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Strategies from A Multi-National Sample of Electroconvulsive Therapy (ECT) Services: Managing Anesthesia for ECT during the COVID-19 Pandemic

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Abstract: Electroconvulsive therapy (ECT) is important in the management of severe, treatment-resistant, and life-threatening psychiatric illness. Anesthesia supports the clinical efficacy and tolerability of ECT. The COVID-19 pandemic has significantly disrupted ECT services, including anesthesia. This study documents strategies for managing ECT anesthesia during the pandemic. Data were collected between March and November 2021, using a mixed-methods, cross-sectional, electronic survey. Clinical directors in ECT services, their delegates, and anesthetists worldwide participated. One hundred and twelve participants provided quantitative responses to the survey. Of these, 23.4% were anesthetists, and the remainder were ECT clinical directors. Most participants were from Australia, New Zealand, North America, and Europe. Most were located in a public hospital, in a metropolitan region, and in a 'medium/high-risk' COVID-19 hotspot. Half of the participants reported their services made changes to ECT anesthetic technique during the pandemic. Services introduced strategies associated with anesthetic induction, ventilation, use of laryngeal mask airways, staffing, medications, plastic barriers to separate staff from patients, and the location of extubation and recovery. This is the first multi-national, mixed-methods study to investigate ECT anesthesia practices during the COVID-19 pandemic. The results are vital to inform practice during the next waves of COVID-19 infection, ensuring patients continue to receive ECT.

Keywords: electroconvulsive; ECT; COVID-19; pandemic; impacts; strategies

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1. Introduction

Electroconvulsive therapy (ECT) is important in the management of severe, treatment-resistant, and life-threatening psychiatric illnesses such as depression, schizophrenia, and bipolar disorder [1–3]. Guidelines on the use of ECT in the management of these illnesses have been developed globally [4–6]. Anesthesia, involving an intravenous bolus of a hypnotic agent and a short-acting muscle relaxant, is vital in supporting the clinical efficacy and tolerability of ECT [7].

In ECT anesthesia, the anesthetist is in close contact with the patient for some time, and anesthesia may also generate aerosols [8,9]. Consequently, ECT anesthesia can be considered a high-risk procedure for infection during the COVID-19 pandemic. There are at least six timepoints during ECT—from the pre-anesthetic consultation, to induction and recovery, and during the handling of anesthetic equipment—at which anesthetists are vulnerable for COVID-19 exposure [8]. More broadly, ECT services have faced shortages of anesthetic staff as anesthetists have been re-deployed to intensive care units, and scarcity of

anesthetic medications [10,11]. Strategies to effectively manage these issues are necessary in avoiding the cessation of ECT services during the pandemic, and the associated negative impacts on psychiatric clinical outcomes, which may include relapse and death [12–15].

Despite a number of national [15,16] and small international studies [11,17] about COVID-19 impacts and responses in ECT services, no study has examined this topic in relation to ECT anesthesia. There is also a lack of multi-national and mixed-methods data on the topic. This survey addresses these gaps and is the first to document strategies for managing ECT anesthesia during the COVID-19 pandemic across ECT services worldwide. It is also considers the views of both anesthetists and psychiatrists.

2. Materials and Methods

The study received ethical approval from the Gold Coast Health Human Research Ethics Committee (HREC/2020/QGC/70077). A cross-sectional, mixed-methods electronic survey was used to collect data. A mixed-methods approach was utilized to capture a broader array of responses than could be achieved using either qualitative or quantitative methods in isolation. The survey had 41 quantitative questions (multiple choice and Likert scale), and three qualitative questions (open-ended short-answer), designed to capture learnings to inform ECT anesthesia practice during subsequent waves of COVID-19 infection (see Supplementary File S1 for details). This paper reports on the four quantitative questions and one qualitative question about the impacts of the COVID-19 pandemic on ECT anesthesia; other results are reported elsewhere. The questions are as follows:

Please respond to these questions in relation to at any time since the COVID-19 pandemic started:

