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## Anaesthesia practice in the first wave of the COVID-19 outbreak in the United States: a population-based cohort study

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Editor—The COVID-19 pandemic has profoundly impacted daily clinical practice. Numerous clinical practice recommendations were published during the first wave focusing on guidance to maximise patient and healthcare worker safety.<sup>1–3</sup> However, many of these recommendations were not backed by rigorous evidence,<sup>4–7</sup> sometimes leading to confusion. For example some experts suggested that use of tracheal intubation was preferable to supraglottic airway devices to create a closed system and minimise aerosolisation and environmental contamination, whereas others cautioned that airway instrumentation itself was aerosol generating.<sup>8,9</sup>

It is unclear to what extent these, at times contradicting, recommendations impacted anaesthesia practice in the early stage of the pandemic. We therefore utilised a large national dataset to describe potential changes in practice in the USA, with a specific focus on anaesthesia practice in orthopaedic surgery. We deliberately set out to first pursue descriptive data to understand potential changes in patients served and anaesthesia practice. We hypothesised that in elective orthopaedic surgery during the first wave of the COVID-19 outbreak, use of anaesthetic techniques would differ compared with the year prior. Even though it generally takes years for practice changes to occur, we believe that the extraordinary nature of the pandemic may have warranted an exception to this general wisdom.

After institutional review board approval (IRB#2016-436), we retrospectively analysed patients captured in the Premier Healthcare database (Premier Healthcare Solutions, Inc., Charlotte, NC, USA) who underwent elective total knee or hip

arthroplasty (TKA/THA) in the USA. We selected patients admitted during the initial surge of COVID-19 from March 1 to June 30, 2020, as these were the most recent data available to us at the time of analysis. In order to compare this cohort to controls, we selected patients admitted during the same time frame the year prior. TKA was defined based on *International Classification of Diseases*, 9th Revision (ICD-9) procedure code 81.54 or 10th Revision (ICD-10) procedure codes 0SRC0xx, 0SRD0xx. THA was defined based on ICD-9 procedure codes 81.51 or ICD-10 procedure codes 0SR90xx, 0SRB0xx. Exclusion criteria were: unknown sex ( $n=3$ ), unknown discharge status ( $n=15$ ), and outpatient procedures ( $n=7918$ ).

The main outcome of interest was type of anaesthesia on the day of surgery, which was identified from billing codes as described<sup>10</sup>; this was as by general anaesthesia only, regional anaesthesia + general anaesthesia, or regional anaesthesia only. In addition to anaesthesia type, anaesthesia practice was also characterised by perioperative use of NSAIDs, cyclooxygenase-2 (COX-2) inhibitors, and benzodiazepines. We compared anaesthesia practice before and during the first wave of the COVID-19 pandemic.

Results are reported as counts and percentages, and presented in figures. Standardised differences were calculated to compare variables of interests before and during COVID-19. A P-value of  $>0.1$  was considered to represent a meaningful group difference.<sup>11</sup> All statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA).

Overall, 87 122 and 13 920 TKA cases, and 64 352 and 11 011 THA cases were performed in the 2019 and 2020 periods of

**Table 1** Anaesthesia type comparison before and during the COVID-19 pandemic. \*A standardised difference >0.1 represents a meaningful group difference. COX-2, cyclooxygenase-2.

	Total knee arthroplasty					Total hip arthroplasty				
	Year		Year		Stdiff*	Year		Year		Stdiff*
	2019	2020	2019	2020		2019	2020	2019	2020	
	n	(%)	n	(%)	n	(%)	n	(%)		
Type of anaesthesia										
General anaesthesia	37 536	43.1	5859	42.1	0.02	30 532	81.9	8909	80.9	0.06
Regional anaesthesia	21 064	24.2	3449	24.8	0.01	11 618	18.1	2102	19.1	0.03
Block only	9746	11.2	1371	9.8	0.04	4398	6.8	556	5.0	0.08
General + block	6222	7.1	683	4.9	0.09	1010	1.6	153	1.4	0.01
Perioperative use of										
NSAIDs	57 080	65.5	8800	63.2	0.05	40 388	62.8	6625	60.2	0.05
COX-2 inhibitors	45 046	51.7	7045	50.6	0.02	34 330	53.3	5587	50.7	0.05
Benzodiazepines	67 702	77.7	10116	72.7	0.12	47 548	73.9	7712	70.0	0.09

study, respectively, indicating a sharp decrease in elective cases performed.<sup>12</sup> All patient characteristics were comparable between time cohorts, except for slightly fewer TKA patients having Medicare insurance, and fewer TKAs performed in the Midwest and Northeast regions (Supplementary Table S1).

