Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Scoping evidence summary for surgical outcomes in patients with COVID-19

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Scoping evidence summary for surgical outcomes in patients with COVID-19

Key points

- This scoping evidence review includes 19 studies that reported on adverse outcomes of surgical procedures in patients with COVID-19.
- Ten studies reported exclusively or predominantly on caesarean sections. In all but one of these, maternal and neonatal outcomes were generally very good.
- Eight studies involved a variety of surgical procedures and reported some evidence of adverse surgical outcomes for patients with COVID-19, including high mortality rates and pulmonary complications.
- One study reported no serious complications as a result of bronchoscopy.
- While the quality of the evidence included in this summary is low overall and limited mainly to small studies without a control group, there is growing evidence of adverse surgical outcomes for patients diagnosed with COVID-19 in the perioperative period.
- Given the risk of nosocomial infection for both other patients and healthcare workers, thorough pre-screening and testing of surgical patients, and where possible, postponement of surgery for patients who test positive for SARS-CoV-2, appear prudent.

Scoping evidence summary for surgical outcomes in patients with COVID-19

The Health Information and Quality Authority (HIQA) has developed a series of 'Evidence Summaries' to assist the acute operations sub-group of the Clinical Expert Advisory Group (EAG) in supporting the National Public Health Emergency Team (NPHET), as well as those developing infection prevention and control guidance in their response to COVID-19. These summaries are based on specific research questions. This draft scoping evidence summary was developed to address the following research question:

> **Is there evidence of increased risk of adverse outcomes of surgical procedures in patients with COVID-19 (confirmed either pre or post-surgery)?**

The processes as outlined in HIQA's *'Protocol for care pathways support for the resumption of scheduled hospital care in the context of COVID-19'* were followed. Below is a summary of relevant evidence identified in the scoping review until 15 May 2020.

Background

In response to the COVID-19 pandemic, and following recommendations from the National Public Health Emergency Team, non-essential scheduled hospital care in Ireland was largely postponed as of 27 March 2020, representing an unprecedented interruption to activity. Data communicated internally by the HSE Quality Improvement Division showed a substantial drop in emergency department attendance. While a steady return to care has been observed since early April, figures for the period 1-17 May 2020 remained 27% lower than those observed for the same period in 2019.[1] Evidence also indicates a reduction in public attendance for unscheduled hospital care activity,[1, 2] thought to be a consequence of public apprehension of contracting the virus within the hospital setting. Given the continuing threat of SARS-CoV-2 infection within the Irish population, resumption of hospital services will occur within a context of ongoing risk of infection to both patients and healthcare staff, and the associated risks to the overall health service.

The Government of Ireland's Roadmap for Reopening Society & Business[3] indicated a planned increase in the "delivery of non-COVID-19 care and services alongside COVID-19 care to meet demand" across phases 1 and 2 of the roadmap. Resumption of scheduled care within the Irish hospital setting must continue to

occur in a planned, appropriate manner which optimises patient care while minimising risks to the public, to healthcare staff, and to the wider health service.

As routine and non-urgent procedures increase in Irish hospitals, the likelihood of such procedures being performed on patients who may be asymptomatic, or in the pre-symptomatic phase of SARS-CoV-2 infection, increases. This scoping review summarises evidence on the risk of adverse outcomes of surgical procedures in patients with COVID-19.

Methods

A protocol outlining the methodology of this evidence summary was developed by HIQA, which was followed throughout its conduct. A scoping literature search was undertaken between 13 May 2020 and 15 May 2020.

Results

The scoping searches identified 16 studies.[4-19] A further three studies[20-22] were identified from studies included in a systematic review on maternal and perinatal outcomes of COVID-19.[23] Fourteen studies were case series,[4-7, 9-15, 20-22] three were cohort studies[17-19] and two were case control studies.[8, 16] Fourteen studies were set in China,[5-8, 10, 11, 13-17, 20-22] two studies each were set in Iran[4, 9] and Italy,[12, 18] and one study included data from 24 countries.[19] Ten studies reported exclusively or predominantly on caesarean sections,[6, 7, 9, 14-17, 20-22] four involved a variety of surgeries,[4, 10, 11, 19] and one study each focused on surgery for cancer,[8] liver transplant,[12] orthopaedic surgeries,[13] surgery for acute limb ischaemia,[18] or bronchoscopy.[5] Sample sizes ranged from two to 1,128 patients. A wide range of adverse outcomes (or absence thereof) were reported by the included studies, including mortality,[4, 6, 8-13, 17-21] pulmonary complications or development of severe pneumonia,[4, 6, 8, 10, 11, 17, 19, 20] pulmonary embolism,[19] intra-operative blood loss,[16] intensive care unit (ICU) admissions,[8, 10, 15, 22] and neonatal outcomes including birth weight, asphyxia, SARS-CoV-2 infections and or mortality.[6, 7, 9, 14-16, 20-22] Three studies also reported on SARS-CoV-2 infection of healthcare workers.[5, 7, 17] Further details of the 19 studies are listed in Table 1.

Outcomes of mixed surgical procedures

The two largest studies reported on outcomes of a variety of surgical procedures, including caesarean sections, gastrointestinal and general surgeries, neurosurgery, orthopaedic, cardiothoracic, hepatobiliary, head and neck, urological and vascular surgery.[10, 19]

The COVIDSurg study, which was published on 29 May 2020, included 1,128 patients from 235 hospitals in 24 countries, undergoing a variety of surgical procedures. Patients were confirmed with SARS-CoV-2 infection within seven days preceding or 30 days following surgery.[19] The majority of the surgeries were emergency procedures (74%). The overall 30-day mortality was 23.8%. All-cause mortality rates were 18.9% in elective patients, 25.6% in emergency patients, 16.3% in patients undergoing minor surgery, and 26.9% in patients undergoing major surgery. In adjusted analyses, 30-day mortality was associated with male sex, age ≥70 years, American Society of Anesthesiologists (ASA) physical status grades 3-5 (indicating severe systemic or life threatening disease) compared with grades 1-2 (indicating healthy patients or mild systemic disease), malignant compared with benign/obstetric diagnosis, emergency compared with elective surgery, and major versus minor surgery. Pulmonary complications occurred in 51.2% of patients, with a 30-day mortality rate of 38.0%, accounting for 81.7% of all deaths. The authors recommended that thresholds for surgery during the SARS-CoV-2 pandemic should be raised compared with normal practice, particularly in men aged 70 years and over. The authors also suggested that postponing non-urgent procedures and promoting non-operative treatment to delay or avoid the need for surgery should be considered.

Lei et al. reported a case series of 34 patients in China who underwent 22 different types of elective surgeries during the incubation period of COVID-19.[10] All patients developed COVID-19 pneumonia shortly after surgery. Fifteen patients (44%) required ICU admission during disease progression and seven patients (21%) died following admission to ICU. The authors noted that this mortality rate was higher than the reported overall case-fatality rate of 2.3% in COVID-19 patients without surgery reported in the literature reviewed by the authors. Other outcomes included acute respiratory distress syndrome (ARDS), shock, secondary infection, arrhythmia, acute cardiac injury, and acute kidney injury.