1. ***Did your service change anesthetic technique (e.g., bag/mask technique, intubation)?***
   Yes, no
2. ***Which of the following drugs and anesthesia medications could you NOT access? (select all that apply)***
   Propofol, suxamethonium, ketamine, thiopentone, alfentanil, remifentanil, no change, other
3. ***Did shortages of anesthetic staff effect capacity to perform ECT?***
   Yes, no
4. ***Any other comments?***

The questions were devised by SS and GB based on a literature review and clinical practice experience, assessed by members of the Clinical Alliance and Research in Electroconvulsive Therapy (CARE) Network [18], and piloted with clinical directors to ensure clarity. The survey was administered in Microsoft Office Forms. It was open from March and November 2021, after most regions had experienced at least one COVID-19 wave.

The survey was intended for ECT clinical service directors (i.e., clinical leads of ECT services who are likely to be consultant psychiatrists), their delegates, and ECT anesthetists. To participate, a person needed to be an adult, and to have adequate comprehension of written English. If a participant clicked through the participant information sheet on the first page of the survey, then completed and submitted a survey, their informed consent was inferred.

Information about the survey was sent to ECT-related mailing lists and forums worldwide. These included the CARE Network, the Royal Australian and New Zealand College of Psychiatry Section for ECT and Neurostimulation, the Society for ECT and Neurostimulation, the UK ECT Accreditation Service, and Australian state ECT Committees. Recruitment involved 'snowballing', and participants were encouraged to share the survey through their networks.

Quantitative data was analyzed descriptively and inductively. Analysis was completed in Stata, version 20. Counts and percentages were calculated; percentages were calculated using the 'number of possible positive responses' as the denominator.

Qualitative data was analyzed thematically. Analysis was completed manually, following the framework developed by Braun and Clarke [19]. The data was coded, codes grouped into themes, then inter-rater checks completed until a consensus about final

themes and representative quotes was achieved. The researchers (SS, GB, LR, SK worked collaboratively to complete these steps.

3. Results

Table 1 presents information about participants' demographics, and about their ECT services. One hundred and twelve people provided quantitative responses to the survey. Of those that responded, 76.6% (n = 85) were ECT clinical directors or their delegates, and 23.4% (n = 26) were anesthetists involved in ECT. Fifty-nine of the participants provided qualitative responses about anesthetic strategies used during the pandemic. Of these, 66.1% (n = 39) were ECT clinical directors or their delegates, and 33.9% (n = 20) were anesthetists involved in ECT.

Table 1. Demographic information about survey respondents and their ECT services.

Participant and Service Demographics	***n***	**%**
Participant role		
Clinical director	85	76.6
Anesthetist	26	23.4
Service funding structure		
Private	26	23.2
Public	84	75.0
Both	1	0.9
Other	1	0.9
Service location		
Australia	43	38.4
North America	27	24.1
Europe	18	16.1
UK	13	11.6
South/Central America	6	5.4
Asia	3	2.7
Africa	2	1.8
Service region		
Metropolitan	86	76.8
Regional	25	22.3
Rural and/or remote	1	0.9
Community transmission of COVID-19 in service region		
Yes	102	91.1
No	10	8.9
COVID-19 hotspot status in service region		
Low risk	11	9.8
Medium risk	19	17.0
High risk	82	73.2
Lockdown status		
Yes, the service has experienced lockdown/s	104	93.7
No, the service has not experienced lockdown/s	7	6.3

N.B. Percentages were calculated using the 'number of possible positive responses' as the denominator.

The participants were primarily from Australia (75.0%, n = 84), North America (24.1%, n = 27), Europe (16.1%, n = 18), and the United Kingdom (UK) (11.6%, n = 13). Most were based in public hospitals (75.0%, n = 84), and most were in a metropolitan region (76.8%, n = 86). Most participants were in regions which they considered at worst to be 'medium risk' or 'high risk' COVID-19 hot spots (86.9%, n = 101), which had experienced community transmission of COVID-19 (91.1%, n = 102), and which had undergone one or more lockdowns (93.7%, n = 104).

