20. Makki I, Zheng-Lin B, Kohli M. Medical marijuana knowledge and attitudes amongst internal medicine residents. *BMC Prim Care* 2022; **23**: 38
21. Beliveau CM, McMahan VM, Arenander J, et al. Stimulant use for self-management of pain among safety-net patients with chronic non-cancer pain. *Subst Abus* 2022; **43**: 179–86
22. Fullwood D, Means S, Merriwether EN, Chimenti RL, Ahluwalia S, Booker SQ. Toward understanding movement-evoked pain (MEP) and its measurement: a scoping review. *Clin J Pain* 2021; **37**: 61–78
23. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. *Cochrane Database Syst Rev* 2017; **4**: CD011279
24. Ferro Moura Franco K, Lenoir D, Dos Santos Franco YR, Jandre Reis FJ, Nunes Cabral CM, Meeus M. Prescription of exercises for the treatment of chronic pain along the continuum of nociplastic pain: a systematic review with meta-analysis. *Eur J Pain* 2021; **25**: 51–70
25. Rausch Osthoff A-K, Niedermann K, Braun J, et al. 2018 EULAR recommendations for physical activity in people with inflammatory arthritis and osteoarthritis. *Ann Rheum Dis* 2018; **77**: 1251–60
26. Owens C, Conaghan PG. Improving joint pain and function in osteoarthritis. *Practitioner* 2016; **260**: 17–20
27. Wei N, Dai Z. The role of nutrition in osteoarthritis: a literature review. *Clin Geriatr Med* 2022; **38**: 303–22
28. Brain K, Burrows TL, Rollo ME, et al. A systematic review and meta-analysis of nutrition interventions for chronic noncancer pain. *J Hum Nutr Diet* 2019; **32**: 198–225
29. Black CJ, Staudacher HM, Ford AC. Efficacy of a low FODMAP diet in irritable bowel syndrome: systematic review and network meta-analysis. *Gut* 2022; **71**: 1117–26
30. Hindiyeh NA, Zhang N, Farrar M, Banerjee P, Lombard L, Aurora SK. The role of diet and nutrition in migraine triggers and treatment: a systematic literature review. *Headache* 2020; **60**: 1300–16
31. Diener HC, Gaul C, Lehmacher W, Weiser T. Aspirin, paracetamol (acetaminophen) and caffeine for the treatment of acute migraine attacks: a systemic review and meta-analysis of randomized placebo-controlled trials. *Eur J Neurol* 2022; **29**: 350–7
32. Vlisides PE, Li D, McKinney A, et al. The effects of intraoperative caffeine on postoperative opioid consumption and related outcomes after laparoscopic surgery: a randomized controlled trial. *Anesth Analg* 2021; **133**: 233–42
33. Straube S, Derry S, Straube C, Moore RA. Vitamin D for the treatment of chronic painful conditions in adults. *Cochrane Database Syst Rev* 2015; **1**: CD007771

British Journal of Anaesthesia, 129 (3): 281–284 (2022)
doi: 10.1016/j.bja.2022.06.010
Advance Access Publication Date: 11 July 2022

Towards better predictive models of chronic post-surgical pain: fitting to the dynamic nature of the pain itself

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This editorial accompanies: Development and validation of a multivariable prediction model for early prediction of chronic postsurgical pain in adults: a prospective cohort study by van Driel et al., *Br J Anaesth* 2022:129:407–415, doi: 10.1016/j.bja.2022.04.030

Summary

Chronic post-surgical pain predictive scores exist, but none has yet demonstrated an impact on patient care. Van Driel and colleagues offer an additional perspective on early postoperative detection of patient at risk of chronic post-surgical pain to enable early interventions in prevention and treatment. The authors derived and validated a model based on four easily obtainable predictors that could help clinicians assess and treat patients at risk. Additional work is needed to prove reliability and clinical benefit of chronic post-surgical pain prediction and intervention.

Keywords: chronic pain; neuropathic pain; postoperative pain; predictive factors; prediction model

Chronic post-surgical pain (CPSP) is a major public health issue. CPSP after surgery exposes an average of 10% of the surgical population to functional impairment and moderate to severe pain. In 2019, the International Association of the Study of

DOI of original article: 10.1016/j.bja.2022.04.030.