Li et al. included 13 patients with COVID-19 (12 of whom were laboratory confirmed) from a thoracic surgery department in China.[11] Eleven patients underwent lung surgery and two had oesophageal surgery. Seven of the 13 patients developed severe disease, and five patients died (38.5%). The authors compared these outcomes to those of 12 healthcare staff with suspected, clinically diagnosed COVID-19, and noted that outcomes for surgical patients were significantly worse. However, healthcare staff were significantly younger than the surgical patients and COVID-19 was laboratory confirmed in only seven of the 12 staff members.

A small case series by Aminian et al. included four patients in Iran, three of whom underwent different surgical procedures, with one patient dying prior to his

scheduled surgery.[4] Two patients were confirmed as COVID-19 positive using RT-PCR. Three patients developed postoperative fever and pulmonary complications after what the authors described as uneventful elective operations. Two patients died, while one patient survived. The time from operation to symptom onset ranged from 2 days to 18 days; therefore, nosocomial infection cannot be ruled out.

Outcomes of caesarean sections

Ten studies, nine of which were conducted in China, reported exclusively or predominantly on caesarean sections.[6, 7, 9, 14-17, 20-22] Of these, one study also included a minority of patients undergoing lower limb surgery.[17] This cohort study by Zhong et al. included 45 pregnant women with COVID-19 who had caesarean sections and four patients with COVID-19 who underwent lower limb surgery.[17] The authors noted that none of the patients developed severe pneumonia or died of COVID-19 pneumonia after surgery. However, follow-up may have been insufficient for surgeries conducted towards the end of the study period, while positive confirmation of COVID-19 by RT-PCR was recorded in only 13 of the 49 patients. A case control study of pregnant women undergoing caesarean sections by Zhang et al. included 16 women with COVID-19 and 45 women without COVID-19.[16] Of the 16 women with COVID-19, 15 cases were mild or moderate, with one case of severe disease. None progressed to critical pneumonia.[16] The authors reported that there were no significant differences between the two groups in preterm birth, foetal distress, intraoperative blood loss, meconium-stained amniotic fluid, neonatal birth weight or neonatal asphyxia.

Seven case series[6, 7, 14, 15, 20-22] reported good maternal and neonatal outcomes for pregnant women with COVID-19 who had a caesarean section. Chen R. et al. reported on 17 pregnant women with COVID-19 who underwent caesarean sections. There were no deaths or serious neonatal asphyxia events; however, 12 of the women experienced significant intraoperative hypotension.[7] The authors noted that three of the neonates were born prematurely, while three women were still recovering at the time of writing and were receiving treatment for COVID-19 in hospital. Liu H. et al. included 16 pregnant women with COVID-19 (six laboratory confirmed infections and 10 clinically diagnosed) who had caesarean sections.[22] The authors reported that none of the women were admitted to ICU, and no clinical abnormalities were observed in the infants.[22] Liu D. et al. included 15 SARS-CoV-2 positive pregnant women, ten of whom gave birth by caesarean section.[21] No patient or neonate died during the follow up period, although only two women had been discharged from hospital. The authors also reported no neonatal asphyxia.

Chen H. et al. included nine pregnant women with COVID-19 who had caesarean sections. None of the patients developed severe pneumonia or died, with no neonatal asphyxia observed in the newborns.[6] Yu et al. included seven pregnant women with COVID-19, all of whom gave birth by caesarean section. The authors reported that the maternal, foetal, and neonatal outcomes of patients who were infected in late pregnancy appeared very good, with no ICU admissions for mothers.[15] Neonatal birth weights and Apgar scores were also normal.[15] A study by Xu et al included five pregnant women with COVID-19, four of whom had caesarean sections. The authors reported that all five women gave birth safely and none of the babies developed any respiratory systems or pneumonia-associated symptoms.[14] A small case series by Chen S. et al. included three pregnant women who underwent caesarean sections.[20] Two women had RT-PCR confirmed COVID-19, the third was clinically diagnosed. None of the women progressed to severe illness or died, although one remained in isolation at the time of publication. Low birth weight was reported in one of the neonates.[20]

One case series by Hantoushzadeh et al. focused exclusively on cases of maternal death due to severe COVID-19 in Iran.[9] This study included nine pregnant women with COVID-19, of whom six had caesarean sections. Seven of the women died, while one remained critically ill at the time of writing. Four of the women who died had caesarean sections. Three of these had babies who survived; one woman had twins who both died neonatally. Two women who had caesarean sections suffered severe morbidity, but survived; one of the babies died.[9] It is unclear to what extent findings from this study generalise to all pregnant women with COVID-19.

Outcomes of other surgeries

Four studies reported outcomes of other surgical procedures. In an Italian study, Bellosta et al. included 20 patients with acute limb ischaemia, 17 of whom underwent operative treatment.[18] COVID-19 was identified through preoperative computed tomography; it is not clear if it was also laboratory confirmed. Five of the 17 surgical patients (29.4%) died in hospital.[18] The authors also noted that successful revascularisation in patients who underwent the surgical procedure was lower than expected, which the authors suggested might have been due to a virus-related hypercoagulable state. Maggi et al. included 17 liver transplant patients in Lombardy, Italy, 13 of whom were screened for SARS-CoV-2 prior to surgery. Medical complications occurred in six patients, five of whom were repeat tested. Two patients subsequently tested positive. One of the patients, who was also HIV positive, was found to be SARS-CoV-2 positive on day 22 post-surgery, and died seven days later. The second patient tested positive for SARS-CoV-2 on day nine post-transplant, and was discharged alive at the end of the study period. The

authors acknowledged that the patient who died most likely acquired COVID-19 post-transplant; but suggested that it is unclear if the second patient had a false-negative result prior to surgery, or acquired the infection in the post-operative period.[12]

In a Chinese study, Mi et al. included 10 patients with fractures, seven of whom had nosocomial infections.[13] Three patients, two of whom had COVID-19 positive RT-PCR results, underwent orthopaedic surgeries. Two of these patients also had other viral co-infections. One of the surgical patients with underlying cirrhosis and Alzheimer's disease died and the other two patients developed severe pneumonia. In total, four of the 10 patients died. The clinical outcomes for the surviving patients were not known at the time of writing.[13] The authors suggested that the clinical characteristics and early prognosis of COVID-19 in patients with fracture tended to be more severe than those reported for adult patients with COVID-19 without fracture, and that surgical treatment should be carried out cautiously. Dai et al. included 105 patients with cancer, of whom eight underwent surgery within 40 days before the onset of COVID-19 symptoms.[8] The authors reported that patients who received surgical treatment demonstrated higher rates of death, higher chances of ICU admission, higher chances of having severe or critical symptoms, and higher use of invasive ventilation than patients who received other treatments (excluding immunotherapy). However, it is not clear if SARS-CoV-2 infection was present at the time of surgery, or was acquired in the post-operative period.

Outcomes of scoping procedures

One study from China was identified that reported on outcomes of bronchoscopy in patients with confirmed COVID-19. Cai et al. included 12 patients with COVID-19 in respiratory failure.[5] All patients successfully completed transnasal endotracheal intubations under the guidance of bronchoscope, with no serious complications reported.[5]

Study quality

The case series studies were generally well conducted, although this study design lacks a control group and is considered low quality evidence overall. Not all COVID-19 infections were laboratory-confirmed and the length of follow up for some studies may have been insufficient to detect all outcomes for surgeries conducted towards the end of the study period. Not all case series included consecutive patients. The case control study by Zhang et al. provided insufficient information on matching, measurement and control of confounding, and was rated as low quality.[16] The strongest evidence comes from a cohort study by the COVIDSurg Collaborative,

which had a clear research question and population of interest, clear inclusion and exclusion criteria and appropriate analysis.[19] However, this study lacked a suitable comparison group and not all participants had laboratory confirmed COVID-19 (85.9% confirmed by laboratory testing).

