE (Endoluminal Access Surgical Efficacy) System, was developed with further technologic upgrades. The new system consists of an independently designed, flexible platform with a built-in endoscopic imaging system and three working channels, two for the passage of robotic arms and one for accessories. Using the new EndoMaster EASE System, Prof Philip Chiu from CUHK performed five robotic colorectal ESDs in a live pig model.[7] The mean operative time was 74 min, and the mean size of the resected specimens was about 3x4 cm. There was no perforation. Recently, our research group at CUHK has completed the world's first clinical trial on robotic colorectal ESD (n = 45) using the EndoMaster EASE System (Fig. 1).[8] Our study has confirmed the safety and efficacy of this novel endoscopic robotic system. Further evaluation is needed before this system can be routinely used in clinical practice.

Fig. 1. Colorectal endoscopic submucosal dissection using the EndoMaster EASE System. (Personal Collection)

SINGLE PORT/TRANSANAL SURGERY

In order to maximise the benefits of MIS for patients, many colorectal surgeons are keen to develop single port/transanal surgery as a step forward towards scarless surgery. Besides superior cosmetic results, single port/transanal surgery may have other potential benefits, such as less wound pain and lower wound morbidity.[9,10] However, single port colorectal surgery is still regarded as a procedure that is technically very challenging, even for experienced surgeons.[11] Surgeons have to operate using a long laparoscope and instruments are crowded together through a small single port device, which results in counterintuitive movement of the instrument, instrument clashing, poor exposure, and loss of instrument triangulation. For transanal endoscopic surgery, which is essentially single port laparoscopic surgery performed through a rigid or flexible transanal access platform, similar technical problems and challenges will be encountered.

These technical problems can be readily overcome by robotic technology, and the latest da Vinci SP Surgical System has been developed for this purpose.[12] It belongs to the fourth generation of da Vinci robots, and it is specifically designed to facilitate single port surgery and narrow access surgery such as transanal surgery. The system delivers an articulating 3D high definition camera and three fully articulating 6-mm instruments through a single 25-mm cannula, which can be readily deployed through a single access site. The da Vinci EndoWrist SP instruments incorporate an additional joint providing an 'elbow' and hence have the capability of restoring internal triangulation while maintaining the maximal degree of freedom for precise manoeuvres and strength for reliable traction.

Fig. 2. The operating room setup for da Vinci SP right hemicolectomy. (Personal Collection)

Our research group at CUHK successfully conducted the first multispecialty clinical trial in the world using the da Vinci SP Surgical System in 2017. Sixty-three patients from colorectal surgery (n = 22), otorhinolaryngology (n = 21), and urology (n = 20) were recruited in this trial (Fig. 2).[13-15] We were able to show that single port transabdominal surgery, transanal surgery, and transoral surgery using the da Vinci SP Surgical System were feasible and safe. There was no major morbidity, and the cosmetic results were excellent. The system received Food and Drug Administration (FDA) approval for urologic procedures in 2018 and transoral surgery in 2019, while the approval for colorectal surgery is still pending.

EXENTERATIVE SURGERY

Despite colorectal cancer screening and advances in neoadjuvant/adjuvant therapy, we still see patients with advanced T4 rectal cancer or recurrent rectal cancer who require pelvic exenteration. Due to the anticipated complexity and difficulty of the surgery, these lesions are usually managed using the conventional open approach. Along with the accumulation of MIS experience, some surgeons have attempted to perform laparoscopic total pelvic exenteration for these advanced pelvic malignancies. A French group reported the first case in 2003.[16] It took the surgical team nine hours to accomplish this difficult operation. A few more case reports or series were published afterwards, but the operative time was also very long. In 2016, Dr Uehara from Nagoya University reported their experience with laparoscopic versus open pelvic exenteration.[17] They performed nine cases of laparoscopic pelvic exenteration, some with combined resection of the bony pelvis, and the operative time was close to 16 hours. However, they were able to show lower morbidity and shorter hospital stay when compared with open exenteration.

Laparoscopic total pelvic exenteration is generally regarded by colorectal surgeons as one of the most difficult operations in view of multiple technical challenges. Firstly, the camera platform can be very unstable during surgery. Secondly, because of the narrow pelvis and bulky tumour, there is limited light and space for instrument handling, and retraction is often difficult and ergonomics poor. Finally, total pelvic exenteration entails multiple organ resections and functional reconstructions, which can be very challenging for the MIS approach. Nevertheless, these technical difficulties can be potentially overcome by robotic technology.

Pioneers in robotic surgery, such as Prof Seon-hahn Kim and his colleagues, had attempted robotic pelvic exenteration with reconstructions using the da Vinci Si Surgical System in three patients with locally advanced rectal cancer, and reported their initial experience in 2013.[18] The robotic console time ranged from 2 to 6 hours, and the operative blood loss was acceptable. Surgeons were able to complete the operation more ergonomically, and hence the robotic approach can benefit both the patients and the surgeons. However, in the editorial comment accompanying the article, the editor issued a warning at the beginning: Do Not Try This At Home![19] The editor believed that in order to perform this complex operation safely, we need expertise in robotic rectal and pelvic surgery, as well as advanced technology.

Nowadays, with better robotic platforms (da Vinci Xi Surgical System), greater experience in robotic surgery, closer collaboration between different specialties, and more careful patient selection and surgical planning at

multidisciplinary team meetings, our team of robotic surgeons at Prince of Wales Hospital/CUHK is currently performing pelvic exenteration using the da Vinci Xi Surgical System on a regular basis. Patients with locally advanced rectal tumours invading into the urologic and/or gynecologic systems are good indications for robotic pelvic exenteration. A typical case usually begins with rectal mobilisation and division of the vascular pedicle by the Colorectal Team, followed by en bloc resection and reconstruction (intracorporeal ureteroileal anastomosis) of the urologic organs by the Urology Team. We have recently reported our experience of robotic abdominoperineal resection with en bloc Retzius-sparing prostatectomy (Fig. 3).[20] For this technique, the peritoneum is incised at the seminal vesicle level to access the prostate, leaving the attachment between the bladder and the anterior abdominal wall intact. This technique has been shown to have better urinary functional outcomes when compared with the conventional retropubic technique.

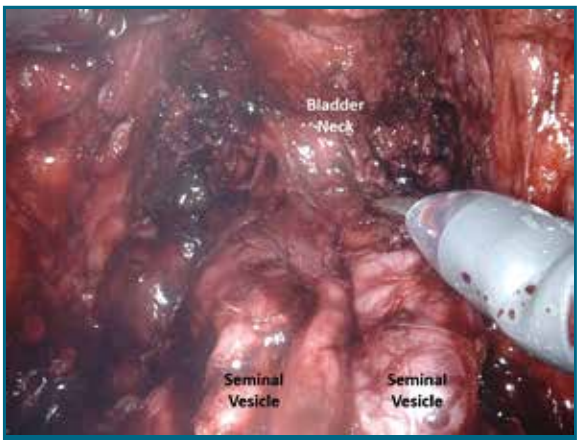

Fig. 3. Operative photo of robotic abdominoperineal resection with en bloc Retzius-sparing prostatectomy using the da Vinci Xi Surgical System. (Personal Collection)

CONCLUSION

Robotic technology has evolved rapidly over the last few decades. Technical problems associated with endoluminal surgery, single port/transanal surgery, and complex rectal MIS can now be overcome by emerging robotic surgical platforms. Robotics will become an integral component of surgery in the future, and our next generation of colorectal surgeons should embrace this new technology and learn to perform robotic surgery to benefit their patients.

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MCHK CME Programme Self-assessment Questions

Please read the article entitled "The Emerging Role of Robotics in Colorectal Surgery: From Endoluminal, Single Port, to Exenterative Surgery" by Prof Simon SM NG and complete the following self-assessment questions. Participants in the MCHK CME Programme will be awarded CME credit under the Programme for returning completed answer sheets via fax (2865 0345) or by mail to the Federation Secretariat on or before 31 May 2023. Answers to questions will be provided in the next issue of The Hong Kong Medical Diary.

Questions 1-10: Please answer T (true) or F (false)

1. All T1 colorectal cancers should be treated with laparoscopic resection to ensure an oncological cure.
2. Endoscopic submucosal dissection (ESD) is an acceptable minimally invasive therapeutic option for treating T2 colorectal cancers.
3. Non-clinician novices were able to perform ESD successfully in pre-clinical models using a flexible endoscopic robot without any perforation.
4. A recent randomised controlled trial has shown that robotic ESD is associated with shorter operating time and lower complication rates when compared with conventional ESD performed using a standard colonoscope.
5. Potential benefits of single port laparoscopic surgery include superior cosmetic results, less wound pain, and lower wound morbidity.
6. Features of the novel single port robotic surgical system include an articulating camera and three fully articulating 6-mm instruments delivered through a single 25-mm cannula, which can be deployed through a single access site.
7. Surgeons from The Chinse University of Hong Kong had successfully conducted the world's first multispecialty (colorectal, thoracic, and urology) clinical trial using a novel single port robotic surgical system.
8. Patients with advanced T4 rectal cancer or recurrent rectal cancer are absolute contraindications for minimally invasive resection.
9. Laparoscopic pelvic exenteration performed by expert surgeons has been shown by studies to have lower morbidity and shorter hospital stay when compared with open exenteration.
10. Favourable factors such as the availability of better robotic platforms, greater experience in robotic surgery, closer collaboration between different specialties, and more careful patient selection and surgical planning at multidisciplinary team meetings have enabled colorectal surgeons in Hong Kong to perform robotic pelvic exenteration on a regular basis.

ANSWER SHEET FOR MAY 2023

Please return the completed answer sheet to the Federation Secretariat on or before 31 May 2023 for documentation. 1 CME point will be awarded for answering the MCHK CME programme (for non-specialists) self-assessment questions.