Table 2 presents information about the impacts of the COVID-19 pandemic on ECT anesthesia. Approximately half of the participants (n = 54, 48.2%) reported that their service made change/s to ECT anesthetic technique. The qualitative data identified the use of strategies associated with anesthetic induction, ventilation, use of laryngeal mask airways,

staffing, medications, barriers, and the location of extubation and recovery. These themes are described following.

Table 2. Impacts of the COVID-19 pandemic on ECT anesthesia.

Impacts of the COVID-19 Pandemic on ECT Anesthesia	***n***	**%**
Service changed anesthetic technique		
Yes	54	48.2
No	58	51.8
Shortages of anesthetic staff impacted ECT		
Yes	19	17.0
No	93	83.0
Service had shortages of anesthetic medications ^	13	12.3
Propofol—shortage	4	3.8
Suxamethonium—shortage	5	4.7
Ketamine—shortage	2	1.9
Thiopentone—shortage	5	4.7
Alfentanil—shortage	2	1.9
Remifentanil—shortage	2	1.9
Methohexital—shortage	1	0.9
Other—shortage	0	0.0

^ Frequencies and percentages do not sum to be the total sample size or 100% as more than one response could be selected. N.B. Percentages were calculated using the 'number of possible positive responses' as the denominator.

Changes were made from early in the anesthesia process, prior to induction. Participants reported that their services extended the duration of pre-oxygenation prior to induction. One participant commented that their service used:

"*A longer period of pre-oxygenation . . . for at least 3 min[utes] before . . . induction*" (P54, Clinical Director)

Participants also reported that their services reduced, or ceased, hyperventilation. One participant commented:

"Hyperventilation [was] limited to minimize aerosolization" (P55, Clinical Director)

Another said, *"No hyperventilation"* (P37, Clinical Director).

Participants also discussed changes to ventilation during anesthesia, particularly in relation to the use of bag valve masks. Some services continued with the use of bag valve masks, but altered how these were used. For example, one participant commented:

"[Our service used] a two-person, two-handed technique for mask ventilation . . . to improve mask adjustment" (P54, Clinical Director)

Another said their service used a:

"Bag mask with two hands [and the] anesthetist behind patient" (P67, Clinical Director)

Some services continued with the use of bag valve masks, but only using a filter on the mask and/or in the ventilation system of the procedure room. Participants described using "*individual high-efficiency particulate air (HEPA) filters"* (P11, Clinical Director), and "*HME [heat and moisture exchange] filters"* (P72, Anesthetist).

Certain services continued with the use of bag valve masks in limited circumstances. Usually, this was based on patient need. For example, one participant said:

"After initial titration, we allowed for apnoeic treatment in patients who were deemed safe to do so. [We] used bag mask ventilation only if O2 sats [the patient's blood oxygen saturation] demanded it" (P55, Clinical Director)

Another participant commented: "*No BVM [bag valve masks] except in emergency*" (P70, Anesthetist).

Certain services ceased the use of bag valve masks. However, participants commented on inconsistencies in decisions about cessation at some services. One commented:

"Ultimately individual anesthetists' preferences have prevailed, with some habitually using BVM [bag valve masks] and others avoiding it completely unless marked desaturation occurs" (P58, Clinical Director)

Another participant explained:

"Some anesthetists have avoided bag and mask ventilation but others continued with it. We have three sites delivering ECT all of which have different anesthetists who have their own standards so the delivery was a little inconsistent" (P78, Clinical Director)

Where the use of bag valve masks was ceased, an airway was placed for ventilation, often a laryngeal mask airway. One participant commented that their service:

"changed from usual bag/mask ventilation technique to insertion of LMA [laryngeal mask airway] for airway management/ventilation [as this is] more closed circuit" (P107, Clinical Director)

Another participant said:

"We changed from a bag mask technique to [using an] LMA [laryngeal mask airway] . . . which dramatically changed the way that ECT was conducted" (P111, Anesthetist)

A third participant reflected:

"At one point, LMAs [laryngeal mask airways] were used for all patients to reduce risk of airborne respiratory secretions, but this was not continued very long" (P90, Anesthetist)

Approximately one-fifth of the participants (n = 17, 19.0%) stated that their service experienced shortages of anesthetic staff to the extent that this impacted on the provision of ECT. Services also reported intentionally reducing anesthetic staff, to reduce the risk of infection. One participant said their service was limited to:

"truly essential staff only" (P72, Anesthetist)

A small number of the participants (n = 13, 12.3%) saw shortages of anesthetic medications at their service. Shortages of suxamethonium (n = 5, 4.7%), thiopentone (n = 5, 4.7%), or propofol (n = 4, 3.8%) were the most common. Fewer reported shortages of ketamine (n = 2, 1.9%), alfentanil (n = 2, 1.9%), remifentanil (n = 2, 1.9%), or methohexital (n = 1, 0.9%).