Discussion

Sixteen studies[4-19] were identified from the scoping searches conducted for this evidence summary, with a further three studies identified from a recent systematic review on maternal and perinatal outcomes of COVID-19.[23] Ten studies[6, 7, 9, 14-17, 20-22] reported exclusively or predominantly on caesarean sections; in all but one of these, maternal and neonatal outcomes were generally very good. One case series[9] specifically focused on maternal death due to severe COVID-19; it is unclear to what extent findings from this study generalise to all pregnant women with COVID-19. The systematic review[23] of maternal and perinatal outcomes of COVID-19 in 108 pregnant women included data from 14 case reports in addition to four of the case series[16, 20-22] included in this evidence summary. This systematic review reported three ICU admissions and no maternal deaths; however, there was one neonatal and one intrauterine death. The authors also noted that COVID-19 during pregnancy may be associated with severe maternal morbidity, although the extent to which this could be driven by complicated medical histories of women with high risk pregnancies is not clear.

The largest included study, by the COVIDSurg Collaborative, reported that postoperative pulmonary complications occurred in half of patients with perioperative SARS-CoV-2 infection, and were associated with high mortality; both the rate of mortality and pulmonary complications were higher than expected.[19] Lei et al. similarly reported high mortality rates and other complications in COVID-19 patients who underwent surgical procedures.[10] However, a number of criticisms of this study have been published. A letter by Shakiba and Irani highlighted that all of the non-survivors in Lei et al. had at least one comorbidity, with 57% suffering from different malignancies, which may have contributed to the mortality rate.[24] Similarly, Di Maida et al. highlighted the lack of comparison with a condition and age-matched control group of COVID-19 negative patients, as well as the lack of data on outcomes of non-surgical hospitalised patients in the same period.[25]

Overall, the quality of the evidence on surgical outcomes in patients with COVID-19 included in this evidence summary is low and mostly limited to small case series. Most of the included studies were not specifically designed to assess post-operative outcomes in patients with COVID-19, but included reports of sub-groups of patients who underwent surgery. The strongest evidence comes from the COVIDSurg study,

which was a good study overall but lacked a comparison group and included patients (14%) who were not laboratory-confirmed COVID-19.[19] In studies where patients tested positive post-surgery, it was not always clear if SARS-CoV-2 infection was present at the time of surgery, or acquired during the post-operative period, as the timing of positive test results varied within and across studies.

A review by Nahshon et al. published on 16 May 2020 considered the evidence on patients with COVID-19 who were asymptomatic pre-surgery and did not undergo testing.[26] This review included data on a total of 64 patients, 51 of whom were diagnosed with COVID-19 post-operatively. The review included one case report in addition to three of the case series[4, 10, 11] included in this evidence summary. The authors calculated a pooled post-operative mortality rate of 27.5%, as well as highlighting severe pulmonary complications and medical staff exposure and transmission. While there is a need for further well-designed studies, the authors recommended screening all asymptomatic patients prior to surgical treatment.

A matched cohort study published on 12 June 2020, after completion of this evidence summary, included 41 patients who tested positive for SARS-CoV-2 before or within five days post-surgery, with a matched control group of 82 surgical patients who did not have COVID-19.[27] 30-day mortality and complications were significantly higher for surgical patients with COVID-19 compared with control patients without COVID-19. While the sample size was small and controls were mainly selected from historical cases due to a lack of control patients during the study period, this is one of the first studies of surgical outcomes in patients with COVID-19 to have included a control group. The authors concluded that as far as possible, surgery should be postponed in patients with COVID-19.[27]

One study was identified that reported on patient outcomes following bronchoscopy, with no serious complications reported. Studies that reported only patient or healthcare worker SARS-CoV-2 infections in the context of scoping procedures were excluded from this summary. These studies were included in a related scoping evidence summary that examined the effectiveness of pathways put in place to enable the resumption of scheduled hospital-based care postponed or cancelled due to mitigation measures implemented in the context of a pandemic respiratory virus.

Given the risk of nosocomial infection for both other patients and healthcare workers, thorough pre-screening and testing of surgical patients, and where possible, postponement of surgery for patients who test positive for SARS-CoV-2, appear prudent.

Conclusion

This scoping summary identified 19 studies that reported outcomes of various surgical procedures in patients with COVID-19. While the quality of the evidence included in this summary overall is low and limited to mostly small studies without a control group, there is growing evidence of adverse surgical outcomes for patients who test positive for SARS-CoV-2 in the perioperative period. The majority of studies focusing on caesarean sections reported good maternal and neonatal outcomes. No serious complications were reported by one study of bronchoscopy in patients with COVID-19.

Table 1. Characteristics of included studies

Author Country Study design DOI	Population setting Sample description Procedure type	Outcomes	Comments/ conclusions
Aminian et al.[4] **Iran** **Case series** https://doi.org/10.1097/SLA.0000000000003925	**Setting** Data collected in February 2020. **Sample description** N=4, 3 of whom underwent surgery. *Sex:* One male and two females. *Age*: 75 years, 81 years and 54 years. **COVID-19 diagnosis** 2 of the 3 cases were confirmed as COVID-19 positive using RT-PCR. **Procedure type** 3 different surgeries (Cholecystectomy, hernia repair and hysterectomy).	**Primary Outcome** Three patients developed postoperative fever and pulmonary complications after uneventful elective operations. Two operations were performed before the official announcement of the COVID-19 outbreak in Iran. Two of these patients died and the third survived. Time from operation to symptom onset was 18 days in patient 1, 14 days in patient 2 and 2 days in patient 3. Therefore, infection may have occurred in the postoperative period.	**Authors' comments** COVID-19 can complicate the perioperative course with diagnostic challenges and a high potential fatality rate. Depending on the severity of an epidemic and availability of resources, the risk and benefits of performing elective surgical procedures should be carefully assessed in this setting.
Bellosta et al.[18] **Italy** **Cohort Study** https://doi.org/10.1016/j.jvs.2020.04.483	**Setting** Single centre study. Patients with acute limb ischaemia confirmed for SARS-CoV-2 pre-operatively during the period January to March 2020. **Sample description** N=20 *Age:* Mean 75 years (SD 9 years; range, 62-95 years) *Sex:* Male, 18 (90%); Female, 2 (10%)	**Primary Outcomes** The incidence rate of patients presenting with ALI in 2020 was significantly greater than that for the same months in 2019 (23 of 141 [16.3%] vs 3 of 163 [1.8%]; P <.001)]. Of the 20 patients, eight (40%) died in the hospital. The patients who died were significantly older (81+/-10 years vs 71+/-5 years; p =.008). Three of the 8 patients did not undergo revascularisation due to severe COVID-19 related pneumonia. Therefore 5 of 17 (29.4%) died after revascularisation. The use of continuous	**Authors' interpretation** The incidence of ALI has significantly increased during the COVID-19 pandemic in the Italian Lombardy region. Successful revascularisation was lower than expected, which was believed to be due to a virus-related hypercoagulable state.