The Emerging Role of Robotics in Colorectal Surgery: From Endoluminal, Single Port, to Exenterative Surgery

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Answers to April 2023 Issue

Pharmacological Therapy for Diabetic Kidney Disease in 2023

1. F 2. F 3. F 4. F 5. T 6. T 7. T 8. T 9. T 10. T

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Robotic Thoracic Surgery - Where Are We Now?

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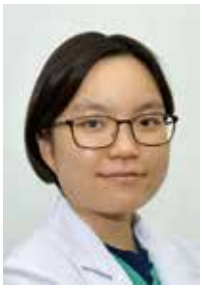

Dr Aliss TC CHANG Prof Calvin SH NG

INTRODUCTION

In the age of automated robotics and artificial intelligence, robotic technologies have been introduced into the field of surgery since the early 1990s, with their applicability spreading across most surgical specialties. The applicability includes the ever-changing thoracic surgery field, where innovative technologies have always been embraced. Thoracic surgery is no stranger to adopting new technologies as it evolved from the traditional open surgery with thoracotomy to minimally invasive thoracic surgery in the 1990s using video-assisted thoracoscopic surgery (VATS). Credits to the advancement in endoscopic equipment and camera, VATS with smaller and fewer wounds is now becoming the standard of care worldwide. VATS offers benefits above and beyond a thoracotomy given the former's shorter hospital stay, lesser postoperative pain, superior cosmesis, and reduced overall rate of postoperative complications.[1]

However, despite the satisfactory outcomes in VATS, limitations such as the restricted 2-dimensional (2D) vision and suboptimal operator ergonomics are hindering further improvement in VATS. The introduction of robots into thoracic surgery in the 2000s and theoretical benefits of robotic surgery in manoeuvrability, ergonomics, and 3-dimensional (3D) vision were the game-changer in the development of minimally invasive thoracic surgery. The commonest used robotic system is the da Vinci robotic system, which was approved by the US Food and Drug Administration (FDA) in 2000. Shortly after the FDA approval, the first ever robotic thoracic surgery was reported in 2001.[2] Since then, more surgeons have started to explore the utilisation of robotic-assisted thoracic surgery (RATS). Nowadays, applications of RATS in anterior mediastinal disease and lung resection have been well established. With the gaining popularity of RATS, other applications in posterior mediastinal disease and oesophagal disease have also been explored.

Aside from minimally invasive surgery, another major paradigm shift in thoracic surgery is the increasing prevalence of small ground-glass opacities (GGO). To manage small GGO, accurate pre-operative localisation, diagnostic procedure, and ablative therapy using an endobronchial approach have been cultivated. Similarly, a robotic-assisted system has been integrated into endobronchial thoracic surgery. The superior manoeuvrability of robotic-assisted bronchoscopy (RAB) results in better diagnostic yield and higher localisation accuracy. In this article, we will discuss the current applications of RATS and RAB, to address the clinical outcomes brought by these technologies and to examine the latest clinical evidence.

TRANSTHORACIC ROBOTIC-ASSISTED SURGERY

The first commercially available robotic system used in surgery was the Automated Endoscopic System for Optimal Positioning (AESOP) system, approved by the FDA in 1994. First-generation AESOP allows stable manipulation of the endoscopic camera during operation by using one single robotic arm. As the technology continued advancing, an updated version of AESOP named ZEUS was introduced, offering additional robotic arms to simultaneously manipulate multiple robotic endoscopic instruments. AESOP and ZEUS were the ancestors of the da Vinci Surgical System, one of the most universally utilised robotic systems and the only FDA-approved in robotic thoracic surgery so far, developed by Intuitive Surgical.[2]

The da Vinci robotic system consists of 3 main components: the vision cart, the surgical cart, and the surgeon console. The surgeon console is the main remote-control centre for the surgeon to control the robotic arms and obtain a 3D surgical viewing from the endoscopic camera. The vision cart allows surgical assistants and team members to visualise the operative field without access to the surgeon's console. The surgical cart contains all the robotic arms and surgical instruments used for the operation. A surgical assistant is required at the surgical cart to aid in instrument management during the operation.

Compared to VATS, the benefits of RATS have been brought about by the higher degree of movement freedom of the robotic endowrist and the 3D magnified vision. Instruments and cameras used in conventional VATS were either straight or angulated at a fixed angle. With the rising trend of minimally invasive thoracic surgery, especially with uniportal VATS (uVATS), instrument handling becomes increasingly challenging as all instruments must be accommodated through one incision. Therefore, limiting the available space for intra-operative manoeuvres leads to instrument fencing. Moreover, given the long and inflexible instruments and videoscope, visualisation angles during VATS might become paralleled and unfavourable, particularly in commanding anatomical locations such as the posterior mediastinum and deep in the hilum. A robotic endowrist, on the other hand, allows a higher degree of movement freedom mimicking the movement of human

wrist thus enabling physiological tremor filtration and elimination of instrument fencing. This endowrist gives surgeons the utmost dexterity and precision to complete intricate tasks in anatomically arduous locations.

Aside from the endowrist technology, advancement in the 3D high-definition optical system used in RATS is advantageous over the conventional 2D camera used in VATS. 3D videoscope offers depth perception during the operation, which is not available in conventional videoscope. It allows high-definition magnification up to 10 times compared to conventional videoscope, making extra-fine dissection possible. Additional benefits of RATS include ergonomic operation and less physical strain on the operating surgeons.[3] Yet, RATS is not free of limitations. In exchange for the improvement in ergonomics and flexibility, RATS carries the disadvantages of higher costs, prolonged operative time due to the preparation and docking prior to the actual operation and the absence of haptic feedback.

The development of RATS began in the early 2000s, when Yoshino described the first robotic thymectomy in 2001. The application of RATS has since spread to a wider range of thoracic pathologies, from lung cancer to thoracic outlet syndrome. Currently, the most well-established evidence lies in robotic thymectomy and robotic lung resection for lung cancer. In 2021, Shen and colleagues published a meta-analysis on using RATS versus VATS for treating thymoma. They included 11 studies involving 1,418 patients, of which 688 were in the RATS group. The meta-analysis demonstrated less blood loss, fewer postoperative pleural drainage days, shorter postoperative hospital stay, and fewer postoperative complications in the RATS group than in the VATS group. The reasons behind these clinical outcomes were likely related to the delicate and accurate dissection done using magnified 3D vision and flexible robotic endowrist. Especially in thymectomy, where the operation is carried out in a limited anatomical space, thorough dissection and haemostasis can be safely carried out thanks to clearer 3D visualisation and flexible, tremor-filtrated instruments . As a result, the risk of vascular or lymphatic injury was reduced, and there was a higher rate of complete resection of the thymus and the surrounding adipose tissue. Interestingly, this meta-analysis also demonstrated similar operative time between the RATS and VATS thymectomy groups, and this finding may be due to the differences in surgical experience between operators.[4]

Robotic thymectomy is commonly carried out in two different approaches: transthoracic and subxiphoid. In the subgroup analysis of Shen's meta-analysis, unilateral transthoracic and subxiphoid RATS thymectomy were associated with shorter duration and lower postoperative drainage volume when compared with the VATS approach. One significant difference between transthoracic and subxiphoid RATS thymectomy is the ability to visualise bilateral phrenic nerves. While visualisation of the contralateral phrenic nerve might be challenging in unilateral transthoracic robotic thymectomy, in subxiphoid robotic thymectomy, precise visualisation and safe dissection of both phrenic nerves can be achieved owing to the optimal midline location of the camera and hence, the ability to position the camera into bilateral thoracic cavities.

Recent clinical cohorts reported satisfactory clinical outcomes in terms of complete resection rate, duration of in-hospital stay, and peri-procedural complications in robotic subxiphoid thymectomy.[5,6,7] For example, in the Leow et al. cohort of 20 patients, no peri-procedural mortality or conversion to open surgery was reported. One patient (5%) had postoperative chylothorax and received conservative treatment, while 95% of patients were complication-free. The median length of hospital stay was 2.5 days, and 55% of patients did not require chest tube drainage post-operatively.[7] These respectable outcomes may further strengthen the argument for using robotics in thymectomy and other anterior mediastinal diseases, but evidence from large-scale controlled trials is still lacking.

Robotic surgery is no stranger to oncological surgery since its historical birth in the late 1990s. RATS have been used in lung cancer to perform major lung resections since 2002. Although there is a need for large, multicentre controlled trials in RATS lung resection, numerous clinical cohorts have been published. Ng et al. published a meta-analysis in 2019 comparing open surgery versus VATS and different VATS approaches, including RATS. In the pooled analysis of five studies involving 7,752 patients, the clinical outcomes were mostly similar between VATS and RATS. There was no significant difference between the length of in-hospital stay between VATS and RATS.[8] Furthermore, a more recent meta-analysis of 18 studies and 11,247 patients was published by Ma and colleagues in 2021 comparing RATS and VATS in lobectomy or segmentectomy for lung cancer. Similarly, no difference was detected in overall complication rate, number of lymph nodes harvested, mortality, and overall survival. Nonetheless, Ma et al. showed shorter hospital stay, less intra-operative blood loss, and shorter duration of chest tube drainage in the RATS group.[9] These findings were echoed in another multicentre retrospective analysis - the PORTaL study.[10]

It is important to note that there is a limited number of publications in RATS than in VATS, and the publication on long-term outcomes of RATS is also limited. Future prospective randomised controlled trial is needed to better confirm the advantages of RATS in lung cancer surgery. As per VATS, the uniportal approach in RATS is feasible on top of the conventional multiportal approach. (Fig. 1) A propensity score-matched analysis with 136 patients comparing uniportal VATS and uniportal RATS was published by Paradela et al. They demonstrated comparable results in operative time, intra-operative complication rate, number of nodal stations explored, length of in-hospital stay, and mortality. Nevertheless, the number of lymph nodes resected was significantly higher in uniportal RATS, while the postoperative complication rate and duration of chest tube drainage were significantly shorter in RATS. Likewise, these outcomes are explained by the ability to perform meticulous dissection with the assistance of the highly flexible robotic arms and the magnified 3D view.[11]

Gonzalez-Rivas et al. published their experience on 30 cases of complex and technically challenging lung cancer surgery done with uniportal RATS, including sleeve lobectomies, sleeve resection with carinal

reconstruction, and more. The published peri-operative outcomes were excellent and comparable to uniportal VATS. There was no operative mortality and there was one postoperative mortality from acute respiratory distress syndrome (ARDS). The complication rate was 17%, and the mean hospital stay was 6.6 days.[12] From the above-mentioned studies, we can conclude that RATS in lung cancer surgery offers equivalent oncological and survival outcomes compared to VATS, bringing along potential benefits such as a shorter length of hospital stay, a shorter duration of chest tube drainage, and facilitation of lymph node resection. Performing complex operations with RATS is feasible and reliable, thanks to the robotic system's wide range of movements and 3D vision.

