

Importantly, this correlation could include successful pain management interventions with more than half (55.2%) of patients with low pain ratings (0–3) being administered local anaesthetic. This may contribute to the inverse correlation with high clinician pain estimates, leading to the administration of local anaesthetic facilitating low postoperative pain patient ratings.

Decisive clinical action frequently necessitates the use of heuristics; thus, examining biases can help us understand intraoperative pain management.<sup>7</sup> Clinicians frequently err on the side of trusting their own clinical skills at the expense of patient statements<sup>8</sup> and can also be overconfident in the effectiveness of their pain management.<sup>9,10</sup> Overestimation of analgesic efficacy could explain why patients receiving the highest dose of analgesia received lower clinician pain estimates, despite their own higher ratings.

In summary, these findings illuminate the experience of pain during hysteroscopy. We provide support for campaigns raising awareness of pain involving this procedure, with 17.6% of patients reporting pain >7/10 and only 7.8% reporting no pain at all. This indicates that patients are likely to experience pain during their procedure, and the descriptions provided to our patients should reflect this. Our results also identified a disconnect between clinician and patient pain reports, as we observed an inverse relationship between patient pain ratings and clinician estimates of the same pain. It is important to note that these results require confirmation, as multiple factors are likely to be important when investigating individual differences in pain vulnerability and the efficacy of analgesia. However, these data do suggest a need to base evaluation of intraoperative pain during hysteroscopy on a more reliable assessment method.

### Declarations of interest

The authors declare that they have no conflict of interest.

### Funding

CASE studentship between the University of Reading and Royal Berkshire Foundation Trust to RH; New Investigator Research Grant from the Medical Research Council to TV.S.

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doi: 10.1016/j.bja.2020.08.015

Advance Access Publication Date: 15 September 2020

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## The big short(age): perioperative and patient-reported outcomes during a fentanyl shortage at a tertiary care facility

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**Keywords:** fentanyl; medication shortage; opioid; pain; patient-reported outcomes

Editor—There is concern that international opioid shortages could adversely affect patient care.<sup>1,2</sup> However, there is a paucity of studies examining fentanyl-specific shortages and their potential disruption on perioperative anaesthesia practices and patient-reported outcomes.<sup>3</sup> Given the present coronavirus disease (COVID-19) pandemic and potential for future supply chain disruptions, fentanyl shortages are anticipated to continue. There is a need to understand how perioperative anaesthesia practices change during medication shortages and, subsequently, the impact shortages have on patient-reported outcomes. The present analysis examined if perioperative opioid dosages changed during a facility-wide fentanyl shortage at Walter Reed National Military Medical Center (WRNMMC), and if so, if changes were associated with alterations in patient-reported pain outcomes using data from an institutional review board-approved prospective observational study (NCT03047434).

The primary outcome was fentanyl, measured in morphine milligram equivalents (MME), used perioperatively (during surgery and immediately after in the PACU). Secondary outcomes included the proportion of participants receiving non-opioid pain medications perioperatively and Defense and Veterans Pain Rating Scale (DVPRS) average past 24-h pain scores.<sup>4</sup> Participants (English-speaking adults undergoing knee or shoulder arthroscopy) completed the DVPRS preoperatively and at 2-weeks postoperatively. No other drug shortages occurred at Walter Reed National Military Medical Center during the study period. Comparative statistics (*t*-test,  $\chi^2$  test) evaluated differences in clinical characteristics of participants and fentanyl doses administered before (from June 1, 2016 to March 28, 2018) and during the shortage (from March 29, 2018 to October 31, 2018). Multivariable generalised

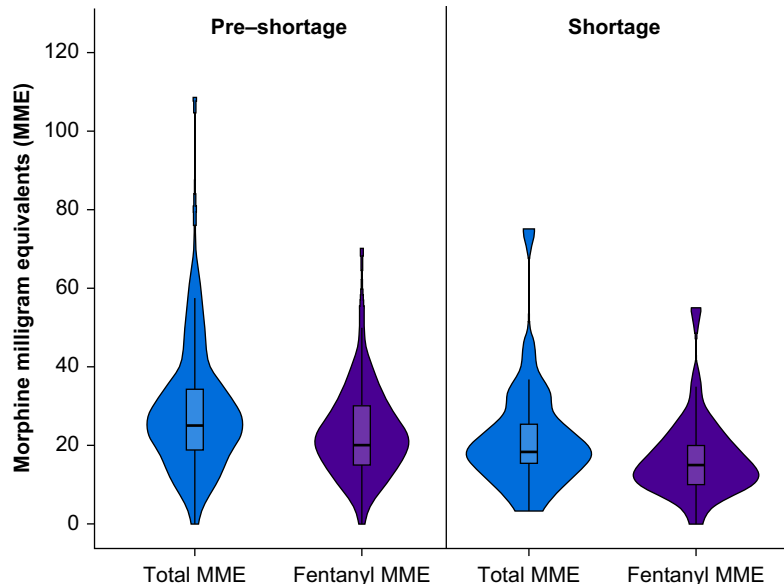
linear models examined the association between shortage period and average pain scores.