	All patients with a medical history positive for atrial fibrillation (n=5; 25%) were taking oral anticoagulants at admission. The acute limb ischaemia (ALI) stage at admission was Rutherford stage IIa in 2 patients (10%), IIb stage in 15 patients (75%), and stage III in 3 patients (15%). The mean preoperative Society of Vascular Surgery (SVS) score was 6 +/- 4 (range, 1-15). **COVID-19 diagnosis** Preoperative computed tomography was performed to identify COVID-19-related pneumonia. It is not clear if COVID-19 was laboratory-confirmed. **Procedure type** Patients treated for ALI. Operative treatment was performed in 17 patients (85%).	postoperative systemic heparin infusion was significantly associated with survival (0% vs 57.1%; P = .042). **Other outcomes** Revascularisation was successful in 12 of the 17 (70.6%), which was considered a high technical failure. This might have resulted from an inherent virus-related underlying hypercoagulability state.	
Cai et al.[5] **China** **Case series** https://doi.org/10.3760/cma.j.cn112147-20200222-00153 **Full text in Chinese**	**Setting** COVID 19 patients in respiratory failure, with tracheal intubation under guidance of bronchoscope. Data collection January 20 to February 10. **Sample description** N=12 *Age:* Median 65 years (range 41-84 years). *Sex:* Male, 9; Female, 3. **COVID-19 diagnosis** SARS-CoV-2 infection confirmed by RT-PCR. Eight cases were positive for nucleic acid three days before intubation (pharyngeal	**Primary outcome** Twelve patients successfully completed tracheal intubation under the guidance of bronchoscope, all were transnasal endotracheal intubations. There were no serious complications during all operations. **Other outcomes** Nine medical staff were involved in the procedures (wearing full PPE), none developed COVID 19.	**Authors' comments** There are several advantages of using a bronchoscope to guide tracheal intubation. 1. There is no need to be close to the patient's mouth, the operator is more than 50 cm away from the patient's mouth, this can greatly reduce the risk of contamination by droplets and secretions. 2. It can be operated directly by ICU doctors, no

	swab, blood or lower respiratory tract secretions), two cases were confirmed positive one day post intubation, one case three days post intubation, and one case six days post intubation. **Procedure type** Bronchoscopy.		anaesthesiologist is needed, and the rescue time can be shortened when the condition is critical. 3. The vision is clear during operation, and the lower respiratory tract is checked at the same time. Disadvantages: it is required to be done by a doctor who is skilled in bronchoscopy. Special equipment is required, and the sterilisation requirements are also high at the end of the operation.
Chen H. et al.[6] **China** **Case series** https://doi.org/10.1016/s0140-6736(20)30360-3	**Setting** Pregnant women in hospital in China who underwent a caesarean section in their 3rd trimester between 20 Jan and 31 Jan. **Sample description** N=9 *Age:* range 26 to 40 years *Gestational age at admission:* range 36 weeks to 39 weeks plus 4 days. None of the patients had underlying diseases such as diabetes, chronic hypertension, or cardiovascular disease. **COVID-19 diagnosis**	**Primary outcomes** Foetal distress was monitored in two cases. Five of nine patients had lymphopenia (<1.0 × 10^9 cells per L). Three patients had increased aminotransferase concentrations. None of the patients developed severe COVID-19 pneumonia or died, as of Feb 4, 2020. Nine live births were recorded. No neonatal asphyxia was observed in new born babies. All nine live births had a 1-min Apgar score of 8-9 and a 5-min Apgar score of 9-10. Amniotic fluid, cord blood, neonatal throat swab, and breast milk samples from six patients were tested for SARS-CoV-2, and all samples tested negative for the virus.	**Authors' interpretation** The clinical characteristics of COVID-19 pneumonia in pregnant women were similar to those reported for non-pregnant adult patients who developed COVID-19 pneumonia. Common symptoms at the onset of COVID-19 pneumonia for these women included a fever and cough, whereas less common symptoms were myalgia, malaise, sore throat, diarrhoea, and shortness of breath.

	Laboratory confirmed. Maternal throat swabs positive for SARS-CoV-2. **Procedure type** Caesarean sections.		
Chen, S. et al.[20] **China** **Case Series** https://doi.org/10.3760/cma.j.cn112151-20200225-00138 **English abstract, full text in Chinese**	**Setting** Pregnant women in hospital in China who underwent a caesarean section between 22 January and 4 February **Sample description** N=3 *Age*: range 23 -34 years All three cases were considered mild COVID 19. **COVID-19 Diagnosis** Two patients confirmed by RT-PCR and 1 patient clinically diagnosed. **Procedure type** Caesarean section.	**Primary Outcome:** As of February 25, 2020, none of the 3 women had progressed to severe illness or death (2 patients recovered and were discharged, and 1 patient was transferred to the isolation hospital for isolation treatment). Three cases of neonatal pharyngeal swabs were negative for 2019-nCoV nucleic acid test. One case was transferred to the neonatology department due to low birth weight. **Other outcomes**: Three cases were accompanied by fever (1 case of prenatal fever, 2 cases of postpartum fever), without obvious leukopenia and lymphopenia.	**Authors' interpretation:** The clinical manifestations of 3 pregnant women with 2019-nCoV infection in the third trimester in this group were similar to those in non-pregnant patients, and no serious adverse pregnancy outcomes were found. Pathological analysis showed that the placental tissue lacked morphological changes related to viral infection. No intrauterine maternal-foetal vertical transmission was found.
Chen, R. et al.[7] **China** **Case series** https://doi.org/10.1007/s12630-020-01630-7	**Setting** Pregnant woman in hospital in China who underwent a caesarean section between 30 Jan and 23 Feb. **Sample description** N=17 *Age:* Epidural anaesthesia group: mean 29.5 (SD 3.1) yrs; general anaesthesia group: mean 28.7 (SD 1.6) yrs.	**Primary outcomes** The clinical characteristics of 17 pregnant women infected with SARS-CoV-2 were similar to those previously reported in non-pregnant adult patients. All of the 17 patients underwent Caesarean delivery with anaesthesia performed according to standardised anaesthesia/surgery procedures. Fourteen of the patients underwent continuous epidural anaesthesia with 12 experiencing significant intraoperative hypotension. Twelve of these patients recovered and	**Authors' interpretation** Both epidural and general anaesthesia were safely used for Caesarean delivery in the patients with COVID-19. The incidence of hypotension during epidural anaesthesia appeared excessive.