As robotic technology advances at an unimaginable speed, many new robotic systems are being developed to accommodate different clinical uses. For example, the da Vinci SP by Intuitive Surgical has been designed explicitly for single-port surgery. It has a 2.5 cm cannula through which an articulating robotic 3D camera with three separate flexible instrumental arms can be passed. The da Vinci SP offers the opportunity to perform surgery on benign and malignant diseases through a small, single incision via an all-in-one robotic platform. The Hugo system by Medtronic is another highly anticipated robotic system. This system has a similar robotic platform to the da Vinci robot. However, additionally, it has a console system in which the operator will visualise his operative view through 3D glasses and an intuitive haptic interface for a better operative experience. Lastly, but definitely not the last robotic system under development, is the Ottava system by Johnson & Johnson, which has an innovative design with six robotic arms which will offer even more flexibility in surgery and provide more excellent manoeuvrability.[2] The impact of these systems on thoracic robotic surgery will require future studies and data.

Fig. 1. Uniportal robotic assisted thoracic lung surgery with Da Vinci Xi system at Prince of Wales Hospital. (Personal collection)

ENDOBRONCHIAL ROBOTIC SURGERY

As of today, low-dose computed tomography (LDCT) has contributed significantly to the early identification of subcentimeter GGO. Management of GGO remains challenging due to their small size and ground-glass nature. Thus, pre-operative diagnosis and localisation via the endobronchial approach have become progressively fundamental in managing these lesions. Moreover, endobronchial ablative therapy provides a suitable local treatment with acceptable oncological outcomes in patients with multiple lung lesions or poor functional status. Robotic technology has been integrated into endobronchial thoracic surgery in recent years. RAB combines a navigational system and a robotic arm to hold the bronchoscope. With a small hand-held remote controller, the operator can advance the bronchoscope through a pre-designed pathway into narrower, more distal bronchioles. As there is no physical contact between the operator and the bronchoscope, physiological tremor from the operator is eliminated, and steady advancement of the bronchoscope is ensured. Like RATS, the operator can enjoy improved ergonomics during the endobronchial procedure.

Pre-operative localisation and biopsy of small GGO using RAB offer the advantages of a high success localisation rate, high diagnostic yield, and low complication rate. The robotic arm provides high stability during bronchoscope advancement. Combined with the exact spatial orientation provided by the system, RAB allows complex localisation procedures to be performed in narrower airways. Experience in Indocyanine Green (ICG) dye-marking and triple dye-marking localisation using RAB was reported in 2022 by Chan et al., who showed a navigational success rate of up to 100% and localisation success rate of up to 80%.[13] The preliminary results of a prospective multicentre post-marketing study of RAB called the BENEFIT trial was presented by Chen et al. in 2021,[14] showing a high localisation rate of 96.2% and a complication rate of 3.6%. These findings showed similarity with the previous cohort published by Chaddha et al. in 2019,[15] which showed a high successful localisation rate of up to 88% and a low complication rate of 2.4%.

There are ongoing prospective multicentre clinical trials, such as the TARGET trial, that will provide us with more evidence of RAB's efficacy and safety profile in reaching the target lesion and its diagnostic ability. As previously discussed, transbronchial ablative therapy is valuable in patients with multiple lung lesions or unfit patients. Most clinical studies on transbronchial ablation were carried out using electromagnetic navigational bronchoscopy (ENB),[16] and RAB transbronchial ablation is still in its youth. The Chinese University of Hong Kong has recently carried out the world's first RAB microwave ablation (MWA) of multiple lung metastases. With the robotic system, the bronchoscope and the ablation catheter can be delivered precisely to the target lesions despite their peripheral locations, and the stability of the ablation catheter is maintained throughout the ablation progress to ensure accurate ablation. (Fig. 2) All six lung metastases in three patients were successfully ablated using RAB MWA.[17,18] In the future, we foresee that RAB ablation will become a promising clinical tool for treating lung nodules.

The Monarch system developed by Auris Health and the Ion Endoluminal system developed by Intuitive Surgical are the two commercially available RAB systems in the market. The Monarch system has an outer sheath with an inner bronchoscope to provide direct visualisation and utilise electromagnetic navigation for virtual

navigation. It has two robotic arms with six degrees of freedom of movement, used to control the sheathed bronchoscope, while the operator controls the robotic arms via a remote controller. As the inner bronchoscope is advanced, the outer sheath provides additional structural support and improves stability during the procedure. In contrast, the Ion Endoluminal system has a 3.5mm 180 degrees articulating and flexible catheter with fibre-optic shape-sensing technology for continuous virtual navigation. The catheter has incorporated a 2mm working channel and a video probe, providing live visualisation.[19] RAB technology is innovative and novel, with the Monarch system being the first to attain FDA approval in 2018. Future clinical trials will shed light on RAB's effectiveness and long-term outcomes. RAB can act as a stepping stone towards higher accuracy on diagnostic and localisation procedures and provide an alternative solution for inoperable lung tumours.

Fig. 2. Robotic assisted bronchoscopic microwave ablation in the hybrid operating room. (Personal collection)

CONCLUSION

Robotic surgery has come a long way since the 1990s, expanding its usage in different fields of surgery. In robotic transthoracic surgery, excellent clinical outcomes comparable to VATS were achieved, with additional potential benefits of better ergonomics and reduced blood loss. In the aspect of robotic-assisted bronchoscopy, RAB offers high stability, excellent manoeuvrability and superior ergonomics for various transbronchial procedures. In the near horizon, it is indisputable that robotic thoracic surgery will continue to evolve and develop. Thoracic surgeons will be required to embrace these technological novelties and expand their applications in robotic thoracic surgery for better patient outcomes.

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Innovative Robotic-Assisted Endoscope Systems for Gastrointestinal Tract Screening and Intervention

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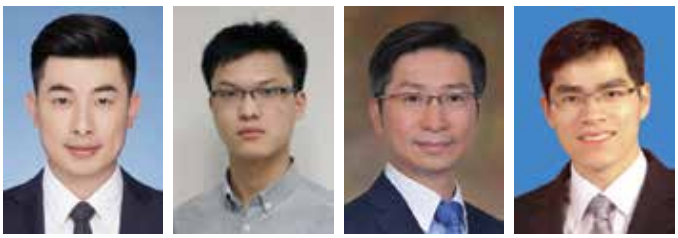

Mr Yisen HUANG | Mr Yehui LI | Prof Philip WY CHIU | Dr Zheng LI

INTRODUCTION

Gastrointestinal (GI) tract-related lesions are prevalent worldwide, with some carrying a high mortality rate.[1] For example, colorectal cancer (CRC) has become the third most common cancer globally and the second leading cause of cancer deaths. Meanwhile, stomach cancer ranks fifth in incidence and fourth in mortality. Evidence clearly shows that early screening and intervention with endoscopy are essential in reducing the incidence and mortality rate of GI tract-related lesions.[2] Taking CRC as an example, early diagnosis renders the survival rate of CRC to reach up to 91%, making regular GI tract screening strongly recommended for individuals aged 48 and above.[3]

Flexible endoscopes are a widely used medical device due to their high diagnostic accuracy and reliability. They are equipped with functions such as high-definition vision, rinsing, insufflation, suction and a working channel for biopsy, polyp removal, drug delivery, etc. Limitations in conventional endoscopy include low patient tolerance, risk of perforation, and high skill requirements and workloads for endoscopists.

Interventions for the GI tract typically involve procedures such as biopsy, polyp removal, and drug delivery. Previously, patients with early cancers were treated with partial intestine or stomach resection.[4] These procedures often resulted in complications and decreased quality of life for patients.[5] In recent decades, Japanese researchers have introduced new endoscopic treatments, such as endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD), for early GI cancer treatment.[6] These organ-preserving techniques provide patients with less postoperative pain, faster recovery, and rapid return home. Due to these benefits, EMR and ESD have become a favoured treatment for early GI cancers in many countries.[7] Unfortunately, traditional GI endoscopes are designed primarily for diagnostic purposes with limited therapeutic functions. Performing ESD with a traditional GI endoscope requires significant technical expertise, which hinders its wide adoption.

Therefore, to meet the increasing demand for GI screening and ESD, novel robotic-assisted endoscope systems that are both patient-friendly and endoscopist-friendly are worth investigating and exploring. This paper introduces the latest advancements and discusses the future development directions of robotic-assisted endoscope systems for GI screening and intervention.

ROBOTIC ENDOSCOPE SYSTEMS FOR GI SCREENING AND TREATMENT

Recent development in GI screening systems mainly involves robotic capsule endoscopes and soft-tethered endoscopes.[8] Advances in GI intervention systems mainly focus on dual-arm robotic endoscopes.