There was no clinically meaningful observable change in overall practice of anaesthesia between 2019 and 2020 in either the TKA or the THA cohort. Moreover, there were no meaningful changes in terms of perioperative NSAID and COX-2 inhibitor use; benzodiazepine use was slightly lower during the COVID-19 period among TKA patients (from 77.7% to 72.3%; standardised difference=0.12) (Table 1).

Despite a significant decrease in overall volume, characteristics of patients admitted for elective orthopaedic surgery during the COVID-19 pandemic were similar to the year prior.

These observations raise various questions, including those related to the risks of performing general anaesthesia and airway instrumentation rather than avoiding it during the COVID-19 pandemic. This is especially interesting as at the time practitioners did not know much about the pathogen, its mode of transmission, and the morbidities and mortality associated with infection. There were also no meaningful differences in use of simple analgesics during the pandemic. Although the number of patients undergoing TKA or THA surgery dropped by almost 70%, the characteristics of patients undergoing either procedure was stable during the 2 yr, signifying that for those orthopaedists who continued to operate in the USA, patient selection did not change. However, perioperative care might have changed. Zhong and colleagues<sup>13</sup> found a higher readmission risk during the pandemic, and suggested that patients were discharged home earlier to mitigate the risk of COVID-19 transmission during institutionalised care, possibly compromising rehabilitation. In this context, it is concerning that we saw reduced use of regional anaesthetic techniques as they might be associated with poorer postoperative mobilisation and rehabilitation. Furthermore, higher opioid use in the setting of no regional anaesthesia might be associated with increased airway compromise necessitating emergent airway management.

Our analysis is limited by various factors. First, potential confounding in terms of a change in patient characteristics in 2020 (compared with 2019), although we did not observe meaningful group differences that could have explained differences in anaesthesia practice. Second, we did not have access to data

beyond those reported here and therefore cannot make any further comparisons to observe whether a longer term change of practice occurred. Third, we studied select aspects of anaesthetic practice. There may have been changes in anaesthetic practice that were not covered by the scope of this study. Fourth, we used a database covering a broad spectrum of hospitals; some inter-institutional differences in reporting and coding for anaesthetic practice cannot be excluded with certainty.

In conclusion, despite the recommendations from worldwide airway experts to avoid airway instrumentation during the period of the COVID-19 pandemic, our data showed that anaesthetic practice in the USA did not change with regard to the conduct of general and regional anaesthesia. In conjunction with previous studies showing worse patient outcomes, this questions the decision to favour general over regional anaesthesia. Further research is warranted to investigate if these recommendations had lasting consequences beyond the initial pandemic period.

## Declarations of interest

SGM is a one-time consultant for Sandoz Inc. and Teikoku. He is an owner of a US Patent for a Multicatheter Infusion System. US-2017-0361063. He is owner of SGM Consulting, LLC and co-owner of FC Monmouth, LLC. None of the above relations influenced the conduct of the present study. All other authors declare no competing interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.bja.2022.04.003>.

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## Use of sildenafil in patients with severe COVID-19 pneumonitis

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Editor—Patients with SARS-CoV-2 infection develop pulmonary vascular dysfunction with immunothrombosis, endotheliitis, pulmonary embolism, and neoangiogenesis of larger vessels.<sup>1–3</sup> These changes contribute to dead-space and shunt, increased pulmonary vascular resistance, and right ventricular (RV) dysfunction,<sup>4</sup> and can be improved by

therapies modulating endothelial function. Of these, inhaled nitric oxide (NO)<sup>5</sup> has pulmonary vasodilating, anti-inflammatory, and potential antiviral properties.<sup>6</sup> The phosphodiesterase type 5 inhibitor sildenafil increases endogenous NO, is well tolerated in patients with lung fibrosis,<sup>7,8</sup> but may worsen shunt in acute respiratory