	Gestational age: Epidural anaesthesia group: 79% (11) >= 37 weeks; general anaesthesia group: 100% (3) >=37 weeks. Epidural anaesthesia: Eight (57%) with coexisting disorders, 5 with anaemia, 1 with hypertension and 2 with diabetes. General anaesthesia: No coexisting disorders. **COVID-19 diagnosis** Confirmed as SARS-CoV-2 by RT-PCR from nasal swabs. 5 women (29%) had anaemia, 1 (6%) had gestational hypertension, 2 (12%) had gestational diabetes. All women were in a stable condition during pregnancy. 5 patients (29%) with COVID-19 had lymphopenia. 7 patients (41%) had elevated concentrations of C-reactive protein. All presented with multiple patchy ground-glass opacities on chest CT scan. **Procedure type** Caesarean section	were discharged from hospital, two patients still recovering from delivery and receiving in-hospital treatment for COVID-19. Three patients received general anaesthesia with tracheal intubation because emergency surgery was needed. One of these patients are still recovering from their Caesarean delivery and was receiving in-hospital treatment for COVID-19. Three neonates were born prematurely, but none had a birthweight <2,500g. The Apgar scores ranged from 7 to 9 at one minute and 9 to 10 at five minutes. There were no deaths or serious neonatal asphyxia events. All neonatal SARS CoV-2 nucleic acid tests were negative. **Other outcomes:** No medical staff were infected throughout the patient care period.	
COVIDSurg Collaborative[19] 24 countries including the USA, UK, 12 European countries	**Setting** Multi-centre study, surgery undertaken in hospital between 1 Jan and 31 March. Patients confirmed with SARS-CoV-2 infection within 7 days preceding or 30 days following surgery (Consecutive patients enrolled).	**Primary outcome measure postoperative mortality** Overall 30-day mortality was 23.8% (268/1128) and was high across all patient subgroups; all-cause mortality rates were 18.9% in elective patients, 25.6% in emergency patients, 16.3% in patients undergoing	**Authors' interpretations** Postoperative pulmonary complications occur in half of patients with perioperative SARS-CoV-2 infection and are

(including Ireland), Mexico, Sudan, Libya, Jordan, Israel, Egypt, Azerbaijan and Algeria) **Cohort study** https://doi.org/10.1016/S0140-6736(20)31182-X	**Sample description** N=1128 patients from 235 hospitals. *Age:* <50 years, 19.0% (214/1128); 50-69 years, 31.3% (353/1128); ≥70 years, 49.5% (558/1128). [Age was missing for three patients.] *Sex:* Male, 605 (53.6%); Female, 523 (46.4%) **COVID-19 diagnosis** SARS-COV-2 confirmed pre-operatively in 294/1128 (26.1%). SARS-CoV-2 diagnosis was confirmed by laboratory testing in 85.9% (969/1128) of patients, radiological findings in 7.1% (80/1128), and clinical findings in 6.0% (68/1128), with method of diagnosis missing for 11 patients. Emergency surgery in 835/1128 (74.0%) and elective surgery in 280/1128 (24.8%) (missing in 13 patients). Indications for surgery were benign disease in 54.5% (615/1128), cancer in 24.6% (278/1128), and trauma in 20.1% (227/1128), with indication missing for 8 patients. A total of 22.3% (251/1128) of procedures were categorised as minor and 74.6% (841/1128) as major, with grade of surgery missing for 36 patients. **Procedure type**	minor surgery, and 26.9% in patients undergoing major surgery. In adjusted analyses, 30-day mortality was associated with male sex (OR 1.75, 95% CI 1.28-2.40, p<0.001), age ≥70yrs vs age <70 yrs (OR 2.30, 95% CI 1.65-3.22, p<0.001), American Society of Anesthesiologists. (ASA) physical status grades 3-5 vs grades 1-2 (OR 2.35, 95% CI 1.57-3.53, p<0.001), malignant vs benign obstetric diagnosis (OR 1.55, 95% CI 1.01-2.39, p=0.046), emergency vs elective surgery (OR 1.67, 95% CI 1.06-2.63, p=0.026), and major vs minor surgery (OR 1.52, 95% CI 1.01-2.31, p=0.047). Overall 7-day mortality was 5.2% (59/1128). Postoperative diagnosis was associated with decreased risk (OR 0.25, 95% CI 0.13-0.46, p<0.001). **Secondary outcome measure - pulmonary complications** Pulmonary complications occurred in 51.2% (577/1128) of patients; these patients had a 38.0% (219/577) 30-day mortality, accounting for 81.7% (219/268) of all deaths. Pulmonary complications were associated with high 30-day mortality rates across elective patients with a postoperative SARS-CoV-2 diagnosis (28.3%, 39/138), emergency patients with a preoperative SARS-CoV-2 diagnosis (39.6%, 53/134), and emergency patients with a postoperative SARS-CoV-2 diagnosis (43.1%, 125/290). Pulmonary complication rates were similar in patients with laboratory confirmed and clinically	associated with high mortality. Thresholds for surgery during the SARS-CoV-2 pandemic should be raised compared to normal practice, particularly in men aged 70 years and over. Consideration should be given for postponing non-urgent procedures and promoting non-operative treatment to delay or avoid the need for surgery.

	Procedures included gastrointestinal and general (33.1%, 373/1128), orthopaedic (26.8%, 302/1128), cardiothoracic (7.6%, 86/1128), hepatobiliary (5.5%, 62/1128), obstetric (4.5%, 51/1128), vascular (4.0%, 45/1128), head and neck (3.6%, 40/1228), neurosurgery (3.5%, 39/1128), urological (3.3%, 37/1128), and other (5.1%, 58/1128) surgeries. Procedure was missing for 36 patients.	diagnosed SARS-CoV-2 infection (50.9% [493/969] versus 47.1% [32/68], p=0.54). **Other outcome data** Rate of pulmonary embolism at 30-days was 2.0% (22/1128). 30-day mortality rate in patients with pulmonary embolism was equivalent to that in patients who did not have pulmonary embolism (22.7% [5/22] vs 23.8% [263/1106], p=0.91). In a sensitivity analysis including only patients with laboratory-confirmed SARS-CoV-2, the overall 30-day mortality rate was 23. 7% (230/969), and pulmonary complications occurred in 50.9% of patients (493/969). In adjusted analyses, predictors of 30-day mortality were consistent with the main analysis: male sex, age 70 years or older, ASA grades 3.5, cancer surgery, and emergency surgery. In a sensitivity analysis including only patients with preoperatively diagnosed SARS-CoV-2, the overall 30-day mortality rate was 21.1% (62/294) and pulmonary complications occurred in 48.3% (142/294) of patients. In adjusted analyses, predictors of 30-day mortality were male sex and ASA grades 3-5.	
Dai et al.[8] **China** **Case control study**	**Setting** Multicentre study with confirmed cases of COVID-19 with cancer from 14 hospitals in Hubei, China. January 1 to February 24 2020. Only cancer treatments within 40 days before the onset of COVID-19 symptoms were considered for this study. Included COVID 19 patients without cancer as a control group.	**Primary Outcomes** Among the 105 COVID-19 patients with cancer in the study, 13 (12.4%) had radiotherapy, 17 (16.2%) received chemotherapy, 8 (7.6%) received surgery, 4 (3.8%) had targeted therapy, and 6 (5.7%) had immunotherapy within 40 days before the onset of COVID-19 symptoms.	**Authors' interpretation** The findings in this study suggest that patients who underwent cancer surgery showed higher death rates and higher chances of having critical symptoms.