Robotic Capsule Endoscopes

Conventional capsule endoscopes (e.g., Pillcam) are developed as swallowable inspection tools that can move through the GI tract passively with the peristaltic waves. Images are captured along the way and sent to the endoscopist for examination. The capsule endoscope-based colonoscopy requires minimal intervention by the endoscopist and is highly tolerated by the patient. However, due to the passive nature, full coverage cannot be guaranteed, incomplete examination and limited diagnostic are inevitable, and therapeutic intervention is impossible. Furthermore, administering capsule endoscopes and interpreting endoscopic images significantly increases the load of surgeons.[9] This motivated the development of active capsule endoscopes, or robotic capsule endoscope. One key challenge to be addressed is active locomotion, which can be categorised as internal actuation (e.g., legged propulsion and treaded advancement) and external actuation (mainly magnetic actuation).[10-13] Existing commercial robotic capsule endoscopes are mainly actuated by external magnetic fields instead of on-board actuators. One example of the magnetic capsule endoscope is the ANKON capsule endoscope (Ankon Medical Technologies, Wuhan, China), developed for stomach screening.[14] In the procedure, the stomach is extended by water, and the capsule is actively steered by the endoscopists with an external magnet to view the stomach.

In terms of capsule endoscopes for the lower GI tract (i.e., small intestine and colon), Xu et al. at the Chinese University of Hong Kong (CUHK) developed a wireless capsule endoscope actuated by a permanent external magnet, as shown in Fig. 1(a), which can achieve autonomous propulsion in an unknown tubular environment.[15-18] Another magnetic capsule endoscope was developed by Zhang et al. in CUHK, which is actuated by multiple electromagnets and can achieve automatic stomach screening based on visual servo control. Nevertheless, interventions are required for detected lesions during the endoscopy procedure, which limits clinical applications of capsule endoscopes since they typically do not preserve the functions in flexible endoscopes.[19]

Soft-tethered Endoscope

Soft-tethered endoscopes have been proposed to maintain the functions of flexible endoscopes and enhance patient tolerance. These endoscopes consist of an active tip section and a much softer shaft than traditional flexible endoscopes. The traction from the tip section could avoid the endoscope looping, which is a major source of patient discomfort and perforation risk. In addition, with the soft tether, external power and instruments could be delivered. The soft-tethered colonoscope allows for providing high-definition images, rinsing, suction, insufflation, and working channel as in flexible endoscopes. Moreover, compared to capsule endoscopes, the soft tether also provides a safe mechanism for withdrawing the colonoscope in the event of a malfunction. The challenge for soft-tethered endoscopes is how to drive the endoscope inside the intestine without the forcible insertion as the conventional flexible endoscopes.

In terms of actuation methods, soft-tethered endoscopes could also be categorised into internally actuated and externally magnetically actuated. Examples of internally actuated soft-tethered endoscope include the Endotics system, which moves in the intestine mimicking the earthworm locomotion by suction and clamping of local colon tissue to anchor either of its two ends.[20] As shown in Fig. 2, Poon et al. and Zhang et al. in CUHK developed two types of soft-tethered endoscopes that conduct screening and intervention in the intestine in earthworm-like locomotion.[21-23] Both of these two earthworms like soft-tethered endoscopes contain three sections and can move forward/backward and steer inside the colon.

Examples of externally actuated soft-tethered endoscopes include the work by Hao et al., Verra et al., and Barducci et al.[24-26] They embedded a permanent magnet in the distal tip, which can be actuated using a permanent external magnet mounted on a robot arm. In CUHK, Li et al. proposed an electromagnetically actuated soft-tethered (EAST) colonoscope, as shown in Fig. 3.[27-29] The system consists of a soft-tethered colonoscope device, an electromagnetic actuation system, and a host computer. The soft-tethered colonoscope device includes a 3D-printed handle, a multi-channel soft tether, and a distal tip with a permanent ring magnet and a camera. The host computer runs the control algorithm and calculates the currents applied to the electromagnetic coils. Combined with advanced control strategies and artificial intelligence (AI) techniques, the EAST colonoscope can achieve automatic tracking of region-of-interest as well as autonomous navigation through the colon and lesions automatic detection along the way. The automated EAST colonoscope helps to reduce the workload of operation in addition to improving patient tolerance.

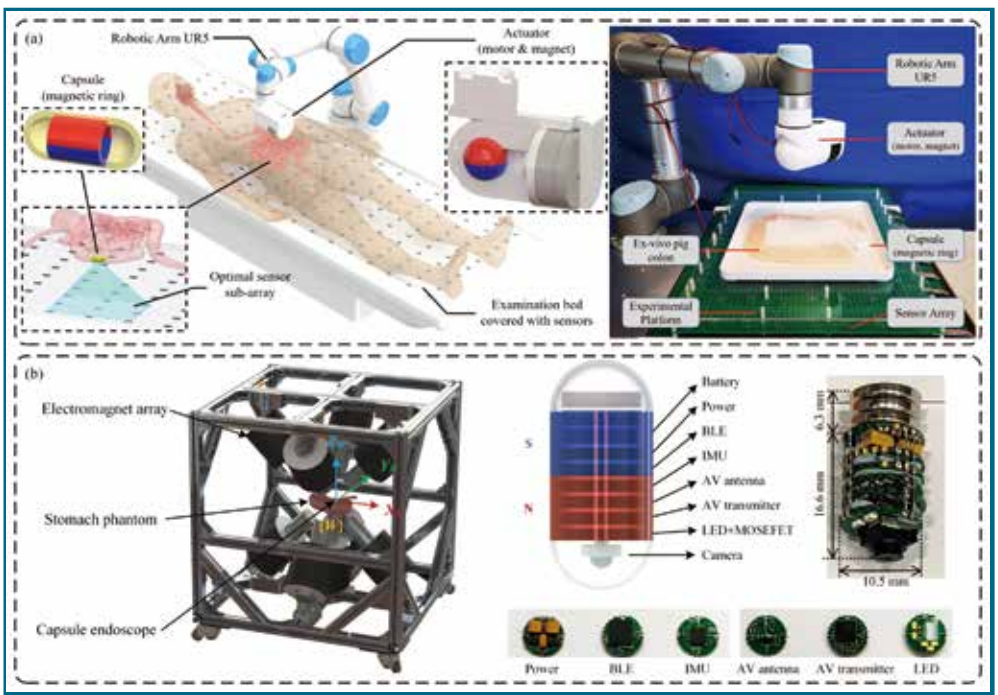

Fig. 1. Overview of the magnetic capsule endoscope systems developed by (a) Xu et al. and (b) Zhang et al. in CUHK. (Adapted from reference[15-18])

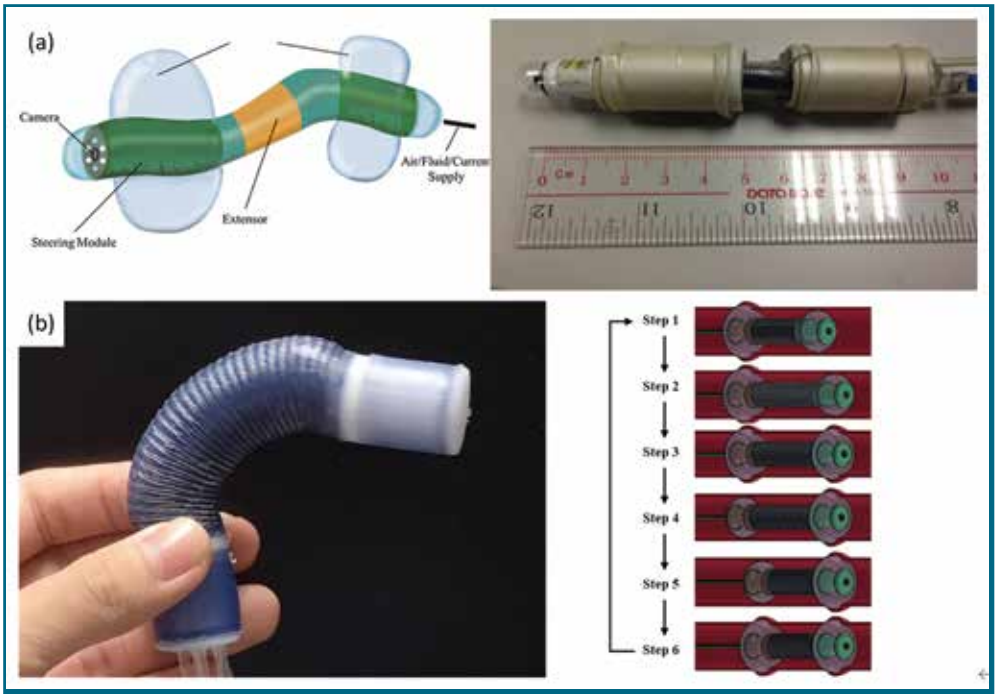

Fig. 2. Earthworm-inspired endoscopes developed by Poon et al. and Zhang et al. in CUHK. (Adapted from reference[21-23])

