EDITORIAL

James Cantlie's early messages for hepatic surgeons: how the concept of pre-operative portal vein occlusion was defined

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Abstract

In 1897, James Cantlie from Scotland published his findings of an autopsy on a patient in which the right side of the liver was atrophied whereas the left side of the liver showed a marked hypertrophy. He noted the hepatic vessels to the atrophied side to be obliterated. From this observation, he drew two important conclusions. First, that the transition of the atrophied part to the hypertrophied part defined the anatomical mid-line of the liver, according to the portal division of blood supply to the liver. This line we now know as Cantlie’s line which he described connecting the fundus of the gallbladder with the centre of the inferior vena cava. Second, he foresaw that the potential of one half of the liver to hypertrophy when the other half is deprived of its blood supply, could be used to the advantage of hepatic resection. It would take another 85 years, however, before the first clinical, pre-operative portal vein embolization was carried out in Japan in 1982.

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As early as 1897, Sir James Cantlie published a series of observations of extraordinary significance in the face of how we now look upon portal blood supply and the pre-resectional use of portal vein ligation or embolization to induce hypertrophy of the part of the liver we intend to preserve. In the Proceedings of the Anatomical Society of Great Britain and Ireland, he describes performing an autopsy on a patient in which the right side of the liver was reduced to a mass of fibrotic tissue whereas the left side of the liver showed a marked hypertrophy.1 He noted ‘the hypertrophy of the left side joined with the atrophied right side, at a line drawn through the fundus of the gallbladder to the center of the inferior vena cava at the back of the liver’. He assumed that an abscess had destructed the right lobe of the liver, and that this resulted in a compensatory hypertrophy of the contralateral part of the liver. Hence, he concluded that the line connecting the fundus of the gallbladder with the centre of the inferior vena cava indicated the mid-line of the liver, unlike common opinion at that time which considered the umbilical fissure as the division of the right and left liver lobes.

He corroborated his observations by performing experiments in which he injected the right and left divisions of the portal vein with coloured dyes showing that the injected areas met along a line connecting ‘the fundus of the gallbladder’ with ‘the spot where the inferior vena cava grooves the back of the liver’. This line we still refer to as Cantlie’s line (Fig. 1) indicating the anatomical mid-line of the liver and defining the border between the right and left liver segments in the plane of the middle hepatic vein. As he realized that the right and left liver were perfused by two separate streams of the portal vein, he recognized the potential this phenomenon could have for hepatic surgery.

He perceived the consequences the watershed between the right and left liver lobes could have for trauma of the liver by writing ‘The liver, when split or fissured by a blow, as between the buffers of railway-carriages, splits along the mid-line of the liver in preference to any other’. He also foresaw that this would not necessarily result in major bleeding as ‘haemorrhage has less to be dreaded as the liver is incised or torn in the neighborhood of that line (i.e the mid-line)’. Indeed in blunt abdominal trauma, the liver may be completely fractured along Cantlie’s line without any major bleeding from that plane. We were able to confirm this message recently in a patient admitted after blunt abdominal trauma who had fractured his liver along Cantlie’s line (Fig. 2) and who had been successfully managed by conservative treatment without the need for any blood transfusion.2

*All phrases shown in italics are quoted from reference 1.
Coming back to his initial observation at the autopsy, he noted the ‘almost elephantine’ hypertrophy of the left side of the liver at the expense of a greatly atrophied right side ‘which looked like, and practically was, a mere appendage to the left side of the organ’. On dissection of the liver he found the veins, artery and duct of the right side of the liver to be obliterated whereas those to the left side were proportionally increased in diameter. From this observation he conceived that by eliminating blood supply to one side of the liver, a functional advantage for the spared half of the liver could be created resulting in hypertrophy of that part of the liver. He then wrote ‘It is theoretically possible to tie the vessels of one side at the gate of the liver, supplying an abnormal growth in one or other of the liver lobes, leaving the other side to do the work’. Realizing the importance this phenomenon could have for resecting the liver, he continued ‘I commend this subject to all those who are working at the surgery of the liver; and I believe that if, in the hands of future observers, the statements I have made receive closer investigation, the surgery of the liver will be advanced a step’. The foresight he had was amazing, with the first formal right hemihepatectomy being performed 55 years later in Beaujon Hospital in Paris and the first clinical portal vein embolization being performed in Japan 85 years after his report.

Sir James Cantlie (Fig. 3) was born in 1851 in Banffshire, Scotland. After finishing his medical studies at Aberdeen University, he trained as a surgeon at Charing Cross Hospital in London. He became a fellow of the Royal College of Surgeons in 1877 and went on to work as a surgeon at Charing Cross. Interestingly, in 1887 he moved to Hong Kong where he became a co-founder of a new medical school, the Hong Kong College of Medicine for Chinese, the forerunner of the Faculty of Medicine of the University of Hong Kong. In this institution, of which he led the surgical department, Cantlie carried out the autopsy described above. One of his students was SunYat Sen who would later become the first provisional president of the Republic of China. When this Chinese leader was detained at the Chinese Legation in London in 1896, Cantlie played a key role in his release. In 1897 Cantlie returned to practice in London.

The division of the portal vein into a right and left branch at the liver hilum was already reported by the anatomists of the 17th century. Francis Glisson (1598–1677) in his textbook Anatomia Hepatis described cannulating the portal vein and making casts of the portal venous system. Cantlie, however, showed that by the separate portal vasculature, the liver could be functionally divided into an anatomically distinct right and left half. The potential of one half of the liver to hypertrophy when the other half is deprived of its blood supply was further confirmed in experimental studies.
by Rous and Larimore in 1920⁵ and Schalm and colleagues in 1956.⁶ The latter authors from Arnhem, the Netherlands, made reference to Cantlie’s work and ideas on unilateral occlusion of the portal vein. Surprisingly, portal vein occlusion found its way to clinical application only in 1982, when Makuuchi and later, Kinoshita, published their first experiences with portal vein embolization in patients.⁷ Hence, although the credit for the first clinical portal vein occlusions goes to these colleagues in Japan, it should be remembered that in 1897, James Cantlie from Scotland had already laid down the concept of pre-operative portal vein occlusion.

Conflicts of interest
None declared

References