Some of the participants also reported changes in the types and amounts of anesthetic medications used. One participant commented that their service used:

"Lower doses of succinylcholine and methohexital" (P91, Clinical Director)

Another explained:

"Before we used thiopental and etomidate in cases of difficult response; now we restart with thiopental and for complex cases propofol and remifentanil" (P108, Clinical Director)

A third reflected:

"Typically, anesthetic induction includes etomidate 0.15–0.2 mg/kg IV or propofol 1.0 mg/kg IV [intravenous] and succinylcholine 0.5–0.6 mg/kg IV, followed by bag-mask ventilation with 100% oxygen. We have decreased the dose of succinylcholine to 0.3–0.4 mg/kg IV and replaced the bag-mask ventilation with 100% preoxygenation for 5 min. Interestingly, the side effects and complication rates have remained the same, whereas anesthetic recovery time is shorter for some patients" (P51, Clinical Director)

Participants also reported their services introduced anticholinergic medications to reduce airway secretions during anesthesia, and thus reduce infection risk. One participant commented:

"To minimize hypersalivation, [we used] atropine 0.08–0.1 mg/Kg administered intravenously . . . Where available, glycopyrrolate 0.2–0.4 mg administered intravenously may be substituted" (P54, Clinical Director)

Other participants also describe the use of glycopyrrolate, and atropine less commonly.

Participants reported that some services used plastic barriers during anesthesia, to separate staff from patients and reduce infection risk. One participant said their service:

"considered plastic covers during [anesthesia] at [the] provider's discretion" (P24, Anesthetist)

Another commented:

"Once the mouth guard and the bag valve mask are placed, disposable waterproof plastic and a protective airway box [are] placed over the patient's head and the bag valve mask, to reduce aerosol spreading during ventilation" (P55, Clinical Director)

A third participant explained how their service took this further:

"[we] utilized a local negative pressure technique with head contained under plastic, [and] suction isolated to head area" (P63, Clinical Director)

Finally, some services made changes to the location of post-anesthesia extubation and recovery, to reduce infection risk. Often, these activities occurred in the same location as the ECT. One participant said that:

"extubation [now took place] in ECT room" (P73, Anesthetist)

Another said:

"recovery [now took place] in procedure suite rather than recovery area" (P85, Anesthetist)

Table 3 present a cross-tabulation of the key impact variables (changes to anesthetic technique, shortages of anesthetic staff, and shortages of anesthetic medications), against the key service variable (service location) and the key COVID-19 variables (community transmission of COVID-19, COVID-19 hotspot status, and COVID-19 lockdown status). Of interest, most services that reported changes to their anesthetic technique were in Africa (50.0%), Asia (33.3%), and North America (18.5%), in regions without community transmission (60.0%), were in medium-risk hotspot regions (63.2%), and in regions that had experienced at least one lockdown (51.0%). Most services which reported that shortages of anesthetic staff had affected the provision of ECT were in Europe (55.6%) and the UK (38.5%), in regions with community transmission (17.6%), in high-risk hotspot regions (20.7%), and in regions that had not experienced lockdown/s (17.3%). Most services that reported shortages of medications staff were in Africa (50.0%), Asia (33.3%), and North America (18.5%), in regions with community transmission (13.3%), in low-risk hotspot regions (30.0%), and in regions that had not experienced lockdown/s (49.2%).

Table 3. Cross-tabulation of key impact, service, and COVID-variables.