Of the 166 participants, 138 underwent surgery before the shortage and 28 during the shortage. Participants were ~40 yr of age, predominately White (74%), and male (83%). There were no statistically significant differences in participants' clinical characteristics before or during the fentanyl shortage (Appendix S1). No participants were admitted to intensive care, readmitted, or died during the study period.

Perioperative fentanyl doses were significantly higher prior to the shortage, with a mean MME of 23.0, compared to during the shortage, 16.8 MME (Fig. 1). This equates to a decline of >6 MME (95% confidence interval [CI]: 1.8–10.6;  $P=0.007$ ). Mean perioperative opioid doses declined from 28.3 MME before the shortage to 22.0 MME during the shortage (95% CI: 0.3–12.3;  $P=0.048$ ). Neither the proportion of participants receiving non-opioids perioperatively, nor the number of adjunct medications utilised changed over time (Appendix S2).

Multivariable modelling indicated that receiving care during the shortage period was not associated with 2-week postoperative average pain scores. The model adjusted for participants' preoperative opioid prescription usage, surgical procedure, age, and preoperative pain scores (Appendix S3). Average 2-week postoperative pain scores were estimated to be 3.2 points (95% CI: 2.2–4.2;  $P<0.001$ ). Elevated preoperative average pain scores were associated with increased postoperative pain ( $\beta=0.41$ ; 95% CI: 0.3–0.6;  $P<0.001$ ).

During the facility-wide shortage, fentanyl doses administered in the perioperative period decreased by ~27%. Anaesthesia providers did not supplement with additional opioids or adjuncts during the shortage. This change in practice was not associated with 2-week postoperative patient-reported pain



**Fig 1.** Violin plot illustrating that average fentanyl usage (purple) was significantly higher before the shortage (left) 23.0 MME, compared with during the shortage (right), 16.8 MME ( $P=0.002$ ). Total MME (blue) declined from 28.3MME before the shortage to 22.0 MME during the shortage, on average ( $P=0.048$ ). MME includes all opioid medication administered during surgery and immediately after in the PACU. Wider sections of the violin plot represent a higher concentration of observations, while the narrower sections correspond to a lower concentration of observations. MME, morphine milligram equivalents.

outcomes. The statistically significant difference in perioperative MME reflects a potentially clinically meaningful decrease. For example, patients receiving high-dose opioids intraoperatively (24 MME) have been found to be at increased risk of readmission compared with patients receiving mid-range doses (17 MME).<sup>5</sup> This difference in MME is similar to what was observed in our sample during the shortage. Higher dosing was curtailed during the shortage based on the dosage distributions observed (Fig. 1). However, future research is needed to examine if medication shortages result in a sustained reduction in doses greater than are therapeutically necessary.

The observational nature of this analysis and small, but sufficiently powered, sample limits generalisability and warrants further investigation. This sample of relatively healthy active duty service members may not be representative of other patient populations. While we were able to examine the association between perioperative dosing and patient-reported pain, future research will need to examine how medication shortages impact more proximal outcomes, such as PACU pain scores. Medication shortages are just one of many factors that influence anaesthesia practice. For instance, medication vial sizes can influence fentanyl dosing.<sup>6</sup> Additionally, this analysis was unable to delineate the effect of perioperative fentanyl dosages compared with the effect of specific pain management protocols on pain outcomes. For example, interdisciplinary teams providing evidence-based multimodal analgesia is standard practice at WRNMMC and may indicate why providers did not compensate for fentanyl with additional opioids or adjuncts.<sup>7</sup> Despite limitations, findings expand upon previous evaluations of facility-level opioid shortages, which are often limited to examining care outcomes among critically ill patients.<sup>8</sup>

This analysis indicates that during fentanyl shortages, anaesthesia providers can reduce perioperative fentanyl doses without negatively affecting patient-reported pain outcomes up to 2 weeks after arthroscopic procedures. Future research evaluating opioid shortages and reductions in dosing will be of interest considering the ongoing COVID-19 pandemic, the global epidemic of opioid misuse, and possible association between opioid-induced hyperalgesia and high-dose intraoperative opioids.<sup>9,10</sup> Our hypothesis generating results can inform the design of future studies aimed at evaluating how medication shortages affect perioperative anaesthesia practices and patient-reported outcomes.

### Authors' contributions

Study design/planning: NAG, RHB, MLK, KH

Data analysis: NAG, KH

Data interpretation: NAG, RHB, KH

Developing and revising manuscript: all authors

### Declarations of interest

The authors declare that they have no conflicts of interest. The views expressed in this manuscript are those of the authors and do not reflect the official policy of the Uniformed Services

University, the Department of the Army, Department of Defense, the United States Government, or The Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc.

### Funding

Uniformed Services University through Henry M. Jackson Foundation for the Advancement of Military Medicine, Inc. under Cooperative Agreement (HU00011920042). Investigator-initiated grant from Pacira Pharmaceuticals Inc. to MLK.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.bja.2020.09.020>.

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doi: 10.1016/j.bja.2020.09.020

Advance Access Publication Date: 26 October 2020

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