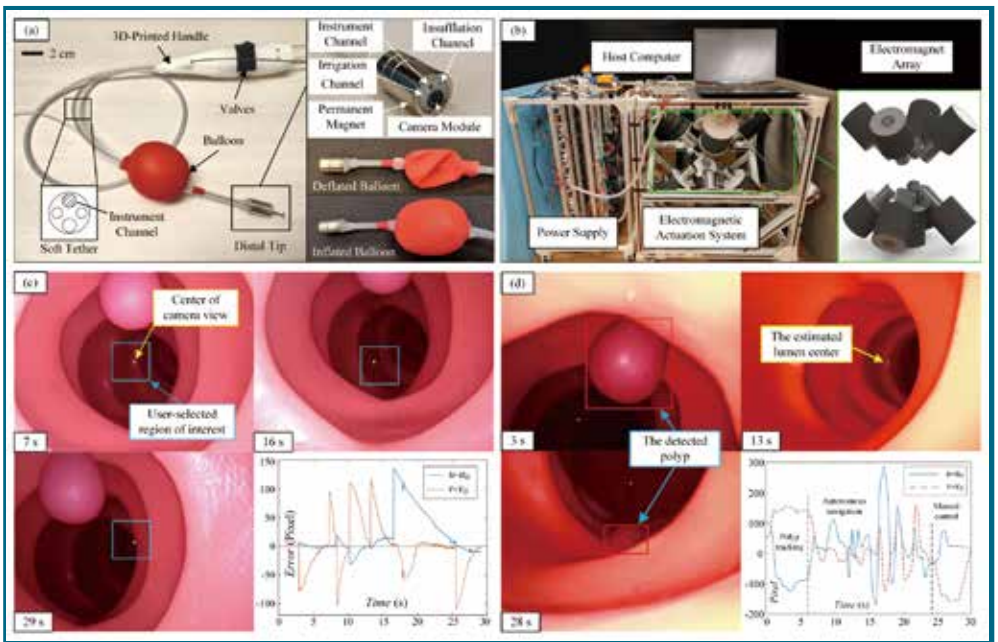

Fig. 3. Electromagnetically actuated soft-tethered (EAST) colonoscope system developed by Li et al. in CUHK. (a) Prototype of the soft-tethered colonoscope with an inflatable balloon and a magnetic tip. (b) Small-scale prototype of the electromagnetic actuation system for proof-of-concept. (c) Automatic region-of-interest tracking based on visual servo control. (d) AI-based autonomous colon navigation with automatic polyp detection. (Adapted from reference[27-29])

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Dual-Arm Robotic Endoscopes

With the prevalence of GI screening, more GI cancers will be diagnosed at an early stage. The early-found GI lesions would increase the need for early treatment, such as ESD operation. Platforms for this operation include pure mechanical systems, such as the Cobra system. It is a modification of the TransPort endoscopic platform developed by USGI Medical. It utilises two robotic arms and a camera channel with two-directional bending capability. The handheld controller, connected by wires, directly controls all degrees of freedom (DoFs).[30] The STRAS system, developed by Lucile et al., is a telemanipulated robotic device designed to assist surgeons during intraluminal surgical endoscopy.[31] Its modularity allows for easy setup and navigation to the operating area, providing 10 DoFs. Both the EndoMaster system, developed by Nanyang Technological University, and the K-Flex system, developed by the Korea Advanced Institute of Science and Technology, are focused on endoscopic surgery and rely on a specially designed endoscope to carry their robotic arms.[32-33] Since these systems are highly complex, they are not typically very compact in size. In CUHK, Lau et al. proposed a robotic system designed specifically for ESD.[34-37] It consists of four components: a master console, a computer, a driving unit, and a robotic arm, as depicted in Fig. 4. The surgeon inputs commands into the master console. The signal is then processed by a computer, which calculates the desired position and velocity of the motors using a designated kinematic algorithm. The power and action are transmitted through the twists and turns of the channel using the tendon-sheath mechanism (TSM), connecting the motors and the robotic arm. In in-vivo experiments, their system has been shown to increase the safety and efficiency of ESD over conventional methods. An advanced robotic platform has been developed based on the prototype, with improved flexibility and potential for commercialisation.

DISCUSSIONS AND CONCLUSION

Robotic-assisted endoscope systems offer an alternative solution for screening and treating the GI tract, which can improve patient comfort and reduce the workload for surgeons. To further enhance these systems, fully autonomous endoscopes would be a promising future direction, requiring advanced control strategies and AI techniques for GI tract diagnosis. However, for GI tract intervention, significant challenges still hinder their widespread application in clinical practice. The first challenge is the need for additional endoscopic instruments that enable robotic platforms to perform full-thickness incisions and successfully close them in the GI tract. These instruments would allow surgeons to remove advanced GI cancers that are more likely to have lymphovascular involvement. The second challenge is incorporating haptic feedback into robotic endoscopic platforms, which can minimise excessive force applied to delicate tissues, reducing the risk of complications such as bleeding and perforation. The third challenge is establishing a comprehensive and dedicated training programme that enables both novices and experienced surgeons to quickly adapt to the learning curve of robotic endoscopic platforms. Automating colonoscopy will allow surgeons to fully utilise the benefits of these robotic endoscopes, rather than being hindered by their lack of experience with the technology.

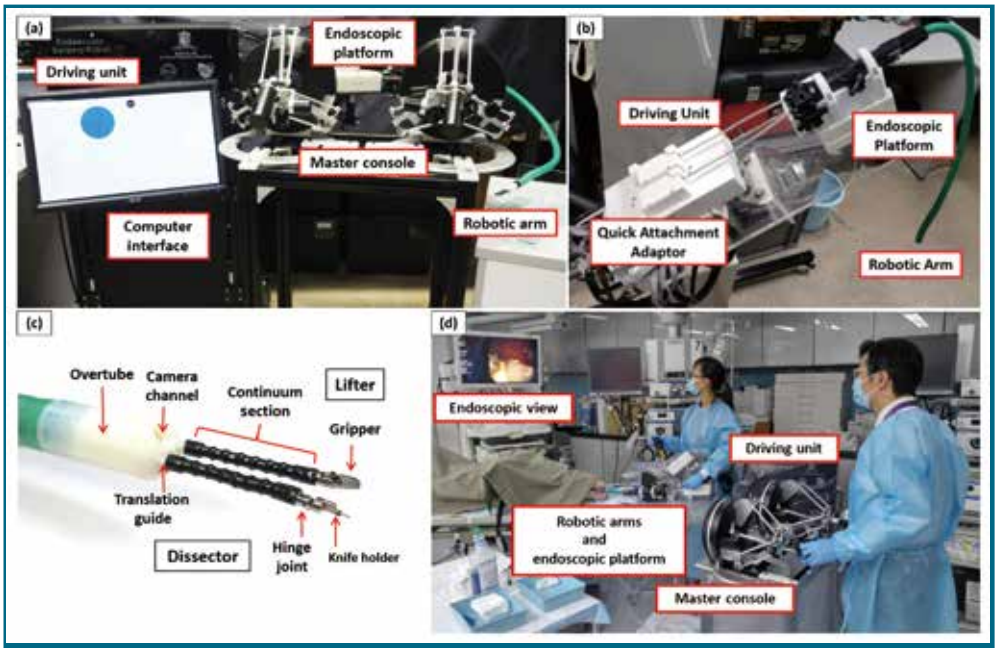

Fig. 4. Endoscopic surgical robotic system developed by Lau et al. in CUHK. (a) Overview of the endoscopic surgical robotic system. (b) Overview of the driving unit. (c) Overview of the robot arms. (d) Experimental setup of the in-vivo experiment. (Adapted from reference[34-37])

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Laparoscopic
CHOLECYSTECTOMY

HUA *et al.*
7-10mmHg

STUDY:
1263 patients,
Meta-analysis
Lap. Choecystectomy

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LOW PRESSURE

LANDMAN *et al.*
8mmHg

STUDY:
56 patients at 15mmHg
Renal surgery

HIGHLIGHTED BENEFIT:
STABLE PNEUMO

LEE *et al.*
N/A

STUDY:
200 patients
RARP

HIGHLIGHTED BENEFIT:
SMOKE EVACUATION

BENIFLA *et al.*
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STUDY:
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The Use of Robotics in Urology

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INTRODUCTION

Worldwide, urology is one of the first specialties that has widely adopted robotic surgery. Urological procedures such as robotic radical prostatectomy, robotic radical cystectomy and urinary diversion, and robotic partial nephrectomy are complex in nature, and even up till now, many urologists prefer an open approach as these procedures may be too technically challenging for a conventional laparoscopic approach. In this review paper, we will discuss the utility of robotic systems in the field of urology, and summarise the current evidence of using robotics in these three main urological procedures.

ROBOTIC RADICAL PROSTATECTOMY

Robotic radical prostatectomy is indicated for men with localised prostate cancer[1]. During the procedure, the whole prostate gland is removed together with part of the vas deferens and both seminal vesicles. For patients with low-risk prostate cancer, unilateral or bilateral nerve-sparing is often considered to preserve erectile function[1]. The nerve apron is, in fact, overlying the prostate gland, and one can imagine the nerve-sparing procedure is almost like 'peeling off the skin of a grape'. Since it is such a precise procedure, it is not uncommon to incise into the prostate gland inadvertently, which may increase the risk of a positive surgical margin. The use of robotics and 3D vision certainly makes the whole nerve-sparing procedure a lot easier. Most of the time, the patient's erectile function can be preserved without compromising the oncological outcome.

For patients with intermediate- and high-risk prostate cancer, bilateral pelvic lymph node dissection is often required[1]. The standard template requires the removal of obturator and external iliac lymph nodes. The use of robotics allows gentle manipulation of the lymph nodes and easy clipping of the lymphatic channels, and the risk of lymphocele formation can be minimised. The obturator nerve can also be easily identified, and the risk of obturator nerve injury is minimal. The final part of the procedure is to perform a vesico-urethral anastomosis (Fig. 1). As this anastomosis takes place in the deep pelvis, a pure laparoscopic approach, is, by nature, technically challenging. The use of robotics has made this step easy, efficient and much more generalisable. With a water-tight vesico-urethral anastomosis, the urinary catheter can usually be removed on post-operative day 7.

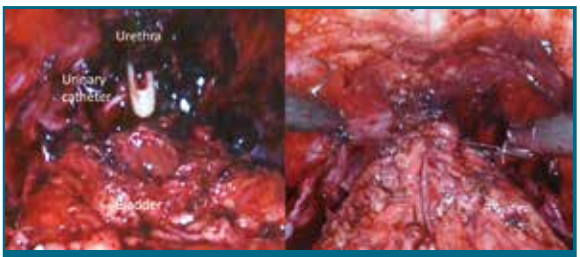

Fig. 1. Robotic radical prostatectomy with vesico-urethral anastomosis (Personal collection)

Carbonara et al. conducted a meta-analysis including 16 randomised trials comparing robotic radical prostatectomy with laparoscopic radical prostatectomy[2]. A total of 13,752 patients were included, and the authors found that robotic radical prostatectomy was associated with a lower biochemical recurrence rate at one year (OR 0.52, 95% CI 0.43-0.63, p<0.001). Robotic radical prostatectomy was also associated with a lower urinary incontinence rate at one year (OR 0.38, 95% CI 0.18-0.80, p=0.01) and a higher erectile function recovery rate at one year (OR 2.16, 95% CI 1.23-3.78, p=0.007). No significant difference in overall and major complication rates was detected between the two groups.