	Changes to Anesthetic Technique			**Shortages of Anesthetic Staff Affecting ECT**			**Shortages of Anesthetic Medications**		
	Yes: *n* (%)	**No: *n* (%)**	**Total: *n* (%)**	**Yes: *n* (%)**	**No: *n* (%)**	**Total: *n* (%)**	**Yes: *n* (%)**	**No: *n* (%)**	**Total: *n* (%)**
Service location									
Australia	24 (55.8)	19 (44.2)	43 (100.0)	3 (7.0)	40 (93.0)	43 (100.0)	4 (10.8)	33 (89.2)	37 (100.0)
North America	12 (44.4)	15 (55.6)	27 (100.0)	1 (3.7)	26 (96.3)	27 (100.0)	5 (18.5)	22 (81.5)	27 (100.0)
Europe	5 (28.8)	13 (72.2)	18 (100.0)	10 (55.6)	8 (44.4)	18 (100.0)	2 (11.1)	16 (88.9)	18 (100.0)
UK	8 (61.5)	5 (38.5)	13 (100.0)	5 (38.5)	8 (61.5)	13 (100.0)	0 (0.0)	13 (100.0)	13 (100.0)
Sth/Ctrl America	3 (50.0)	3 (50.0)	6 (100.0)	0 (0.0)	6 (100.0)	6 (100.0)	1 (16.7)	5 (83.3)	6 (100.0)
Asia	2 (66.7)	1 (33.3)	3 (100.0)	0 (0.0)	3 (100.0)	3 (100.0)	1 (33.3)	2 (66.7)	3 (100.0)
Africa	0 (0.0)	2 (100.0)	2 (100.0)	0 (0.0)	2 (100.0)	2 (100.0)	1 (50.0)	1 (50.0)	1 (100.0)
COVID-19 community transmission									
Yes	6 (60.0)	4 (40.0)	10 (100.0)	1 (10.0)	9 (90.0)	10 (100.0)	1 (12.5)	7 (87.5)	8 (100.0)
No	48 (47.1)	54 (52.9)	102 (100.0)	18 (17.6)	84 (82.4)	102 (100.0)	13 (13.3)	85 (86.7)	85 (100.0)
COVID-19 hotspot status									
Low risk	3 (27.3)	8 (72.7)	11 (100.0)	1 (9.1)	10 (90.9)	11 (100.0)	3 (30.0)	7 (70.0)	10 (100.0)
Medium risk	12 (63.2)	7 (36.8)	19 (100.0)	1 (5.3)	18 (94.7)	19 (100.0)	2 (11.1)	16 (88.9)	18 (100.0)
High risk	39 (47.6)	43 (52.4)	82 (100.0)	17 (20.7)	65 (79.3)	82 (100.0)	9 (11.5)	69 (88.5)	78 (100.0)

Table 3. *Cont.*

	Changes to Anesthetic Technique			Shortages of Anesthetic Staff Affecting ECT			Shortages of Anesthetic Medications		
	Yes: *n* (%)	**No: *n* (%)**	**Total: *n* (%)**	**Yes: *n* (%)**	**No: *n* (%)**	**Total: *n* (%)**	**Yes: *n* (%)**	**No: *n* (%)**	**Total: *n* (%)**
COVID-19 lockdown status									
Yes, lockdown/s	53 (51.0)	51 (49.0)	104 (100.0)	1 (14.3)	6 (85.7)	7 (100.0)	11 (11.2)	87 (88.8)	98 (100.0)
No lockdown/s	1 (14.3)	6 (85.7)	7 (100.0)	18 (17.3)	86 (82.7)	104 (100.0)	3 (42.9)	4 (51.7)	7 (100.0)

Sth/Ctrl = South/Central. N.B. Percentages were calculated using the 'number of possible positive responses' as the denominator.

4. Discussion

This mixed-methods, cross-sectional survey is the first to document strategies for managing ECT anesthesia during the COVID-19 pandemic. It describes the COVID-19 impact and responses in ECT services worldwide, using mixed-methods, and considers the views of both anesthetists and psychiatrists. It is interesting that the survey was intended originally for psychiatrists, and that the focus was not on ECT anesthesia. However, the research was expanded to include anesthetists when the researchers identified anesthetists' enthusiasm to participate, and their willingness to provide detailed, relevant information about their knowledge and what they had learned.

