Minimal Pain, Maximum Gain

Advances in the Surgical Treatment of Liver Cancers

Hepatitis is a global public health challenge, with a recent study from the World Health Organization (WHO) revealing that the disease contributes to the highest number of deaths globally (around 1.3 million deaths a year) compared to major infectious diseases like AIDS, tuberculosis and malaria.

Hepatitis A, B, C and E are all endemic in Singapore. Hepatitis B, a serious liver infection, is often dubbed as the "Silent Killer" as it is usually diagnosed in the later stages, when patients start seeking medical help for advanced liver problems. Nearly 4% of the adult population in Singapore are hepatitis B carriers, but many are unaware of their condition.

If a patient's immune system is unable to clear a hepatitis B infection within six months, it can lead to chronic hepatitis B (permanent liver inflammation). Over time, serious complications can include liver cirrhosis (permanent liver scarring and shrinking), liver failure and liver cancer (hepatocellular carcinoma).

The WHO estimates that 71 million people worldwide have chronic hepatitis C. In Singapore, the prevalence of hepatitis C is less than 1% of the population. Like hepatitis B, most individuals with hepatitis C are unaware that they are infected because they have no symptoms. Most hepatitis C-infected individuals (> 70%) end up with chronic hepatitis C. Hepatitis C can also result in chronic liver inflammation and eventual liver failure. It is also a major risk factor for liver cancer (hepatocellular carcinoma).

Thankfully, new anti-viral medications are very effective, with a cure rate of more than 95% for hepatitis C. Even then, early diagnosis and treatment of hepatitis C is crucial to avoid the potentially life-threatening complications that can result from chronic infection. Hepatitis B and C cause up to 70% of liver cancers locally. In fact, hepatitis B and C carriers are about 100 times more likely to develop liver cancer than non-carriers. Liver cancer is the fourth most common cancer in men in Singapore.

TREATMENT OF LIVER CANCER

Treatment of liver cancer (hepatocellular carcinoma) has improved significantly over the past few years. Treatment options depend on many factors, such as the patient's age, his/her general and liver's health, the location and extent of the tumour, and the tumour's behaviour (biology). Generally, surgery, loco-regional therapy, systemic therapy and radiation therapy are the main methods of liver cancer treatment. For early cancers, surgery provides the best chance of a cure and when appropriate, should always be considered upfront.

Surgery is the treatment of choice for liver cancer, where possible. All other methods have not been shown to be as effective as surgery. However, as liver cancer is often associated with liver damage, surgery for liver cancer is not always safe for some patients. Liver transplantation, in selected cases, is another surgical option for curative treatment.

ADVANCES IN SURGICAL TREATMENT OF LIVER CANCERS

Minimally invasive liver surgery is probably the most significant step in the advancement of liver cancer surgical treatment in recent years. Early concerns regarding the safety of minimally invasive techniques for complex surgery, such as liver resections, have been laid to rest with growing experience and technological advances. There is now well-established clinical evidence to show that when patients are well selected, the long-term results are as good, if not better than "traditional" open surgery. In addition, there are significant short-term benefits such as reduced pain, shorter hospital stay and faster recovery after surgery.

As an additional tool to laparoscopic surgery, one of the most exciting advancements is in the field of robotic surgery. The most utilised robotic platform in liver surgery is the Intuitive Surgical da Vinci surgical system. The term "robotic" is misleading. The robot does not perform surgery, but it translates the surgeon's hand movements at the console in real time, bending and rotating tiny wristed instruments akin to that of a human hand, but with a greater range of motion and ability. The current 4th generation is increasingly finding its role in liver surgery.

Figure 1: Dr Lee and the surgical team wearing 3D glasses performing a laparoscopic major liver resection in Mount Elizabeth Hospital, utilising a 3D flexible tip camera and High-Definition (HD) monitors.

Surgical techniques have also improved to allow complex resections to remove the cancer according to its anatomical segment and blood supply. This approach maximises margins and minimises recurrence, while preserving as much healthy liver as possible.

Pre-surgery planning has also improved by leaps and bounds, with the advent of 3-Dimensional (3D) reconstruction of the scan images. Virtual reality simulation has also provided surgeons with the ability to "imagine" the tumour and associated crucial structures around it in augmented reality to better plan the surgery.

Inside the operating theatre, new laparoscopic cameras and the surgical robotic system (da-Vinci system) with its high definition (4K, 8K) visuals, 3D cameras and monitor screens provide a sharp and magnified view with improved perception of depth (see Figure 1). These are especially helpful as liver anatomy is complex with many small but critical structures such as blood vessels and bile ducts. New cameras can even flex to see around corners and structures to provide the optimal view.

Image-guided surgery has also been introduced to aid surgeons in the operating room. Using fluorescent dye

> Early detection, surveillance and treatment of Hepatitis B and C is important to prevent progression to irreversible liver damage and liver cancer. Early treatment is also the most effective and provides a chance of cure.