Pain (IASP) in collaboration with the WHO (World Health Organisation) redefined CPSP as pain that develops or increases in intensity after a surgical procedure, persists for at least 3 months, and is localised to the surgical field or related innervation territory.[1] It is estimated that >300 million surgical procedures are performed globally each year; when the total volume of surgical procedures performed on an annual basis is taken into consideration, the number of affected surgical patients and the global burden of CPSP are likely to be high. Unfortunately, the prevalence of CPSP has not changed over the past decade. This highlights the failure of various preventive strategies that have been tried and also questions the value of current prognostic prediction models.[2–4]

In this issue of *British Journal of Anaesthesia*, Van Driel and colleagues[5] report on the development and validation of a new prediction model for the early prediction of CPSP.[5] They used a prospective cohort of adult patients undergoing orthopaedic, vascular, trauma, or general surgery between 2018 and 2019. Multivariable logistic regression models for CPSP were developed using data from the University Medical Centre (UMC) Utrecht and externally validated using data from the Erasmus UMC Rotterdam, the Netherlands. In the development (n=344) and validation (n=150) cohorts, 28.8% and 21.3% of patients, respectively, reported CPSP. The best performing model (area under the curve: 0.82, 95% confidence interval [CI]: 0.76–0.87) included preoperative treatment with opioids (odds ratio [OR]: 4.04, 95% CI: 2.13–7.70), bone surgery (OR: 2.01, 95% CI: 1.10–3.67), pain score on postoperative day 14 (OR: 1.57, 95% CI: 1.34–1.83), and the presence of painful cold within the painful area 2 weeks after surgery (OR: 4.85, 95% CI: 1.85–12.68). Predictive performance was confirmed by external validation. The authors concluded that because the model was based on four easily obtainable predictors, it could help alert clinicians to further assess and treat individual patients at risk.

A number of studies have identified CPSP risk factors in different domains related to the surgery or patient.[6,7] Surgical risk factors include traumatic approaches, nerve injury, longer duration of surgery, and re-operation. For patients, younger age, female sex, and preoperative health including presence of chronic pain or psychological vulnerability, have been incriminated. A recent meta-analysis has pointed to an association of several psychological predictors like anxiety, depression, catastrophising, and kinesiophobia with CPSP.[8] Several CPSP risk scores have been published and recently reviewed.[4] Nineteen prediction models, all at high risk of bias, have been identified. Model discrimination, measured by the area under receiver operating curves or c-statistic ranged from 0.690 to 0.816. Predictors most frequently presented in final development models included preoperative pain in the surgical area (85% of models), preoperative pain in other areas (43%), sex or gender (31%), and acute postoperative pain severity (31%). Intraoperative factors such as surgical procedure and technique and postoperative pain intensity are only included in a few current models.[4] Among the interesting aspects of the model presented by van Driel and colleagues[5] is the predictive value of the type of procedure (i.e. orthopaedic surgery), and the predictive values of both pain intensity and painful cold within the painful area assessed at 2 weeks after surgery.

The relationship between postoperative pain intensity and the risk of CPSP development deserves our attention. A review assessing the relationship between acute postoperative pain scores taken separately and CPSP found the relation to be moderate at best.[9] In 2015, an observational study about CPSP in Europe identified the percentage of time in severe pain on day 1 as a risk factor (a 10% increase in percentage of time spent in severe pain was associated with a 30% increase of CPSP incidence at 12 months).[10] The resolution of postoperative pain is a dynamic and complex process that was highlighted by the concept of 'pain trajectories'. Optimal and suboptimal postoperative pain trajectories are now dichotomised, with suboptimal trajectories being associated with pain persistence.[11] Recently, the role of subacute pain, a grey zone extending between hospital discharge and the CPSP, suggested a cut-off time (usually between 10 days and 3 months after surgery) has emerged as a possible predictor of CPSP. In inguinal hernia repair, patients suffering 30 days of high intensity pain are significantly more prone to develop CPSP at 3 months.[12] In orthopaedic surgery, where many procedures cause severe acute postoperative pain and long-lasting pain, pain intensity at day 10 and 6 weeks are associated with CPSP at 12 months.[13] On the existing 20 CPSP predictive scores, five have included intensity of postoperative pain (Table 1).

Table 1 Prognostic models including postoperative pain intensity. *Day 30 pain intensity was associated with chronic post-surgical pain (CPSP) but not included in the final model. †Updated model from Althaus and colleagues,[14] internally validated. CI, confidence interval; NA, not available.

Predictive model	Model performance (95% CI)	Preoperative factors	Intraoperative factors	Postoperative factors
Aasvang and colleagues,[12] 2010; n=664	NA	Function Pain response to heat	Surgical technique	Day 30 Pain intensity*
Althaus and colleagues,[14] 2012; n=105	0.77 (0.69–0.84)	Pain in the area Other chronic pain Capacity overload Comorbid stress	NA	Day 5 Pain intensity
Mathes and colleagues,[15] 2018†; n=205	0.81 (0.74–0.89)	Pain in the area Other chronic pain Female sex Marital status	Orthopaedic procedures	Day 5 Pain intensity
Meretoja and colleagues,[16] 2017; n=1544	0.74	Pain in the area BMI	Surgical technique	Day 7 Pain intensity
Van Driel and colleagues,[5] 2022; n=494	0.82 (0.76–0.87)	Opioid intake	Bone surgery	Day 14 Pain intensity Painful cold