https://doi.org/10.1158/2159-8290.Cd-20-0422	**Sample description** N=8 patients with cancer had surgery (out of 105 patients with cancer and 536 age-matched non-cancer patients) *Age:* Surgical patients mean 61 years (range 42–84); Patients with cancer median 64.0 years (IRQ 14.0); patients without cancers median 63.5 years (IQR 14.0). *Sex:* surgical patients male, 3; female, 5 **COVID 19 diagnosis** COVID19 was diagnosed according to the WHO interim guidance. **Procedure type** Various treatments, including surgery. Types of surgery included: Oesophageal carcinoma, lung cancer x2, rectal cancer, cervical carcinoma x 2, breast cancer and pancreatic cancer.	Patients who received surgery demonstrated higher rates of death [2 (25.0%) of 8 patients], higher chances of ICU admission [3 (37.5%) of 8 patients], higher chances of having severe or critical symptoms [5 (62.5%) of 8 patients], and higher use of invasive ventilation [2 (25.0%) of 8 patients] than other treatments excluding immunotherapy. **Other outcomes** Patients who received immunotherapy tended to have high rates of death [2 (33.3%) of 6 patients] and high chances of developing critical symptoms [4 (66.7%) of 6 patients]. Patients with cancer who received radiotherapy did not show statistically significant differences in having any severe events when compared with patients without cancer.	
Hantoushzadeh et al.[9] **Iran** **Case series** https://doi.org/10.1016/j.ajog.2020.04.030	**Setting** Multicentre study of pregnant women diagnosed with severe COVID-19 during 2nd or 3rd trimester admitted to any 1 of 7 level III maternity hospitals in Iran over a 30-day period (mid-February to mid-March, 2020). **Sample description** N=6 out of 9 mothers had caesarean sections *Age (for 9 mothers):* 2 were 25-29 years, 2 were 30-34 years, 3 were 35-39 years, 1 was 40-44 years and 1 was 45-49 years.	**Primary Outcomes** Seven of nine pregnant women with severe COVID-19 died, while one remained critically ill at time of writing. One woman recovered after prolonged hospitalisation. Four of the women who died had a caesarean section and three did not. Three out of four of the women who had a Caesarean section had babies who survived, one woman had twins who both died neonatally. Two of the nine pregnant woman suffered severe morbidity but survived, both had caesarean sections. One of the babies died.	The intent of this retrospective case series was to document maternal death and describe maternal, foetal, neonatal, and familial self-reported characteristics among 9 patients known to have experienced severe maternal cardiopulmonary morbidity or mortality. Cases were not selected

	Gestational age (for 9 mothers): between 24 weeks and 38 weeks. No patient had pre-existing comorbidities above baseline population risk and none had hypertension, cardiovascular disease, asthma, nor renal disease. **COVID-19 diagnosis** SARS-CoV-2 infection confirmed with RT-PCR Outcomes for these women compared to familial/household members with exposure to the affected patient on or after their symptom onset. **Procedure type** Caesarean section.	**Other outcomes** Familial/household contacts for the nine patients (n=33) were compared: In each case the maternal outcomes were more severe when compared to other high and low-risk familial/household members.	by any form of systematic surveillance, but arose through a voluntary reporting of 105 maternal cases with known morbidity or mortality attributable to COVID-19. The authors note that the series is limited by lack of surveillance data and is prone to adverse outcome ascertainment bias. The authors further acknowledge that whether the maternal case fatality rate or maternal morbidity estimates will ultimately be the same, less, or greater than that of other populations is as yet unknown.
Lei et al. 2020[10] **China** **Retrospective Case Series** https://doi.org/10.1016/j.eclinm.2020.100331	**Setting** Patients undergoing elective surgeries during the incubation period of COVID-19 between Jan 1 and Feb 5 in hospitals in Wuhan, China. **Sample description** N=34 *Age:* median 55 years (IQR 43-63) *Sex:* Female, 20 (58.8%); male, 14 (42.2%).	All patients developed COVID-19 pneumonia shortly after surgery with abnormal findings on chest computed tomographic scans. **Primary outcome** 15 (44.1%) patients required admission to ICU during disease progression, and 7 patients (20.5%) died after admission to ICU. These patients all underwent surgeries at the surgical difficulty category level-3. The age range was 34 to 83 years, and 4 were women. This mortality rate is much higher than the reported overall	**Authors' interpretation** The data in this study suggest that surgery may accelerate and exacerbate disease progression of COVID-19.

	Common symptoms included fever (31[91.2%]), fatigue (25[73.5%]) and dry cough (18[52.9%]). All patients were asymptomatic at the time of surgery. **COVID-19 diagnosis** All confirmed with RT-PCR from respiratory samples after surgery but not all were confirmed before surgery. **Procedure type** Twenty two different types of surgery were included. For example: caesarean section, laparoscopic partial colectomy, anterior decompression of cervical spinal canal, laparoscopic appendectomy, thoracoscopic lobectomy and total hip replacement.	case-fatality rate of 2.3% in COVID-19 patients without surgery (from literature) and also higher than the case-fatality rate of 7.9% in non-cardiac surgical patients without COVID-19 infection who were admitted to multidisciplinary ICU (from literature). Common complications among the 34 patients included ARDS (11[32.4%]), shock (10[29.4%]), secondary infection (10[29.4%]), arrhythmia(8[23.5%]), acute cardiac injury (5[14.7%]), and acute kidney injury (2[5.9%]). **Other outcomes** During the disease progression, 15 of 34 postoperative patients received ICU care. This proportion (44.1%) is much higher than the reported 26.1% in hospitalised COVID-19 patients without surgery. Compared with non ICU patients, ICU patients were older, were more likely to have underlying comorbidities, underwent more difficult surgeries, as well as more severe laboratory abnormalities (e.g., hyperleukocytemia, lymphopenia). The most common complications in non-survivors included ARDS, shock, arrhythmia and acute cardiac injury. Most patients underwent surgeries with the surgical difficulty category at level-2 (11[32.4%]) and level-3 20 [58.8%]), only 2(5.9%) patients underwent surgeries with the surgical difficulty category at level-4, the highest surgical difficulty category. 13 of 15 patients admitted to ICU underwent level-3 surgeries. Patients admitted to the ICU had longer surgical times and	

		shorter times from surgery to first symptom, than that of non-ICU patients Of note, symptoms of COVID-19 manifested quickly after the completion of surgery, and SARS-CoV-2 infection was laboratory-confirmed soon thereafter. The length of time from hospital admission to surgery (median time, 2.5 days [IQR,1.0-4.0]) is shorter than the median incubation time of 5.2 days obtained from a study of patients with confirmed SARS-CoV-2 infections in Wuhan, and also shorter than the overall incubation time (median time,4.0 days [IQR,2.0-7.0]) derived from a study of patients with COVID-19 from 552 hospitals in China. This supports the authors' belief that patients were in their incubation period of COVID-19 infection before undergoing surgeries.	
Li et al.[11] **China** **Case series** https://doi.org/10.1007/s11596-020-2176-2	**Setting** COVID-19 patients from a single thoracic surgical department. Data collection up to 3rd March. **Sample description** N=13 patients (also 12 health care staff). *Age:* median 61 years (range 51 to 69) for patients; median 35 years (range 22 to 51) for health care staff. *Sex:* Male, 10 (76.9%) for hospitalised patients and 2 (16.7%) for health care staff. **COVID-19 diagnosis** Confirmed with nucleic acid test in 12/13 (92.3%) patients and 7/12 (58.3%) health care staff. All received chest CT scan.	**Primary Outcome:** By the end of the follow-up date, in the patient group 7/13 patients had severe COVID 19, and 5/13 deaths occurred (38.5%). In the health care staff group with COVID-19, patients were younger, more were female and only 2/12 were severe type with no deaths. There was significant difference in vital status between postoperative patients and health care staff (P=0.039), and age and COPD were significantly associated with disease severity (P=0.041 and P=0.040, respectively) and death (P=0.015 and P=0.038, respectively) for COVID-19 patients.	**Authors' interpretation:** COVID-19 is associated with poor prognosis for patients undergoing thoracic operation, especially for those with COPD.

