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**Proposal for a surrogate surgical invasiveness score to obtain a 'post hoc'
quantification of surgical stress and tissue trauma in the context of
postoperative outcome assessments**

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appears to be high. The number of patients enrolled in the study is small, and may limit the interpretation of such findings, although this is the only study which has looked at this prospectively. Other retrospective studies have reported lower incidence, with the history of prior cervical radiculopathy as a risk factor.⁵ The patient with PDD confirmed on chest radiograph was subsequently found to have cervical stenosis. Other possible factors which may lead to prolonged diaphragmatic paresis include direct nerve injury, neurotoxicity from use of local anaesthetic, intraneural injection, nerve compression from haematoma, and surgical malpositioning.^{6, 7} Nerve injury from shoulder surgery has also been reported under general anaesthesia.⁸ Recovery from prolonged diaphragmatic paresis, however, is thought to be quite good. In studies looking at the effect of unilateral phrenic nerve section on lung function, patients recover by 6–12 months with normalization of vital capacity.^{9, 10}

The study was initially designed to only use the paraesthesia technique for the ISB. With time, participating anaesthesiologists felt more comfortable using a nerve stimulator since diaphragmatic twitches would be detected if the needle was close to the nerve. However, it did not protect against PDD. This concern over safety resulted in the small number of patients for each anaesthesia technique. This study shows the evolution of ISB to the most current way of performing it, via ultrasound. This method, however, does not seem to prevent PDD as we are aware of one case at our institution using this technique. We have also seen PDD in two patients who had shoulder surgery utilizing supraclavicular blocks performed with ultrasound. The aetiology of prolonged diaphragmatic paralysis is multifactorial, but regardless of anaesthesia type, the possibility of PDD should be considered in the setting of shoulder surgery.

Declaration of interest

None declared.

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Proposal for a surrogate surgical invasiveness score to obtain a 'post hoc' quantification of surgical stress and tissue trauma in the context of postoperative outcome assessments

Editor—When dealing with post-anaesthesia outcome, it is natural to take into consideration the type, length, and choice of the antecedent anaesthesia and the amount of drugs given. These items have an immediate influence on the course of postoperative recovery. However, surgery has at least a similar, if not an even stronger and longer lasting impact on the postoperative outcome, in particular by its duration and amount of concomitant tissue trauma. This aspect has not yet been involved in anaesthesiological reports related to postoperative outcome. However, there have been efforts to quantify surgical stress and tissue trauma as in the case of the 'spine surgery invasiveness index',^{1,2} but this is suited for a very specific surgical intervention only. Another resembling term is the 'surgical stress index' which is a surrogate parameter resulting from objective measurements of the vegetative balance between nociception and anti-nociception during general anaesthesia.^{3–5} This one-dimensional value reflects the intraoperative level of stimulation in real time, but rapidly fades away as soon as surgery has been concluded. Therefore, it seems not to be suitable to quantify the amount of surgical invasiveness and tissue trauma with its longer lasting repercussions.

A comprehensive method to quantify surgical invasiveness would be certainly useful in order to permit and facilitate the comparisons among various surgical cases. The aim of such a variable is in the first instance to obtain a universally applicable assessment tool to quantify the postoperative 'impact' of surgery independently of the type and scope of the surgical intervention or the involved operative speciality. Under the term 'impact', one has to understand the sum of various concomitant postoperative effects of surgery such as pain, stress, and tissue factors released from the operated organs. If such

a tool would be based on a scoring system, it would necessarily encompass all possible surgical effects on the whole body and on the targeted organs/tissues. And finally, the result should be expressed in a numerical value. For this scope, we propose a scoring system called 'surgical invasiveness

score' (SIS). In order to cover the relevant surgical strain, it is composed by three cumulative parts:

- (A) Surgical access: considering location, size of the incision(s), and the type of accessing the targeted operation site (either open or endoscopic).

	Surgical measure	Calculation	
A	1. Size of skin incision	1 point per 5 cm length of incision	Surgical access
	2. Size of soft tissue incision	1 point per 5 cm length of incision	
	3. Opening of a body cavity by endoscopy	1 point for head/neck region 1 point for uterus, bladder 2 points for abdomen 3 points for thorax	
	4. Opening of a body cavity by incision	2 points for head/neck region 3 points for uterus, bladder 4 points for abdomen 6 points for thorax	
B	5. Target organ/tissues	1 point per hour of operating the targeted organ/tissue multiplied with the organ/tissue-factor as follows:	Organ/tissue trauma
	Head/neck	x 1 for brain and nervous system x 1 face/neck structures ex. cavities x 2 sinuses, maxilla, mandibula x 3 sensory organs (eyes, ears) x 4 oral/nasal cavity, pharynx, larynx, trachea	
	Thorax	x 2 heart, mediastinal organs x 3 lungs, pleura	
	Abdominal region	x 3 abdominal organs x 2 retro-peritoneal organs	
	Perineum	x 2 urogenital systems	
	Vascular	x 3 aorta, carotides x 2 porto-caval vessels x 1 peripheral vessels	
	Musculo-skeletal system (bones, muscles, tendons, ligaments)	x 3 pelvis x 2 vertebral column x 2 femur, humerus and large joints x 1 other	
C	1. Blood loss	1 point per 250 ml blood loss	Associated factors
	2. Drainages	2 points per soft tissue drainage 3 points per abdominal cavity drainage 4 points per thoracic cavity drainage	
Final SIS value at end of surgery = sum of points in A + B + C			

Fig 1 The SIS, which is the sum of the numerical values obtained in the three categories: A for the site and size of surgical access, B for the site and duration of tissue/organ traumatization, and C for concomitant factors associated with surgery.

- (B) Magnitude of the targeted organ/tissue traumatization by considering the site and time duration of the surgical activity in that location.
- (C) Associated factors of surgery that have an impact on postoperative recovery such as the amount of blood loss and the number and location of inserted drainages.

The sum of the collected points from A, B, and C yield the final SIS. This system intends to include those factors into the assessment which obviously are more or less proportionally associated with the traumatizing effect of surgery, thus encompassing spatial, temporal, and technical circumstances of the surgical intervention. Each incorporated feature has a numerical points allocation for the type of surgical access (e.g. differentiating whether it is endoscopic or open) and the length of the access making procedure in centimetres. Concerning the targeted organ/tissue, the envisaged numerical subset is composed by the duration of the surgical manipulation (thus assuming that the involved tissue amount is proportional to the time of operating that specific site), and the tissue type resp. the organ itself. Figure 1 contains all necessary ingredients to be able to calculate the final SIS value. To start with step A, one has to quantify the skin and soft tissue incisions for which 1 point is given per 5 cm length. This is followed by the type of surgical access for which one has to choose the assigned points. These points from part A are cumulated. The next step (B) consists of the targeted organ(s)/tissue(s) type that has assigned a certain factor. This factor has to be multiplied by the number of hours of surgical work in that respective tissue. In the case of operations on multiple organs, the resulting products have to be added up for the total of step B. Step C contains additional information about factors associated with surgery such as the magnitude of intraoperative blood loss and the presence and location of remaining drainages. Finally, the sum of the steps A, B, and C yields the SIS.

A next step would be to assess the validity and clinical relevance of multiple SIS calculations for a variety of surgical interventions. It also would be interesting to search for its correlation with stress response parameters such as 'stress hormone' levels and postoperative pain load and necessary analgesic treatment.

Declaration of interest

None declared.

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