The aforementioned observations question the best timing of prediction and ease of implementation of predictive tools, which are both important issues regarding clinical impact. A preoperative prediction will allow preoperative, intraoperative, and postoperative periods to personalise treatments for both surgical and anaesthesia management. Most common predictors identified (e.g. preoperative pain in the surgical area, preoperative pain in other areas, age, sex, or gender), are unmodifiable risk factors limiting preventive interventions. In the case of high risk of CPSP, surgery can be adapted with potential avoidance or less invasive surgery when possible.[12] Should we rather detect vulnerable patients after surgery? At this stage patients can be better oriented to transitional pain services avoiding delay in evaluation and treatment of subacute and possibly chronic post-surgical pain. In transitional pain services, the majority of patients have undergone either thoracic or orthopaedic (limb or spine) procedures, and 70% present with allodynia, hyperalgesia, or both (i.e. have a neuropathic component in their subacute pain).[17] Hyperalgesia and nerve lesions expose patients to an abnormal pain trajectory in the early postoperative period.[18,19] The specificity of the report of van Driel and colleagues[5] using sensory modifications related to potential nerve lesions and hyperalgesia is in line with these mechanisms. The clinical benefits of early postoperative detection and the preventive efficacy of treatments at that stage have still to be demonstrated.[20]

The study of van Driel and colleagues[5] has some limitations such as the restricted cut off of 3 months for CPSP with no subsequent follow-up, no clinical diagnosis of CPSP, and no evaluation of pain-related functional impairment. Interestingly, the authors used the DN4 interview questionnaire but included only two items in their predictive model (cold pain and pruritus).[21] Neuropathic pain characteristics can vary over time.[22] Nevertheless, inclusion of a neuropathic component of postoperative pain as a predictor for CPSP is original, since none of the previous predictive models included such a factor.[4] The neuropathic pain component has been shown to be associated with development of severe CPSP and higher functional impairment.[10,23] Finally, various known psychosocial risk factors were not included in the model because of their applicability in daily practice (use of validated questionnaires).[24] It is worth noting that the predictive value of catastrophising has been questioned, and it only slightly increased performance of the model.[12,25]

In conclusion, we now have some clues concerning prediction of CPSP with existing predictive scores. However, the impact in clinical practice and the reality of CPSP prediction and prevention is still debated. For future research, two goals must be targeted: validation of the clinical impact of a predictive score (existing or to be validated) on management and patient outcomes, and larger-scale, high-quality studies to confirm or refute the effectiveness and safety of preventive interventions on the development CPSP. We still have a long way to go!

Declarations of interest

The authors have no conflicts to declare.

References

1. Schug SA, Lavand'homme P, Barke A, et al. The IASP classification of chronic pain for ICD-11: chronic postsurgical or posttraumatic pain. *Pain* 2019; **160**: 45–52
2. Carley ME, Chaparro LE, Choiniere M, et al. Pharmacotherapy for the prevention of chronic pain after surgery in adults: an updated systematic review and meta-analysis. *Anesthesiology* 2021; **135**: 304–25
3. Weinstein EJ, Levene JL, Cohen MS, et al. Local anaesthetics and regional anaesthesia versus conventional analgesia for preventing persistent postoperative pain in adults and children. *Cochrane Database Syst Rev* 2018; **4**: CD007105
4. Papadomanolakis-Pakis N, Uhrbrand P, Haroutounian S, Nikolajsen L. Prognostic prediction models for chronic postsurgical pain in adults: a systematic review. *Pain* 2021; **162**: 2644–57
5. van Driel MEC, van Dijk JFM, Baart SJ, Meissner W, Huygen FJPM, Rijsdijk M. Development and validation of a multivariable prediction model for the early prediction of chronic postsurgical pain. *Br J Anaesth* 2022; **129**: 407–15
6. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. *Lancet* 2006; **367**: 1618–25
7. Schug SA, Bruce J. Risk stratification for the development of chronic postsurgical pain. *Pain Rep* 2017; **2**: e627
8. Giusti EM, Lacerenza M, Manzoni GM, Castelnuovo G. Psychological and psychosocial predictors of chronic postsurgical pain: a systematic review and meta-analysis. *Pain* 2021; **162**: 10–30
9. Gilron I, Vandenkerkhof E, Katz J, Kehlet H, Carley M. Evaluating the association between acute and chronic pain after surgery: impact of pain measurement methods. *Clin J Pain* 2017; **33**: 588–94
10. Fletcher D, Stamer UM, Pogatzki-Zahn E, et al. Chronic postsurgical pain in Europe: an observational study. *Eur J Anaesthesiol* 2015; **32**: 725–34
11. L'Hermite J, Page MG, Chevallier T, et al. Characterisation of pragmatic postoperative PAin Trajectories over seven days and their association with CHronicity after 3 months: a prospective, pilot cohort study (PATCH study). *Anaesth Crit Care Pain Med* 2021; **40**, 100793
12. Aasvang EK, Gmaehle E, Hansen JB, et al. Predictive risk factors for persistent postherniotomy pain. *Anesthesiology* 2010; **112**: 957–69
13. Veal FC, Bereznicki LRE, Thompson AJ, Peterson GM, Orlikowski C. Subacute pain as a predictor of long-term pain following orthopedic surgery: an Australian prospective 12 month observational cohort study. *Medicine (Baltimore)* 2015; **94**: 1
14. Althaus A, Hinrichs-Rocker A, Chapman R, et al. Development of a risk index for the prediction of chronic postsurgical pain. *Eur J Pain* 2012; **16**: 901–10
15. Mathes T, Pape-Kohler C, Moerders L, Lux E, Neugebauer EAM. External validation and update of the RICP – a multivariate model to predict chronic postoperative pain. *Pain Med* 2018; **19**: 1674–82
16. Meretoja TJ, Andersen KG, Bruce J, et al. Clinical prediction model and tool for assessing risk of persistent pain after breast cancer surgery. *J Clin Oncol* 2017; **35**: 1660–7
17. Jensen TS, Stubhaug A, Breivik H. Important development: extended Acute Pain Service for patients at high risk of chronic pain after surgery. *Scand J Pain* 2016; **12**: 58–9
18. Martinez V, Ammar SB, Judet T, et al. Risk factors predictive of chronic postsurgical neuropathic pain: the value of the iliac crest bone harvest model. *Pain* 2012; **153**: 1478–83