The participants reported changes associated with most aspects of ECT anesthetic practice. They discussed strategies associated with anesthetic induction, ventilation, use of laryngeal mask airways, staffing, medications, barriers, and the location of extubation and recovery. Discussion of these themes must be prefaced with a comment about ECT anesthesia as an 'aerosol generating procedure'. COVID-19 spreads efficiently via aerosols. At the time the survey was administered, anesthesia—and, in particular, tasks such as hyperventilation, bag valve mask ventilation, and intubation/extubation—was widely considered an aerosol generating procedure [9]. However, research has since found that effective face mask ventilation and intubation/extubation during anesthesia does not, in fact, generate large volumes of aerosols [20]. This juxtaposition must be noted when interpreting the results.

Some of the participants in this study reported that their ECT services extended the duration of pre-oxygenation prior to anesthetic induction. Guidelines for ECT services during COVID-19 from North America and Europe recommend at least three minutes of pre-oxygenation with a regular or non-rebreather mask to build oxygen stores for future periods of apnea and significantly reduce the need for later ventilation using a bag valve mask [21–24]. A national study from Canada found that 11% of ECT services increased pre-oxygenation duration during the pandemic [16], and increases were also reported in a single site study from India [8]. One retrospective study from the United States tested a COVID-19 ECT anesthesia protocol focused on rigorous pre-oxygenation using a non-rebreather mask for up to 5 min prior to induction, and found that this reduced the need for bag mask ventilation by >50% without significantly reducing seizure duration or effect [25].

Results of the present study suggested that some services reduced, or ceased, hyperventilation prior to anesthetic induction. Moderate hyperventilation (at up 20 breaths per minute) can improve the duration and clinical effect of a seizure, and reduce the seizure threshold [7]. However, hyperventilation may generate aerosols, and as such, guidelines for ECT services during COVID-19 from North America and Europe generally recommended it be ceased [21,22]. In such cases, some guidelines from North America and Asia recommend administering medications such as ketamine or etomidate to reduce the seizure threshold [8,21]. Nevertheless, it is important to note that some ECT services in North America and Europe continued hyperventilation during the pandemic, with the aim of avoiding the need for later ventilation with a bag valve mask [24,26]. The effects of this on COVID-19 transmission among staff and patients, if any, are unknown.

Given the route of transmission of COVID-19, many strategies implemented throughout the pandemic related to changes in practice with ventilation. Our survey showed that bag valve mask ventilation was continued in limited circumstances in some services during the pandemic, including using a two-handed technique to optimize the seal around the patient's face and in patients experiencing hypoxia. To explain these results, the broader literature agrees that many ECT services around the world continued to use bag valve mask ventilation only with a two-handed technique [23,27,28]. Guidelines for ECT services during COVID-19 from North America also recommend using a head strap to hold the mask in place and optimize the seal [28]. ECT services also continued to use bag valve mask ventilation in hypoxic patients, with a peripheral blood oxygen saturation of $\leq$85% [25] or $\leq$92% [8] variously cited as the trigger. Guidelines from North America and Europe also suggest that bag valve mask ventilation may continue if a low tidal volume is used [22,29], if it is administered in a theatre with negative pressure [21], or even if the patient receives povidone-iodine nasal swabs prior to reduce nasopharyngeal viral burden [28]. If bag valve mask ventilation is used during ECT, the equipment must be rigorously disinfected between patients [22,30].

Some participants in this study also said that their ECT services continued bag valve mask ventilation with the use of filters. Plausible reasons for this are that guidelines for ECT services during COVID-19 from North America and Europe recommend that high-efficiency particulate air (HEPA) filters in particular are placed between the valve and the bag in bag valve masks [24,28]. HEPA filters may also be placed in the ventilation system of the ECT procedure room. A national study from Canada found that 47% of ECT services used HEPA filters [16]. However, at least in the initial stages of the pandemic, there were shortages of HEPA filters in many regions, and ECT services reported needing to save and reuse these for the same patient [24], with uncertain impacts on safety and efficacy. The literature suggests that where HEPA filters are unavailable, ECT services may use high-quality heat and moisture exchanger filters [22,28].

