



THE LEARNING CURVE IN SURGERY

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Opinion

From an early age onwards, we are exploring, investigating and discovering. We are learning. Then we go to primary school, secondary school and sometimes eventually enrol in university or college. During all these diverse phases of our lives, we continue to learn. The learning process does not stop there, especially in the (bio)medical field. Obviously, this learning process is often accompanied by trial and error, and that is no different in the surgical field. The performance of a surgeon tends to improve with experience, as described by the theory of the learning curve. But what does this learning curve entail? What are the consequences for surgeons, patients, and the implication of new surgical techniques?

The learning curve was first described in the field of aviation. An aeronautical engineer noticed that the efficiency of aeroplane production increased together with experience within a workforce, while the production costs decreased. Later on, a similar phenomenon was described and studied in many medical specialities. As many of the most severe complications occur in the field of surgery, research on the learning curve of surgeons is highly appreciated [1].

The focus of the assessment of the learning curve within surgical procedures is in most cases a minimal access technique (in which one or more small incisions are made instead of a large incision), such as laparoscopic cholecystectomy or hernia repair. Many different learning related parameters are measured here. There is also discussion about what is a strong proxy for learning and what is a weak proxy and cannot relate to the proficiency of a surgeon. Measurements of learning related to a certain surgical technique can be divided into two categories: measures of the surgical process and measures related to patient outcome. Operative time, radicality of tumour resection and haemorrhage during surgery are some examples of surgical process parameters. Patient outcomes are more often postoperative, such as (long-term) survival, length of hospital stay and postoperative infections. For every surgical technique, different measurements of learning are studied to estimate the course of the learning curve [2].

The surgical learning curve nowadays is different from the learning curve that was depicted years ago. In the past, the introduction of a new surgical technique was limited. If a new technique was introduced, it often was very different from the previously used technique and it led to a substantial difference in effectiveness (Figure 1). The learning curve was often small while effectiveness was reached over a short period of time. Over time the complexity of surgical interventions has drastically increased. A more complex technique has led to longer learning curves (Figure 2). On top of that, new surgical techniques are implemented at a much higher rate and the effectiveness of the new interventions have become smaller. The increased complexity also increased the learning associated morbidity, since it takes more time and more practice to reach proficiency level.

It is stated that, in patients who are operated on early after implementation of a new technique, there might be an increased risk of associated morbidity. Highly relevant is the morbidity that is associated with completing the learning curve. Multiple studies recommend that new surgical techniques should be closely monitored because often there is a high learning associated morbidity [3,4]. It is still a point of discussion on how this morbidity can be decreased. It is thought that a better and

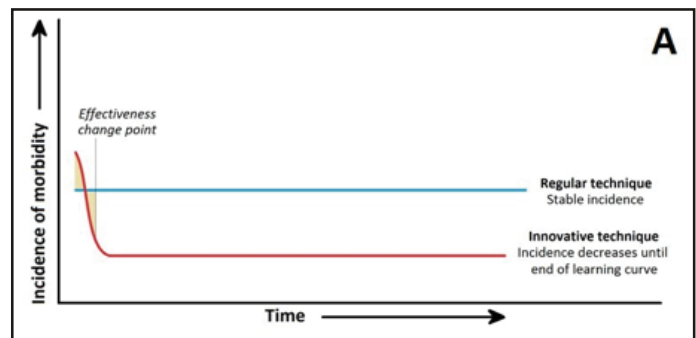


Figure 1: The learning curve as pictured over the last years. This learning curve is short and has a large post-proficiency difference in effectiveness, which means the new technique was effective after only a small period of time.

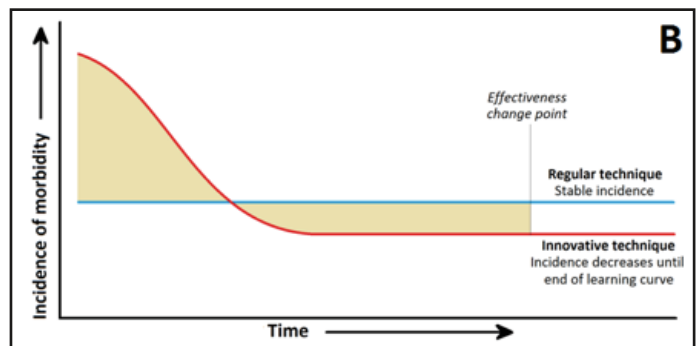


Figure 2: The learning curve nowadays. Newly introduced surgical techniques are of increased complexity, this leads to longer learning curves and it takes more time before the innovative technique becomes effective. At the same time, the post-proficiency difference in effectiveness is smaller, because there are more and more new surgical techniques that get introduced but they only lead to a minor improvement in surgical outcome.

more intensive preoperative training should be implemented. On top of that, not only the surgeon should be trained, but the whole surgical team [5]. However, data on the reduction of learning curve associated morbidity is scarce.

Van Workum et al. have studied the learning curve and its associated morbidity in minimally invasive esophagectomy (MIE) and show what

the importance can be for patients. In their study, they focused on the burden of learning associated morbidity. This burden is something that is often not taken into consideration when calculating the length of the learning curve. Van Workum et al. conducted a multicenter study on MIE in four European expert centers. After an MIE, an anastomosis is constructed, which can lead to multiple complications such as leakage. This anastomotic leakage was the primary outcome parameter in this study. They found that the incidence of anastomotic leakage decreased from 28.9% at the start of the learning curve to 1.3% after the learning curve was completed. The mean length of the learning curve was found to be 119 cases. But most importantly, 36 patients (10.1% of all patients operated on) had anastomotic leakage that was associated with the learning curve. The researchers conclude that these leakages could have been prevented if the patients were operated by surgeons who already had completed the learning curve [6]. Therefore, it is important to keep in mind what the impact of the learning curve can be on patients.

Conclusion

To conclude, the learning curve in surgery remains a topic much in need of continuous research. The learning curve associated with morbidity can have serious implications for patients. It is still unclear how we can best reduce this learning curve associated morbidity. Further research is necessary to evaluate different learning curves for new surgical techniques and how patient safety can be increased during the learning curve.

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