19. De Kock M, Lavand'homme P, Waterloos H. Balanced analgesia' in the perioperative period: is there a place for ketamine? *Pain* 2001; **92**: 373–80
20. Hansson P, Baron R, Stubhaug A. Acute neuropathic pain: equivalent or different to chronic neuropathic pain? A call for gathering of scientifically based information on acute neuropathic pain. *Pain* 2019; **160**: 2413–4
21. Bouhassira D, Attal N, Alchaar H, et al. Comparison of pain syndromes associated with nervous or somatic lesions and development of a new neuropathic pain diagnostic questionnaire (DN4). *Pain* 2005; **114**: 29–36
22. Duale C, Ouchchane L, Schoeffler P, Investigating Group Edonis, Dubray C. Neuropathic aspects of persistent postsurgical pain: a French multicenter survey with a 6-month prospective follow-up. *J Pain* 2014; **15**: 24.e1–24.e20
23. Stamer UM, Ehrler M, Lehmann T, Meissner W, Fletcher D. Pain-related functional interference in patients with chronic neuropathic postsurgical pain: an analysis of registry data. *Pain* 2019; **160**: 1856–65
24. Weinrib AZ, Azam MA, Birnie KA, et al. The psychology of chronic post-surgical pain: new frontiers in risk factor identification, prevention and management. *Br J Pain* 2017; **11**: 169–77
25. Montes A, Roca G, Cantillo J, Sabate S, GENDOLCAT Study Group. Presurgical risk model for chronic postsurgical pain based on 6 clinical predictors: a prospective external validation. *Pain* 2020; **161**: 2611–8

British Journal of Anaesthesia, 129 (3): 284–289 (2022)
doi: 10.1016/j.bja.2022.06.008
Advance Access Publication Date: 11 July 2022

On the horns of a dilemma: choosing total intravenous anaesthesia or volatile anaesthesia

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This editorial accompanies: Inhalation anaesthesia compared with total intravenous anaesthesia and postoperative complications in colorectal cancer surgery: an observational registry-based study by Hasselager et al., *Br J Anaesth* 2022:129:416–426, doi: 10.1016/j.bja.2022.03.019

Summary

There are two established techniques of delivering general anaesthesia: propofol-based total intravenous anaesthesia (TIVA) and volatile agent-based inhaled anaesthesia. Both techniques are offered as standard of care and have an established safety track record lasting more than 30 years. However, it is not currently known whether the choice of anaesthetic technique results in a fundamentally different patient experience or affects early, intermediate-term, and longer-term postoperative outcomes. This editorial comments on a recently published study that suggests that inhaled volatile anaesthesia might be associated with fewer postoperative surgical complications than propofol-based TIVA for patients undergoing colorectal cancer surgery. We consider the strengths and limitations of the study, place these findings in the context of the broader evidence, and discuss how the current controversies regarding anaesthetic technique can be resolved, thereby helping to bring precision medicine into the modern practice of perioperative care.

Keywords: inhalational anaesthesia; postoperative complications; postoperative outcomes; precision medicine; propofol; TIVA; total intravenous anaesthesia; volatile anaesthesia

DOI of original article: 10.1016/j.bja.2022.03.019.