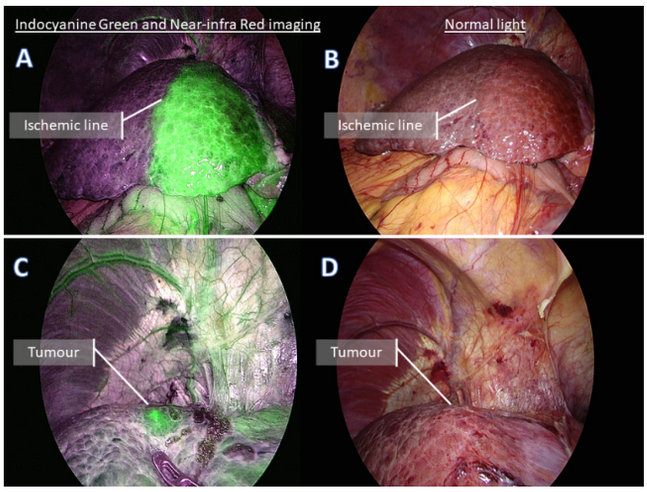

Figure 2: Near-infrared (A, C) and normal light imaging (B, D). A, B - Visualization of the resection line to guide the surgery after occluding the blood supply to the left side of the liver and administration of ICG. (A - Near-infrared imaging; B - Normal light). C, D - Tumour localization with the aid of ICG (C), tumour not well seen on Normal light (D).

(e.g. Indocyanine Green) and specialised cameras such as near-infrared imaging, surgeons can now identify tumours and resection planes more accurately as the tumour or the healthy remnant liver will "glow" (see Figure 2). When used in adjunct with traditional methods such as intra-operative ultrasound, this method makes surgery safer and more precise. I introduced this technique in Singapore a few years ago and published the first series here, demonstrating its role and safety. Another emerging field is in surgical navigation. This technology allows surgeons to precisely track their approach, instrument positions and their projection onto pre-operative imaging data in real time. This sophisticated technology is akin to GPS tracking, which allows drivers to see their position on a map (see Figure 3).

ENHANCED RECOVERY PROGRAMMES

As part of efforts to improve our patients' recovery, significant strides have been taken to give our patients a head-start in their journey to recovery by implementing programmes and protocols before, during and after surgery.

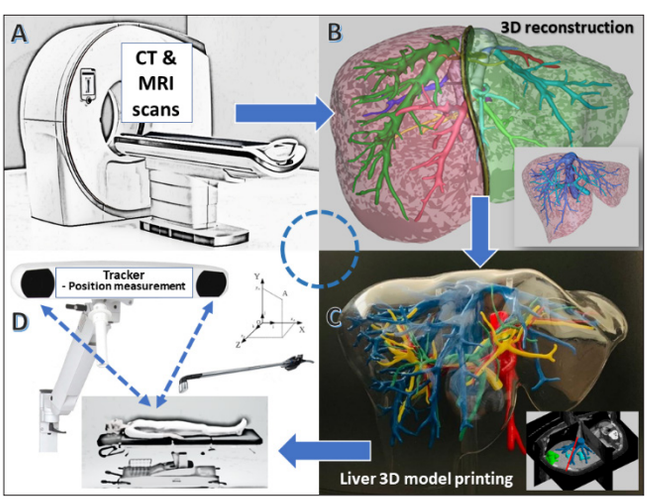

Figure 3: Advances in pre- and intra-operative surgical planning for liver surgery. A - Pre-operative high resolution cross sectioning imaging. B - 3D reconstruction of the pre-operative scans. C - 3D printing of liver model based on CT/MRI scans. D - Intra-operative surgical navigation tracking.

Examples include pre-surgery nutritional optimisation with diet supplementation, chest physiotherapy and breathing exercises, judicious fluid balance management in the operating room to early eating, ambulation, and rehabilitation after surgery. When these measures are implemented with the help of our allied health professionals and specialist nurses, alongside minimally invasive surgical techniques causing less "trauma" to the body's physiology, we have successfully reduced the length of stay, post-operative complications and by extension, hospital costs significantly.

OTHER NON-SURGICAL TREATMENT OF LIVER CANCERS

Other treatment methods may be offered in combination with a surgical strategy or when surgery is not appropriate. These can be classified as locoregional or systemic therapy. Some of the above treatments may be used in combination or staged to achieve optimal outcomes. There are also encouraging results in the field of immunotherapy in the battle against advanced liver cancers.

The multitude of treatment options available suggest that there is no single best method for every situation. Patients should discuss these options with a liver cancer specialist who will explain the role of each approach. The best treatment strategy is well-served via a multi-disciplinary team approach, with a thoughtful balance of the associated risks and benefits. It should be personalized to each individual.

There continues to be exciting and promising advances in the treatment of hepatitis, surgery for liver cancer as well as in the field of immunotherapy. We look forward with hope. PRIME

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Dr Lee specializes in Hepatopancreatobiliary surgery (HPB), Liver transplantation and Minimally-Invasive Surgery (MIS). His area of expertise lies in minimally invasive techniques such as laparoscopic and robotic surgery in the treatment of liver, gallbladder and pancreas diseases, and cancers. Prior to private practice, he was a founding member and Senior Consultant at the Department of Hepatopancreatobiliary (HPB) and Transplant Surgery at Singapore General Hospital (SGH). He served as the Director of the Laparoscopic program and the Director of the Surgical Skills Training Program, and the SingHealth Surgical Skills Centre. He started his medical training at the National University of Singapore in 1996, and completed his training in General Surgery, HPB surgery and Liver Transplantation at SGH and National Cancer Centre, Singapore. He also completed dual USA fellowships in Advanced Laparoscopic HPB surgery and Liver Transplantation under Professor Daniel Cherqui at the New York Presbyterian Hospital-Weill Cornell Medical Center and a Complex Surgical Oncology clinical fellowship at Memorial Sloan Kettering Cancer Center in New York.