The use of a robotic system also allows newer approaches to radical prostatectomy to be performed. One of the more promising approaches that has gained increasing interest is Retzius-sparing radical prostatectomy. Instead of dropping the bladder and excising the prostate gland in an anterior approach, the Retzius-sparing approach is a totally posterior approach where the peritoneum and bladder remain attached to the anterior abdominal wall throughout the whole surgery. The idea is to cause minimal disruption to the structures around the prostate and bladder area, aiming to preserve maximal urinary continence. A randomised study on 120 low- to intermediate-risk prostate cancer patients comparing the Retzius-sparing approach with the anterior approach was conducted[3]. The study showed that the Retzius-sparing approach resulted in higher continence rates at one week after urinary catheter removal (Retzius-sparing approach group: 71%, Anterior approach group: 48%, p=0.001). A propensity-score matched study in Hong Kong also showed a higher continence rate in patients who received Retzius-sparing robotic radical prostatectomy when compared to patients who received conventional robotic radical prostatectomy[4]. This procedure is, however, technically challenging and requires a significant learning curve.

ROBOTIC RADICAL CYSTECTOMY AND URINARY DIVERSION

Robotic radical cystectomy is indicated for patients with localised muscle-invasive bladder cancer, and patients with BCG-unresponsive non-muscle-invasive bladder cancer[5,6]. In male patients, radical cystectomy includes the removal of the bladder, the prostate gland and the seminal vesicles. In female patients, radical cystectomy includes the removal of the bladder, the uterus, bilateral ovaries and the anterior vaginal wall. In patients with urethral involvement, a concomitant urethrectomy is also needed[5,6]. As muscle-invasive bladder cancer is often large and bulky, the use of a robotic system makes radical cystectomy a much easier procedure with a good retraction of the bladder using the robotic arm and a good visualisation of the deep pelvis with the 3D vision. Bilateral pelvic lymph node dissection is performed up to the common iliac vessels, and in advanced cases, it can even be performed up to the aortic bifurcation. A precise clipping of the lymphatic channels is needed to minimise drain output and expedite the patient's recovery. Next, we need to proceed with urinary diversion, and the two main types of urinary diversion are ileal conduit and neobladder. The ileal conduit is a simpler procedure with less complications, but the patient needs to accept the presence of a stoma and learn how to take care of it. For the neobladder, the patient does not need a stoma, but it is a much more complicated procedure requiring longer recovery time. Patients also need good renal function and to learn how to perform self-catheterisation when neobladder is contemplated. Traditionally, urinary diversion is performed in an open manner due to its complexity. Nowadays, the use of a robotic system allows the bowel preparation and the bowel anastomosis to be performed intracorporeally (i.e. totally within the abdominal cavity) (Fig. 2). A fast and efficient procedure with minimal bowel manipulation is the key to avoiding post-operative ileus and enhancing recovery. In particular, the whole bladder specimen can be removed transvaginally in female patients. With intracorporeal urinary diversion, only several port site wounds are needed for such a complex surgery. Therefore, wound pain is minimal, which can further expedite the patient's recovery after the procedure.

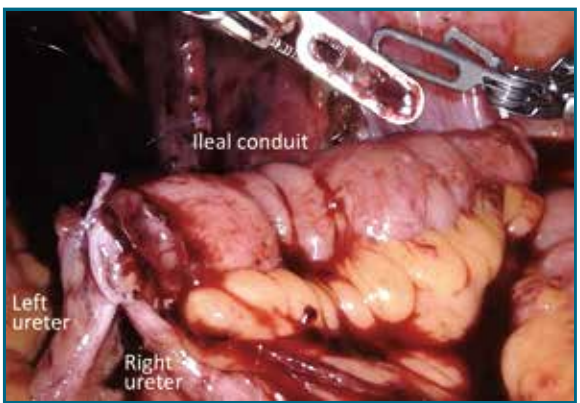

Fig. 2. Robotic radical cystectomy with urinary diversion and uretero-ileal anastomosis performed intracorporeally (Personal collection)

In a meta-analysis comparing robotic versus open radical cystectomy[7], the authors found that robotic radical cystectomy was safe to perform without any increase in major complications. In addition, the robotic approach was associated with lower rates of blood transfusion. The Asian Robot-Assisted Radical Cystectomy Consortium further investigated the peri-operative outcomes of robotic radical cystectomy with intracorporeal versus extracorporeal urinary diversion[8]. A total of 556 patients were included, and the authors found that patients undergoing intracorporeal urinary diversion had less estimated blood loss (423.1 ± 361.1 vs. 541.3 ± 474.3 mL, p=0.002) and a shorter hospital stay (15.7 ± 12.3 vs. 17.8 ± 11.6 days, p = 0.042) than the extracorporeal urinary diversion group[8]. Complications rates were similar between the two groups. Therefore, robotic radical cystectomy has become the standard of care in many expert centres globally. On the other hand, despite all the benefits, robotic radical cystectomy with intracorporeal urinary diversion is a highly technical procedure, and a significant learning curve is expected upon the adoption of the surgical technique.

ROBOTIC PARTIAL NEPHRECTOMY

In the past, total nephrectomy is often performed regardless of tumour size for patients with kidney tumour. However, a randomised study comparing partial with total radical nephrectomy for patients with solitary renal tumours of ≤ 5 cm found that there was no difference in cancer-specific mortality between the two groups[9]. Nowadays, given the equivalent oncological outcomes, partial nephrectomy is often performed to preserve maximal kidney function as soon as the excision procedure is surgically feasible (Fig. 3)[10]. On the other hand, partial nephrectomy is a technically challenging surgery. During the surgery, the renal artery has to be isolated and temporarily clamped, followed by excision of the kidney tumour and suturing of the kidney defect. The excision and suturing steps have to be precise yet fast and efficient, in order to minimise warm ischemic time and reduce its harmful effects on the remaining normal kidney parenchyma. Suturing is also more secure using the robotic system. Therefore, the use of robotics has gained interest globally, especially for complex renal tumours, which may be too difficult for the conventional laparoscopic approach.

Fig. 3. Robotic partial nephrectomy (Personal collection)

In a meta-analysis comparing robotic with laparoscopic partial nephrectomy[11], it was found that robotic partial nephrectomy was associated with lower rates of open conversion (p=0.02), lower rates of conversion to radical nephrectomy (p<0.001), shorter warm ischaemic time

(p=0.005), smaller change of estimated glomerular filtration rate (p=0.03), and shorter length of hospital stay (p=0.004). Given the advantages, robotic partial nephrectomy has been widely adopted globally. With the advancement in technology and surgical technique, selective clamping of the renal artery branch supplying the kidney tumour has been proposed to control bleeding during excision without compromising the blood supply to the remaining healthy kidney tissue[12]. By doing this, there is maximal preservation of kidney function, and this surgical approach is also termed 'zero-ischaemia' partial nephrectomy. However, pre-operative planning and surgical expertise are extremely important to adopt such approach.

CONCLUSIONS

Robotics have been widely adopted in the field of urology, especially for robotic radical prostatectomy, robotic radical cystectomy and urinary diversion, and robotic partial nephrectomy. Current evidence generally favours the robotic approach in terms of its safety, technical feasibility, and improvement in peri-operative and functional outcomes. With adequate training and education, learning curves of robotic procedures can be overcome, and more patients with urological cancers can benefit from such minimally invasive surgeries.

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Dermatology Quiz

Dr Chi-keung KWAN

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Specialist in Dermatology and Venereology

Dr Chi-keung KWAN

Fig. 1. Pale brown hairy patch on the chest wall

This 18-year-old gentleman complained of a brownish hairy patch over his right chest wall. The lesion was asymptomatic. He forgot the duration and onset and was just told by his parents that the lesion had occurred since he was in primary school. Physical examination reviewed a tan to pale brown hairy patch over the right upper chest wall (Fig. 1). There was no ulcer or erosion on the lesion.

Questions

1. What is the diagnosis of the skin lesion?
2. What are the underlying causes?
3. How do you manage this gentleman?

(See P.36 for answers)

Scuba Diving

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Dr Shannon M CHAN

Scuba diving has always been my favourite recreational sport. The sheer majesty and serenity of the ocean appeals to me. The moment you take the great stride off the boat, you are submerged into a completely different world, an utterly silent and often eerie world, that is so full of life. The moment you jump off the boat, you leave your worries behind. All you can hear is your own breathing and the swimming of the creatures around you. I find this very calming and fascinating.

Under the water, all that matters is you and your dive buddy: pointing things out, covering each other's backs and communicating without saying a word. Scuba diving is also mostly a weightless experience. When diving, you essentially merge with the ocean and allow the currents to carry you forward. While diving, the body is practically lightweight, cradled effortlessly by the calming waves.

My favourite underwater creature is the giant oceanic manta ray. Some can grow up to 22 feet wide. These underwater giants are peaceful creatures who feed on plankton and shrimps. They are also very agile. It is difficult to describe the gracefulness of their movements, in how they flap their radial fins like the wings of a bird gliding across the sky, while doing amazing pirouettes, somersaults and jumps in the air. I once had the experience of swimming against the current underwater (not intentional at all!) alongside a manta ray. While I was struggling frantically to hold on to the corals, this beautiful creature gently flapped its wings as it hovered effortlessly in the current.

Night diving is also another fascinating and mysterious experience. Night dives are always full of surprises, even with the same site you dived in the morning. It is because many reef animals sleep during the day and only come out at night, like octopuses, crabs, shrimps, lobsters, and even sharks. You will discover that many sea creatures are hidden in plain sight! How these sea creatures camouflage into their environment is absolutely amazing!