	Procedure type Lung surgery n=11, oesophagus surgery n=2.		
Liu, H. et al.[22] **China** **Case series** https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7156118/pdf/main.pdf	**Setting** Pregnant women, non-pregnant adults and children with COVID-19 in two hospitals. **Sample description** N=59, 16 pregnant women had caesarean sections *Age:* for the 41 pregnant women, median 30 years (range 22–42) *Gestational age:* range 22 weeks to 40 weeks plus 5 days. 4 pregnant women had gestational diabetes, 3 gestational hypertension, 1 had hepatitis B infection. The most common symptoms were also fever (100%) and cough (64%). **COVID-19 diagnosis** 16 pregnant women were laboratory-confirmed (RT-PCR from throat swabs) SARS-CoV-2 positive, 17 laboratory-negative but with typical CT features of COVID-19 pneumonia, and 8 did not undergo SARS-CoV-2 testing. **Procedure type** Caesarean section.	**Primary outcome** Six women with laboratory confirmed infections and 10 who were clinically diagnosed underwent delivery by C-section. No pregnant woman was admitted to the ICU, and no clinical abnormalities were observed in the infants. The leukocytosis (50%) and elevated neutrophil ratio (88%) were more common in the laboratory-confirmed pregnant groups compared with the non-pregnant adult group (0% and 14%).	The authors concluded that their preliminary study demonstrated that the clinical findings of pregnant women with COVID-19 pneumonia were atypical, bringing about difficulties in early detection. Clinically diagnosed cases with typical CT features were treated as COVID-19 patients to offset possible false negative findings from the nucleic acid test. The authors speculated that samples from the lower respiratory tract via lavage and repeat tests would be helpful to rule out false negative results.
Liu, D. et al.[21]	**Setting**	**Primary Outcomes:**	**Authors interpretation:**

China **Case series** https://www.ajronline.org/doi/full/10.2214/AJR.20.23072	Pregnant women with COVID-19 in a hospital in China from 20 Jan to 10 Feb 2020. **Sample description** N=10 out of 15 pregnancies were delivered by caesarean section *Age*: range 23 – 40 years (Mean 32; SD 5 years). *Gestational age at admission:* range 12-38 weeks (34-38 weeks for those who had Caesarean sections). 1 patient had thalassemia and gestational diabetes, 1 patient had mitral valve and tricuspid valve replacement 10 years earlier, and 1 patient had complete placenta previa. 3 patients delivered by caesarean section at 34–36 weeks because of the belief that antiviral treatment was needed as early as possible in the disease course. The most common onset symptoms of COVID-19 pneumonia in pregnant women were fever (13/15 patients) and cough (9/15 patients). The most common abnormal laboratory finding was lymphocytopenia (12/15 patients). **COVID-19 diagnosis** RT-PCR confirmed at the time of admission. **Procedure type** Caesarean section.	All women had mild pneumonia at admission. Time between admission and symptom onset was between 2 and 10 days. No patient or neonate died during the follow up period (only 2 had been discharged from hospital). No neonatal asphyxia occurred. Apgar scores at the 1st minute and 5th minute were normal in all neonates. Until the data were censored, 14 of the 15 patients' SARS-CoV-2 quantitative RT-PCR results had turned negative, clinical symptoms disappeared and laboratory values returned to normal levels. However, as most of the patients in this study were still in the hospital at the time of writing, the final outcomes were unclear.	All the pregnant women with COVID-19 pneumonia in the study presented with clinical manifestations and CT features of mild pneumonia. No SARS-CoV-2 infection was found in the neonates. Pregnancy and delivery did not aggravate the severity of COVID-19 pneumonia. All the women in this study—some of whom did not receive antiviral drugs—achieved good recovery from COVID-19 pneumonia.
Maggi et al.[12]	**Setting**	**Primary outcomes**	The authors note that in the patient who tested

Italy **Case series** https://doi.org/10.1111/ajt.15948	Liver transplants in Lombardy, Italy between 23 Feb and 10 Apr 2020. **Sample description** N=17, 2 patients tested positive for SARS-CoV-2 after 9 and 22 days post liver transplant. *Age:* 61 and 69 years *Sex:* Male, 2 **COVID-19 diagnosis** 13/17 patients (including the 2 patients who later tested positive) were screened for SARS-CoV-2 using nasal pharyngeal swabs prior to surgery. **Procedure type** Liver transplant surgeries.	Medical complications occurred in six of the 17 transplant recipients; five were repeat screened for SARS-CoV-2 and two patients tested positive. The first patient manifested with fever on postoperative day 9 but had a normal chest X-ray findings and was later discharged The second patient, who was HIV positive, had positivity for SARS-CoV-2 on postoperative day 22 and died with COVID-19 on postoperative day 30.	positive 9 days post-transplant, it is not possible to know if infection was present prior to the surgery or contracted during recovery in hospital, as the single nasal pharyngeal swab performed prior to surgery may be unreliable. The second patient, who tested positive 22 days post-transplant, is likely to have become infected post-transplant.
Mi et al.[13] **China** **Case series** http://dx.doi.org/10.2106/JBJS.20.00390	**Setting** Patients with a fracture and COVID-19 from 8 different hospitals in Hubei province, China, from Jan 1, 2020, to Feb 27, 2020. **Sample description** N=10; 3 patients underwent surgery *Age:* Range 34 to 87 years *Sex:* Female, 8; Male, 2 7 patients had a nosocomial infection. The most common symptoms were fever, cough, and fatigue at the time of	**Primary outcomes** Three patients underwent surgery (two of whom had COVID-19 positive RT-PCR results). Two of these patients also had other viral co-infections. One patient aged 76 with underlying cirrhosis and Alzheimer's Disease died. The two other patients developed severe pneumonia. The clinical outcomes for the surviving patients were not determined at time of writing. In total, four patients died after admission; three others developed severe pneumonia. The clinical outcomes for the surviving patients were not determined at time of writing.	The authors suggested that the clinical characteristics and early prognosis of COVID-19 in patients with fracture tended to be more severe than those reported for adult patients with COVID-19 without fracture. The authors recommended that surgical treatment should be carried out cautiously or non-operative care

	presentation (7 patients each). Other, less common signs included sore throat (4 patients), dyspnoea (5 patients), chest pain (1 patient), nasal congestion (1 patient), headache (1 patient), dizziness (3 patients), abdominal pain (1 patient), and vomiting (1 patient). **COVID-19 diagnosis** 6 patients confirmed positive by qRT-PCR of throat swabs. 3 had a negative result and 1 did not receive the test. All patients presented with clear evidence of viral pneumonia on CT scans. **Procedure type** Orthopaedic surgery.		should be chosen for patients with fracture in COVID-19-affected areas, especially older individuals with intertrochanteric fractures.
Xu et al.[14] **China** **Case series** https://doi.org/10.1016/j.scib.2020.04.040	**Setting** Pregnant women with COVID-19 admitted to a hospital in Wuhan, China, from Jan 21, 2020 to Feb 9, 2020. **Sample description** N=5 *Age:* Mean 29 years (range 23 to 34 years) *Gestational age at admission:* range 34w+4d to 38w+6d The most common symptom was fever, followed by dry cough, fatigue and dyspnoea. All patients developed mild pneumonia. **COVID-19 diagnosis**	**Primary outcomes** All COVID-19 infected women gave birth safely (four by caesarean section). None of the babies developed any respiratory systems or pneumonia-associated symptoms. All neonates' throat swabs were PCR negative.	