In some services, the use of bag valve mask ventilation was ceased completely during the pandemic. To understand this result, a national study from Canada reports that 26% of ECT services ceased the use of bag valve masks during the pandemic [16]. Some of the participants in this study emphasized inconsistencies in decisions and practices about ceasing bag valve mask ventilation, and the broader literature shows similar problems at other ECT services [8]. Standardized guidelines about bag valve mask ventilation may be useful.

In services where bag valve mask ventilation was ceased, an airway was placed for ventilation, often a laryngeal mask airway. This may be justified by examining guidelines from the United Kingdom for ECT services during COVID-19 which recommend the use supraglottic airways like laryngeal mask airways [31], with research showing that well-positioned, second-generation airways are particularly effective at reducing aerosol generation [32]. It is important to note that some ECT services avoided the use of laryngeal mask airways during the pandemic, with authors questioning the evidence of reduced aerosol generation with laryngeal mask airway insertion, even suggesting they may trigger coughing and therefore increase aerosols [28]. There were also concerns about increased anesthesia time associated with the use of laryngeal mask airways for ECT [8].

Most of the participants reported that ECT services did not experience shortages of anesthetic staff to an extent that impacted ECT delivery. While the broader literature suggests that many ECT services did experience anesthetic staff shortages, at least early in the pandemic, the differences in results may be due to the timing of the survey. For example, a service in Spain reported ceasing the delivery of ECT for nearly two months commencing in March 2020 due the redeployment of anesthetists to intensive care units [33]. However, in many regions, shortages of anesthetic staff resolved as the pandemic progressed. For example, surveys of ECT services in the United Kingdom and Ireland found that in April 2020, 52% experienced a shortage of anesthetists, but by July 2020 this had reduced to just 11% [11].

Some ECT services intentionally reduced anesthetic staff numbers, to control infection risk. To explain this, guidelines for ECT services during COVID-19 from North America and Asia recommend that only 'essential staff', which includes anesthetists, are present in ECT theatres [21,30]. In practice, ECT services often limited staff to an anesthetist, the treating psychiatrist, and a nurse [27,29], and one site in Belgium also reported also including an assistant anesthetist [34]. Interestingly, one ECT service in the United States reported increasing its number of ECT anesthetists to two, to enable effective use of the two-handed technique for bag valve mask ventilation [28]. As anesthetists in larger health services frequently rotate from ECT theatres to other clinical areas, having dedicated ECT anesthetists may help to reduce infection risk [12,22,30].

Few participants in this study reported shortages of anesthetic medications at their service, which is consistent with findings from a study in India [8]. This is interesting, considering shortages of anesthetic medications certainly occurred during the COVID-19 pandemic [10]. It may be explained by the fact that ECT services use smaller volumes of anesthetic medications than other clinical areas, such as surgical theatres. It may also be explained by the fact that many services reduced or ceased ECT delivery at some point during the pandemic [11,12,16,17], and so had lesser need for anesthetic medications.

Although few services experienced shortages of anesthetic medications, some participants in this study did report changes to the types and amounts of medications used. For example, several sites reported lowering doses of succinylcholine and methohexital, and adding propofol and remifentanil for complex cases. A plausible reason for this is that a national study from Canada found that 24% of anesthetists changed the doses of the anesthetic medications they used for ECT procedures, and 16% reported using a different class of anesthetic medication during the pandemic [16]. These changes may have been due to medication shortages, but also in response to the move away from bag valve mask ventilation. For example, some ECT services dosed succinylcholine at the lower end of the safe range to promote quicker return of spontaneous breathing after seizure, and thereby minimize the need for ventilation [24].