So far, I have only been diving in the Indo-Pacific Ocean. The top two on my bucket list for diving are the Galapagos Islands in Ecuador, and to chase after the Sardine Run that starts at South Africa Agulhas Bank and continues as far north as the Mozambique's coastline. These two would be the most epic dives ever!

After immersing oneself in nature, you will understand how minute human beings are in this world. It is indeed a humbling experience and excellent as a stress buster!

Fig. 1. Octopus hidden under the seabed, completely blended into the surrounding, only revealing its eyes. (Personal Collection)

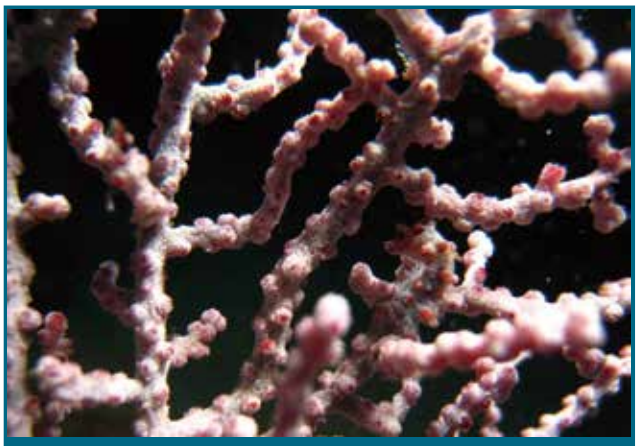

Fig. 2. Well-camouflaged pygmy seahorse on a gorgonian coral. Try to find it in the picture! (Personal Collection)

Fig. 3. Small white crab camouflaged in the soft corals. (Personal Collection)

Fig. 4. Oceanic manta ray(Personal Collection)

Fig. 5. Blue corner in Palau, the habitat of grey reef sharks, white and black tip sharks (Personal Collection)

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7	8	★Certificate Course on Medical Ultrasound 2023 (Video Lectures) 9	★The Hong Kong Neurosurgical Society Monthly Academic Meeting –To be confirmed ★In-person / Zoom Live Common health problems amongst middle age – Topic: Weight management & Metabolic & Bariatric Surgery 10	★Zoom Live New Horizon of Psoriatic Disease Management ★Certificate Course on Communication and Swallowing Problems in the Elderly Population 2023 (Video Lectures) 11	★Zoom Live Role of Imiquimod in the Management of Actinic Keratoses (AK) and Superficial Basal Cell Carcinomas (sBCC) 12	13
14	★Zoom Live IBS and overlapping FGID symptoms 15	★In-person / Zoom Live HKMA-GHK CME Programme 2023 - Interventional Radiology In Primary Healthcare 16	17	★In-person Practical Updates in Osteoporosis Management in Primary Care Setting ★The Modern-era Precision Medicine on Lung and Breast Cancer Treatment ★Certificate Course on Communication and Swallowing Problems in the Elderly Population 2023 (Video Lectures) ★FMSHK Executive Committee Meeting ★FMSHK Council Meeting 18	★Zoom Live Optimizing the Management of Refractory Angina 19	20
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28	29	★Certificate Course on Update on Common Urinary Tract Disorders 2023 (Video Lectures) 30	★In-person Personalized Prostate Health Assessment and Treatment ★Zoom Live Recent Advancement of Gut Microbiome Research and its Applications in COVID-19 Recovery and Preventing Long COVID 31			

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Certificate Course on

Mental Health 2023

(Video Lectures)

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Objectives:

This course aims to introduce to the allied health professionals and Registered / Enrolled Nurses (General) on the aetiology, course, and management of common psychiatric disorders in Hong Kong. Each topic will be delivered by a specialist psychiatrist who has extensive clinical expertise and academic knowledge in that particular area. After the course, the participants will have better understanding about the course, nature and current evidence-based treatments of various common psychiatric disorders. The course will be suitable for allied health professionals and Registered / Enrolled Nurses (General) working in mental health fields, general hospital settings, as well as social care settings in the community.

Date	Topics	Speakers
21 June 2023	Anxiety and phobias	Dr John SO Specialist in Psychiatry
28 June 2023	Dementia	Dr Calvin PW CHENG Specialist in Psychiatry
5 July 2023	Insomnia and management of sleep disorders	Dr Chi-lun LAI Specialist in Psychiatry
12 July 2023	Common psychiatric disorders in children and adolescents	Dr Nga-lei HO Specialist in Psychiatry
19 July 2023	Psychosocial approaches in psychiatry	Dr Rommel CH HUNG Specialist in Psychiatry
26 July 2023	Psychosis	Dr Chun LAM Specialist in Psychiatry

Date : 21,28 June & 5, 12, 19, 26 July 2023(Wednesday)
Duration of Session : 1.5 hours (6 sessions)
Time : 7:00 pm – 8:30 pm
Course Feature: Video lectures (with Q&A platform for participants to post the questions)
Quiz for doctors: DOCTORS are required to complete a quiz after the completion of each lecture
Language Media : Cantonese (Supplemented with English)
Course Fee : HK$1,000
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Enquiry : The Secretariat of The Federation of Medical Societies of Hong Kong
Tel.: 2527 8898 Fax : 2865 0345 Email : vienna.lam@fmshk.org

CME / CNE Accreditation in application
Online Application from website: http://www.fmshk.org

Date / Time	Function	Enquiry / Remarks
2 TUE 1:00 PM	**In-person / Zoom Live** **HKMA-HKSH CME Programme 2022-2023** **Topic: Management of Triple Negative Breast Cancer** Organisers: The Hong Kong Medical Association and the Hong Kong Sanatorium & Hospital Speaker: Dr Michael Koon-ming LAM, Venue: HKMA Dr. Li Shu Pui Professional Education Centre, 2/F, Chinese Club Building, 21-22 Connaught Road, Central, Hong Kong	HKMA CME Dept. Tel: 3108 2507 1 CME Point
7:00 PM	**Certificate Course on Medical Ultrasound 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Dr Grace HO	Ms Vienna LAM Tel: 2527 8898
4 THU 2:00 PM	**Zoom Live** **Treating Hypertension or Treating Patient?** Organiser: HKMA-HK East Community Network Speaker: Dr TANG King-fun	Ms Candice TONG Tel: 3108 2513 1 CME Point
7:00 PM	**Certificate Course on Communication and Swallowing Problems in the Elderly Population 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Prof Anthony Pak-hin KONG	Ms Vienna LAM Tel: 2527 8898
5 FRI 2:00 PM	**Zoom Live** **Approach to Numbness** Organiser: HKMA-YTM Community Network Speaker: Dr. LEE Chi-nam	Ms Candice TONG Tel: 3108 2513 1 CME Point
9 TUE 7:00 PM	**Certificate Course on Medical Ultrasound 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Dr LEUNG Kwok-yin	Ms Vienna LAM Tel: 2527 8898
10 WED 7:30 AM	**The Hong Kong Neurosurgical Society Monthly Academic Meeting –To be confirmed** Organizer: Hong Kong Neurosurgical Society Speaker(s): Dr Ben Kin-long LUK Chairman: Dr WONG Sui-to Venue: Conference Room, F2, Department of Neurosurgery, Queen Elizabeth Hospital; or via Zoom meeting	Dr Calvin MAK Tel: 2595 6456 Fax. No.: 2965 4061 1.5 points College of Surgeons of Hong Kong
1:00 PM	**In-person / Zoom Live** **Common health problems amongst middle age – Topic: Weight management & Metabolic & Bariatric Surgery** Organisers: The Hong Kong Medical Association and the CUHK-Medical Centre Speaker: Dr Simon Kin-hung WONG Venue: HKMA Dr. Li Shu Pui Professional Education Centre, 2/F, Chinese Club Building, 21-22 Connaught Road, Central, Hong Kong	HKMA CME Dept. Tel: 3108 2507 1 CME Point
11 THU 2:00 PM	**Zoom Live** **New Horizon of Psoriatic Disease Management** Organiser: The Hong Kong Medical Association Speaker: Dr Davis Yung CHAN	HKMA CME Dept. Tel: 3108 2507 1 CME Point
7:00 PM	**Certificate Course on Communication and Swallowing Problems in the Elderly Population 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Dr Raymond FONG	Ms Vienna LAM Tel: 2527 8898
12 FRI 2:00 PM	**Zoom Live** **Role of Imiquimod in the Management of Actinic Keratoses (AK) and Superficial Basal Cell Carcinomas (sBCC)** Organiser: HKMA-KLN West Community Network Speaker: Dr Davis Yung CHAN	Mr Peter HO Tel: 3108 2514 1 CME Point
15 MON 2:00 PM	**Zoom Live** **IBS and overlapping FGID symptoms** Organiser: The Hong Kong Medical Association Speaker: Dr Angeline Oi-shan LO,	HKMA CME Dept. Tel: 3108 2507 1 CME Point
16 TUE 2:00 PM	**In-person / Zoom Live** **HKMA-GHK CME Programme 2023 - Interventional Radiology In Primary Healthcare** Organisers: The Hong Kong Medical Association and the Gleneagles Hong Kong Hospital Speaker: Dr Vince Wing-hang LAU Venue: HKMA Dr. Li Shu Pui Professional Education Centre, 2/F, Chinese Club Building, 21-22 Connaught Road, Central, Hong Kong	HKMA CME Dept Tel: 3108 2507 1 CME Point
18 THU 1:00 PM	**In-person** **Practical Updates in Osteoporosis Management in Primary Care Setting** Organiser: HKMA-New Territories West Community Network Speaker: Dr Julian Lai-lok CHAN Venue: Lei Garden, Shop 1130-1143, 1/F, Phase I, Yoho Mall, Yuen Long, NT	Mr Peter HO Tel: 3108 2514 1 CME Point
2:00 PM	**The Modern-era Precision Medicine on Lung and Breast Cancer Treatment** Organiser: Hong Kong Chinese Medical Association Ltd Speaker: Dr Kenny Kim-pong NG Venue: Paramount Banquet Hall, 12, Mount Sterling, Lai Wan Road, Mei Foo Sun Chuen, Kowloon	Ms. Iris HAU Tel: 2527 8898
7:00 PM	**Certificate Course on Communication and Swallowing Problems in the Elderly Population 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Dr Iris Hoi-yee NG	Ms Vienna LAM Tel: 2527 8898