	RT-PCR positive **Procedure type** Caesarean section (n=4)		
Yu et al.[15] **China** **Case series** https://doi.org/10.1016/S1473-3099(20)30176-6	**Setting** Pregnant women with COVID-19 admitted to one hospital in Wuhan, China from Jan 1 to Feb 8, 2020. **Sample description** N=7 Age: mean 32 years (range 29–34 years) Gestational age: mean 39 weeks plus 1 day (range 37 weeks to 41 weeks plus 2 days). 2 (29%) patients had chronic diseases (hypothyroidism and polycystic ovary syndrome) and 3 (43%) patients had uterine scarring. Clinical manifestations were fever (6 [86%] patients), cough (1 [14%] patient), shortness of breath (1 [14%] patient), and diarrhoea (1 [14%] patient). Data from laboratory tests showed that all patients had a normal leucocyte count and 5 (71%) had neutrophil levels above the normal range. Lymphocytes were below the normal range in 5 (71%) patients, platelets were below the normal range in 2 (29%) patients, and D-dimer was above the normal range in all patients. 2 (29%) patients had differing degrees of liver function abnormality, as well as increased alanine aminotransferase or aspartate	The maternal, foetal, and neonatal outcomes of patients who were infected in late pregnancy appeared very good, and these outcomes were achieved with intensive, active management that might be the best practice in the absence of more robust data. **Primary outcomes** There were no intensive care unit admissions for mothers throughout the study period, including before and after delivery. At the end of follow-up (March 12, 2020), all patients had been discharged from the hospital per the following discharge criteria: body temperature returned to normal for more than 3 days; respiratory symptoms improved significantly; pulmonary imaging showed a significant improvement in acute exudative lesions; and nucleic acid test of respiratory specimens such as results of sputum and nasopharyngeal swabs were negative twice in a row (sampling interval ≥24 h). The neonatal birth weights and Apgar scores were normal. **Other outcomes** Four infants were taken home and were not tested for SARS-CoV-2; no fever, pathological jaundice, or other symptoms were reported during the follow-up call at 28 days after birth. Another three infants remained for observation in the neonatology department and were tested for SARS-CoV-2. Nucleic acid test for the throat swab of one neonate (child of patient 1) was positive at 36 h after birth; nucleic acid tests for the other two	Most patients were treated with ribavirin, corticosteroids, and antibiotics. Steroids were only used after caesarean section. The authors concluded that the clinical characteristics of these patients with COVID-19 during late pregnancy were similar to those reported by non-pregnant adults with COVID-19.

	aminotransferase, or both. All patients had abnormally high concentrations of C-reactive protein. 2 patients had H1N1 and one had *Legionella pneumophila* co-infections. **COVID-19 diagnosis** RT-PCR from throat swabs. According to chest CT, 6 (86%) patients had bilateral pneumonia and the remaining 1 (14%) had unilateral pneumonia. **Procedure type** All patients had caesarean section within 3 days of clinical presentation with an average gestational age of 39 weeks plus 2 days (range 37 weeks to 41 weeks plus 5 days).	were negative. At 28 days after birth, the remaining three neonates were healthy and had no respiratory symptoms or fever.	
Zhang et al.[16] **China** **Case control** https://doi.org/10.3760/cma.j.cn112141-20200218-00111 **English abstract, full text in Chinese**	**Setting** Pregnant women in Hubei province, China. **Sample description** N=16 women with COVID-19; N=45 women without COVID-19. *Age:* Women with COVID-19 mean 29.3 years (SD 2.9); Women without COVID-19 mean 32.2 years (SD 4.2). *Gestational age:* Women with COVID-19 mean 38.7 weeks (SD 1.4); Women without COVID-19 mean 37.9 weeks (SD 1.6).	**Primary outcomes** There were no significant differences in the intraoperative blood loss and birth weight of the newborns between the two groups. **Other outcomes** There were no significant differences in foetal distress, meconium-stained amniotic fluid, preterm birth, and neonatal asphyxia between the two groups. Ten neonatal pharyngeal swabs collected in this study were negative for the detection of novel coronavirus nucleic acid. Three newborns were diagnosed with bacterial pneumonia based on medical history symptoms, blood routine, procalcitonin, C-reactive protein, sputum culture, and imaging examinations. All of them returned to normal after anti-inflammatory treatment.	**Authors' conclusions** If there is an indication for obstetric surgery or critical illness of COVID-19 in pregnant women, timely termination of pregnancy through Caesarean section will not increase the risk of premature birth and asphyxia of the newborn, but it is beneficial to the treatment and rehabilitation of maternal pneumonia. Preventive use of long-acting uterotonic agents could

	Of the 16 pregnant women with COVID-19, 15 cases were mild/moderate and one case was severe. None progressed to critical pneumonia. **COVID-19 diagnosis** Unclear (Chinese full text). **Procedure type** Caesarean section.		reduce the incidence of postpartum haemorrhage during surgery.
Zhong et al.[17] **China** **Cohort study** https://doi.org/10.1016/j.bja.2020.03.007	**Setting** Patients undergoing spinal anaesthesia in one hospital in Wuhan, China between Jan 1, 2020 and Feb 14, 2020. **Sample description** N=49 *Age:* Median 31 years (IQR 29-34) *Sex:* Female, 42 (85.7%), Male, unclear (45 patients [91.8%] had caesarean sections) Symptoms: cough n=21 (42.8%), sore throat n=14 (28.6%), myalgia 6 (12.2%), shortness of breath n=4 (8.2%), gastrointestinal reaction 2 (4.0%). **COVID-19 diagnosis** Radiologically confirmed for all patients; Positive confirmation of COVID-19 by RT-PCR was recorded in 13/49 (26.5%) patients. **Procedure type**	**Primary outcomes** Spinal anaesthesia was delivered safely in patients (mostly women requiring Caesarean sections) with active, although mild, COVID-19 infection. Spinal anaesthesia was not associated with cardiorespiratory compromise intraoperatively. Spinal anaesthesia had no adverse effects, either during the intraoperative period or subsequently. Three (6.1%) of 49 patients vomited after spinal anaesthesia was established. After surgery, the total leucocyte count and neutrophil counts were higher, accompanied by a lower lymphocyte count compared to pre-surgery. No surgical patients developed severe pneumonia or died of COVID-19 pneumonia after surgery, as of February 14, 2020. **Other outcomes** COVID-19 was subsequently confirmed by PCR in 5/44 (11.4%) anaesthetists.	COVID-19 was only confirmed by RT-PCR in 26.5% of patients - unclear if remaining patients may have had other forms of pneumonia. Includes both caesarean sections and orthopaedic surgeries. Follow-up may have been insufficient for surgeries conducted towards the end of the study period.

	Caesarean section (n=45, 91.8%) or lower limb surgery (n=4, 8.2%) (all undergoing spinal anaesthesia).		

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