Anticholinergic agents such as glycopyrrolate and atropine are often administered during ECT to reduce the likelihood and severity of aspiration, bradycardia, or asystole [7]. Some participants in this study also reported using glycopyrrolate and atropine to control patient salivation and, therefore, reduce infection risk. This makes theoretical sense as guidelines for ECT services during COVID-19 from North America and Europe agree that glycopyrrolate in particular, at a rate of 0.2 to 0.4 mg intravenously, may be used for this purpose [21,23], and its use in practice is reported in the broader literature [22,34]. It is important to note that there have been shortages of glycopyrrolate in some regions, notably in Europe [22]. In such situations, atropine may be used in place of glycopyrrolate. Glycopyrrolate may also lead to patients having an uncomfortably dry mouth in recovery [34], and this must be managed.

Some participants in this study described using plastic barriers to protect anesthetists and other staff from contact with the SARS-CoV-2 virus during ECT anesthesia. This is congruent with guidelines which state that devices recommended for ECT services during COVID-19 from Europe, Asia, and Australia range from flexible plastic sheets or tents, to acrylic boxes or chambers [8,22,23,27,30,35]. ECT patients may feel claustrophobic when placed under these devices while conscious [36]. Devices with a large surface area, and that project away from the patient's face/torso, may be more tolerable [36]. However, it is important to acknowledge that major changes such as the introduction of plastic and/or negatively pressured barriers is a shift away from normal practice, and may increase errors during delivery.

Finally, some participants reported their services began to undertake post-anesthetic extubation and recovery in the same theatre as the ECT itself, to reduce infection risk. Similar practices were undertaken in other services, with the literature reporting that patients were not removed from the ECT theatre until they were no longer coughing [24], until 30 min after the removal of the laryngeal mask airway [35], or until their complete

recovery from anesthesia [8]. This is important as physical distancing (e.g., 1.5 m between beds), ventilation, and other COVID-19 precautions in recovery rooms may be difficult and have significant impacts on time efficiency and patient flow [8,22].

It is interesting that many early guidelines from Asia, Australia, and Europe recommended against delivering ECT to COVID-positive patients [8,22,27]. This seems to have been in the context of concerns regarding cross-infection risk as well as anesthetic risk. It is recognized that there are increased risks of perioperative morbidity (including venous thromboembolism) and mortality associated with anesthesia and current or recent COVID-19 infection [37,38]. For this reason, ECT treatment may be delayed depending on urgency for, ideally, up to 8 weeks. It seems reasonable that COVID-positive patients receive ECT if the psychiatric benefits outweigh the risks. These risks should be discussed with the anesthetist and the treating clinician prior to the procedure. Indeed, there are multiple reports of ECT being delivered safely and with good effect to COVID-positive patients [39–41].

This study has a number of limitations. The survey was only accessible to staff with sufficient written English, and most participants were from high-income regions. Further research is required with the survey translated into multiple languages to increase uptake from non-English speaking countries and expand the sample size. Despite ECT Directors or delegates completing the survey more than anesthetists, it is likely that the Director of ECT services (usually a psychiatrist who is an ECT doctor) would be familiar with any changes in anesthetic technique as the Director of ECT works closely with the anesthetists to deliver ECT treatment as the anesthetic technique has an impact in the outcome of the effectiveness of ECT treatment (e.g., hypnotic agents affecting seizure threshold). Furthermore, both the ECT doctor and anesthesiologist both need to access the patient's head within a very short period of time. As a result, changes in the anesthetic technique may influence how the psychiatrist can deliver ECT.

5. Conclusions

This is the first multi-national, mixed-methods study to document strategies for managing ECT anesthesia during the COVID-19 pandemic. Participants reported a number of strategies including increasing the duration of pre-oxygenation prior to induction; ceasing hyperventilation (to reduce aerosols); ceasing BMV or continuing using a two-handed technique (to reduce escape of aerosols); increasing use of laryngeal masks; use of HEPA filters and use of plastic barriers. Although staff shortages were reported, few identified shortages in medications. Future research could be directed towards identifying how many of these changes continued as ECT services adapted to COVID-normal operation. The purpose of this study was to identify and share different ECT anesthesia practices during COVID-19 which will be important in supporting services to prepare for the next pandemic and allow ECT to continue safely. Although we did not obtain information that was substantial enough to inform evidence-based recommendations our findings can be used to inform future research in this area.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/psychiatryint3040026/s1, File S1: The survey instrument.

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