THE FEDERATION OF MEDICAL SOCIETIES OF HONG KONG
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Date / Time	Function	Enquiry / Remarks
18 THU 7:00 PM	**FMSHK Executive Committee Meeting** Organiser: The Federation of Medical Societies of Hong Kong; Venue: Council Chamber, 4/F, Duke of Windor Social Service Building, 15 Hennessy Road, Wanchai, Hong Kong	Ms Nancy CHAN Tel: 2527 8898
8:00 PM	**FMSHK Council Meeting** Organiser: The Federation of Medical Societies of Hong Kong; Venue: Council Chamber, 4/F, Duke of Windor Social Service Building, 15 Hennessy Road, Wanchai, Hong Kong	Ms Nancy CHAN Tel: 2527 8898
19 FRI 2:00 PM	**Zoom Live** **Optimizing the Management of Refractory Angina** Organiser: HKMA-KLN City Community Network Speaker: Dr Bernard Bun-lap WONG	Ms Candice TONG Tel: 3108 2513 1 CME Point
23 TUE 2:00 PM	**Zoom Live** **Management of Acne Vulgaris with Holistic Skin Care** Organiser: The Hong Kong Medical Association Speaker: Dr HO King-man	HKMA CME Dept. Tel: 3108 2507 1 CME Point
7:00 PM	**Certificate Course on Update on Common Urinary Tract Disorders 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Dr Jason WONG	Ms Vienna LAM Tel: 2527 8898
30 TUE 7:00 PM	**Certificate Course on Update on Common Urinary Tract Disorders 2023 (Video Lectures)** Organiser: The Federation of Medical Societies of Hong Kong Speaker: Dr Bryan CHENG	Ms Vienna LAM Tel: 2527 8898
31 WED 1:00 PM	**In-person** **Personalized Prostate Health Assessment and Treatment** Organiser: HKMA-Shatin Community Network Speaker: Dr Raymond Wai-man KAN, Venue: Ballroom 1, 2/F, Hong Kong Courtyard by Marriot Hong Kong Shatin, 1 On Ping Street, Shatin, NT	Ms Candice TONG Tel: 3108 2513 1 CME Point
2:00 PM	**Zoom Live** **Recent Advancement of Gut Microbiome Research and its Applications in COVID-19 Recovery and Preventing Long COVID** Organiser: The Hong Kong Medical Association Speaker: Prof Martin Chi-sang WONG	HKMA CME Dept. Tel: 3108 2507 1 CME Point

Upcoming Event

23 to 25 June 2023	**HKPCC 2023 "Flourishing Primary Care: Family Doctor for Everyone"** Conference information: https://www.hkpcc.org.hk/ Online registration: https://www.hkpcc.org.hk/registration	HKPCC 2023 Conference Secretariat, The Hong Kong College of Family Physicians E-mail: hkpcc@hkcfp.org.hk Tel: (852) 2871 8899

Answers to Dermatology Quiz

Answers:

1. Becker Naevus (melanosis)
   The diagnosis is Becker naevus or Becker melanosis. The diagnosis is often made by its typical clinical presentation. It is often a large unilateral tan-to-brown patch with hypertrichosis commonly found on the shoulder, upper chest wall or upper arm. Male is more common than female. It is often started before puberty; however, it becomes darker and with more hypertrichosis after puberty starts (Figure 1).

2. The cause of Becker naevus is idiopathic, and there are no well-established risk factors. The exact pathogenesis is also unclear. It is usually a sporadic condition of overgrowth of the epidermis, melanocytes and hair follicles that is manifested in the peri-pubertal period. Its development may be triggered by increasing androgen during puberty, which may explain why it occurs more commonly in males and why it becomes darker and more hairy after puberty.

3. There is no specific treatment for Becker naevus. However, some strategies, such as avoiding sunshine to prevent further pigmentation; camouflage and hair removal by waxing, shaving, epilation cream and laser, can apply if the patient has a cosmetic concern. However, pigment reduction by laser may not always be effective and, may even worsen the pigmentation. In severe cases, Becker naevus may be associated with acne, the latter requiring standard acne treatments, including systemic isotretinoin.

Dr Chi-keung KWAN
MBBS(HK), MRCP(UK), FRCP(Lond, Glasg, Edin), Dip Derm(Glasg), PDipID(HK), FHKCP, FHKAM(Medicine)
Specialist in Dermatology and Venereology

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Reference: 1. molnupiravir US EUA Product Insert.

MOLNUPIRAVIR Selected Safety Information

Authorized Use

1. Molnupiravir is authorized for use under an Emergency Use Authorization (EUA) for the treatment of mild-to-moderate coronavirus disease 2019 (COVID-19) in adults:
   - with positive results of direct SARS-CoV-2 viral testing, and
   - who are at high risk for progression to severe COVID-19, including hospitalization or death, and
   - for whom alternative COVID-19 treatment options approved or authorized by FDA are not accessible or clinically appropriate
2. Molnupiravir is not approved for any use, including the treatment of COVID-19, but is authorized for emergency use by the FDA under an Emergency Use Authorization (EUA).
3. The emergency use of molnupiravir is only authorized for the duration of the declaration that circumstances exist justifying the authorization of the emergency use of drugs and biological products during the COVID-19 pandemic under Section 564(b)(1) of the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. § 360bbb-3(b)(1) unless the declaration is terminated or authorization revoked sooner.

Limitations of Authorized Use

4. Molnupiravir is not authorized:
   - for use in patients who are less than 18 years of age
   - for initiation of treatment in patients hospitalized due to COVID-19. Benefit of treatment with molnupiravir has not been observed in subjects when treatment was initiated after hospitalization due to COVID-19
   - for use for longer than 5 consecutive days
   - or pre-exposure or post-exposure prophylaxis for prevention of COVID-19
5. Molnupiravir may only be prescribed for an individual patient by physicians, advanced practice registered nurses, and physician assistants that are licensed or authorized under state law to prescribe drugs in the therapeutic class to which molnupiravir belongs (i.e., anti-infectives).

Contraindications

6. No contraindications have been identified based on the limited available data on the emergency use of molnupiravir authorized under this EUA.

Warnings and Precautions

7. There are limited clinical data available for molnupiravir. Serious and unexpected adverse events may occur that have not been previously reported with molnupiravir use.
8. Molnupiravir is not recommended for use during pregnancy. Based on findings from animal reproduction studies, molnupiravir may cause fetal harm when administered to pregnant individuals. There are no available human data on the use of molnupiravir in pregnant individuals to evaluate the risk of major birth defects, miscarriage or adverse maternal or fetal outcomes.
9. Molnupiravir is authorized to be prescribed to a pregnant individual only after the healthcare provider has determined that the benefits would outweigh the risks for that individual patient. If the decision is made to use molnupiravir during pregnancy, the prescribing healthcare provider must document that the known and potential benefits and the potential risks of using molnupiravir during pregnancy were communicated to the pregnant individual.
10. Advise individuals of childbearing potential of the potential risk to a fetus and to use an effective method of contraception correctly and consistently during treatment with molnupiravir and for 4 days after the final dose.
11. Prior to initiating treatment with molnupiravir, assess whether an individual of childbearing potential is pregnant or not, if clinically indicated.
12. Hypersensitivity reactions, including anaphylaxis, have been reported with molnupiravir. If signs and symptoms of a clinically significant hypersensitivity reaction or anaphylaxis occur, immediately discontinue molnupiravir and initiate appropriate medications and/or supportive care.
13. Molnupiravir is not authorized for use in patients less than 18 years of age because it may affect bone and cartilage growth. The safety and efficacy of molnupiravir have not been established in pediatric patients.

Adverse Reactions

14. The most common adverse reactions occurring in ≥1% of subjects in the molnupiravir treatment group in the Phase 3 double-blind MOVe-OUT study were diarrhea (2% versus placebo at 2%),nausea (1% versus placebo at 1%), and dizziness (1% versus placebo at 1%) all of which were Grade 1 (mild) or Grade 2 (moderate).
    Serious adverse events occurred in 7% of subjects receiving molnupiravir and 10% receiving placebo; most serious adverse events were COVID-19 related. Adverse events leading to death occurred in 2 (<1%) of the subjects receiving molnupiravir and 12 (2%) of subjects receiving placebo.

Drug Interactions

15. No drug interactions have been identified based on the limited available data on the emergency use of molnupiravir. No clinical drug-drug interaction trials of molnupiravir with concomitant medications, including other treatments for mild to moderate COVID-19, have been conducted.

Breastfeeding

16. There are no data on the presence of molnupiravir or its metabolites in human milk. It is unknown whether molnupiravir has an effect on the breastfed infant or effects on milk production. Based on the potential for adverse reactions in the infant from molnupiravir, breastfeeding is not recommended during treatment with molnupiravir and for 4 days after the final dose. A lactating individual may consider interrupting breastfeeding and may consider pumping and discarding breast milk during treatment and for 4 days after the last dose of molnupiravir.

Males of Reproductive Potential

17. Nonclinical studies to fully assess the potential for molnupiravir to affect offspring of treated males have not been completed. Advise sexually active individuals with partners of childbearing potential to use a reliable method of contraception correctly and consistently during treatment and for at least 3 months after the last dose of molnupiravir. The risk beyond three months after the last dose of molnupiravir is unknown.

Before prescribing, please consult the full prescribing information.

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