



Plastic surgery in times of pandemic and vaccines: safety recommendations to avoid postoperative complications (evidence based medicine)

Cirugía plástica en tiempos de pandemia y de vacunas: recomendaciones de seguridad para evitar complicaciones postoperatorias (medicina basada en evidencia)

Jesús Cuenca-Pardo, M.D.,* Estela Vélez-Benítez, M.D.,*
Guillermo Ramos-Gallardo, M.D.,†
Alfonso Vallarta-Rodríguez, M.D.,* Rodrigo Domínguez-Millán, M.D.,*
Livia Contreras-Bulnes, M.D.,* Óscar Salmean-Piña, M.D.,*
Rufino Iribarren-Moreno, M.D.,* Martín Lira-Álvarez, M.D.*

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Palabras clave:

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ABSTRACT

Complications in elective surgery procedures, in times of COVID-19 have risen considerably. The main factors are sequelae and unexpected infections in the postoperative period. The risk of contagion tends to decrease; however, the number of patients with post-COVID sequelae, which can cause severe postoperative complications, has increased. We conducted a systematic review on the risk of complications related to COVID-19 and on the vaccines in patients undergoing elective and plastic surgery procedures. The main complications reported are respiratory and cardiac failure, thrombosis, and increased mortality, which leads to a longer hospital stay and re-entrance, as well as incremented admission to Intensive Care Units. Patients who were asymptomatic or had mild COVID-19 cases and who do not have comorbidities can be operated on after six weeks with minimal risk; those who had severe cases and who developed sequelae or those with severe comorbidities must be evaluated by cardiologists and/or pneumologists. Patients may undergo surgery when the specialists consulted determine that the problem has been controlled. We found no reports regarding the impact of vaccines in the postoperative period of the elective surgery. There are several reports of late unfavorable effects in facial fillers and breast implants. The adverse effects of the vaccines and the activation of the inflammatory response should alert

RESUMEN

Las complicaciones en los procedimientos de cirugía electiva en tiempos de COVID-19 se han incrementado considerablemente. Los principales factores son las secuelas y las infecciones inesperadas en el posoperatorio. El riesgo de contagio tiende a disminuir; sin embargo, ha aumentado el número de pacientes con secuelas post COVID, mismas que pueden ocasionar severas complicaciones postoperatorias. Realizamos una revisión sistemática sobre el riesgo de complicaciones relacionadas a la COVID-19 y a las vacunas en pacientes a los que se les realizan procedimientos electivos y de cirugía plástica. Las principales complicaciones reportadas son fallas respiratorias y cardíacas, trombosis, y aumento en la mortalidad, lo que conlleva a una mayor estancia hospitalaria y readmisión, así como mayor ingreso a las Unidades de Terapia Intensiva. Los pacientes que presentaron COVID-19 asintomáticos o con un grado leve y que no tienen comorbilidades pueden ser operados después de seis semanas con mínimo riesgo; los que tuvieron la enfermedad severa y que desarrollaron secuelas, o con comorbilidades severas, tienen que ser valorados por cardiólogos y/o neumólogos. Los pacientes podrán operarse cuando los especialistas consultados determinen que el problema ha sido controlado. No encontramos reportes respecto al impacto que tienen las vacunas en el posoperatorio de la cirugía electiva. Existen varios reportes de efectos desfavorables tardíos en los rellenos faciales e implantes mamarios. Los efectos adversos de las vacunas y la activación de la respuesta inflamatoria deben

* Member of the Safety Committee.

† Coordinator of the Safety Committee.

Mexican Association of Plastic, Aesthetic and Reconstructive Surgery, C. A.

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surgeons to the possibility that postoperative patients may present some complication related to the vaccines.

alertar a los cirujanos sobre la posibilidad que los pacientes en el postoperatorio puedan presentar alguna complicación asociada a las vacunas.

OBJECTIVES

1. Determine the impact COVID-19 has and its consequences on postoperative complications of elective surgical procedures and plastic surgery performed during the pandemic.
2. Determine the impact of anti-COVID-19 vaccines on postoperative complications of elective surgical procedures and plastic surgery performed during the pandemic.
3. Identify the recommendations to carry out safe elective procedures and avoid complications associated with the disease, the vaccines, and their sequelae.

MATERIAL AND METHODS

We carried out a systematic review on the complications attributable to COVID-19 in patients who undergo elective surgical procedures and plastic surgery and the safety recommendations to reduce morbidity and mortality during the pandemic. The search was carried out in Spanish and English in different information sites: PubMed, Embase, Cochrane, Medline, Fistera, Medigraphic, Google Scholar. We used the following keywords: complications, elective surgery complications, post-COVID-19 sequelae, risk of complications, risk stratification, plastic surgery, SARS-CoV-2, COVID-19, coronavirus, adverse effects of COVID-19 vaccines. We elaborated questions on the subject, to answer them we looked for the best available medical evidence until January 2022. The answers were analyzed and interpreted in consensus with a group of surgeons with experience in this matter.

WHAT IS THE MORBIDITY AND MORTALITY IN ELECTIVE SURGERY PATIENTS (PLASTIC) RELATED TO COVID 19?

Post-COVID sequelae occur both in patients who have been hospitalized and those

who remained at home. The main post-COVID alterations are: pulmonary: including dyspnea, cough, organizing pneumonia and fibrosis; cardiac: myocarditis, heart failure and arterial hypertension; thrombotic: pulmonary embolism and thrombosis of venous and arterial extremities, coronary and cerebral vessels; neurological: characterized by persistent headache, depression and difficulty concentrating.¹⁻³

There are several publications that report a significant increase in morbidity and mortality in patients who underwent elective procedures and who were infected with COVID-19 in the perioperative period.⁴⁻¹⁸ The patients who suffered from COVID and who continued with symptoms at the time of surgery had higher mortality than asymptomatic patients.¹⁶⁻²¹

In one of the publications, patients who underwent bariatric surgery and inadvertently became infected with COVID-19 in the perioperative period were reported; these patients had severe morbidity.⁴ The report of a multi-center study on the safety of bariatric surgery during the COVID-19 pandemic mentions a significant rise in morbidity attributable to viral infection; the risk factors they identified were type 2 diabetes treated with insulin and obstructive sleep apnea. The highest incidence of complications occurred during the peaks of the infection.¹⁹

In 9 NHS hospitals in London, UK, 422 patients with hip fractures were treated; COVID-19 was detected in 82 of them. COVID-19 positive patients had higher postoperative mortality rates than non-COVID patients (30.5 vs 10.3%; $p < 0.001$). Risk factors for increased mortality were positive smoking and more than three comorbidities. Patients with COVID-19 were associated with a longer hospital stay, more intensive care unit admissions, more postoperative complications, and a higher mortality rate.¹⁵

An analysis carried out in patients who suffered from COVID-19 and who underwent

elective surgery for cancer, showed an increased risk of 10.7% of presenting respiratory complications, compared to those who were not infected. When separated by the time between the positive swab and surgery, they found that after 4 weeks the risk of death and respiratory complications decreased significantly.¹⁶⁻¹⁸

In a retrospective cohort study with 778 patients, the outcome was assessed by the postoperative mortality and the respiratory insufficiency, characterized by the inability to extubate during ≥ 24 hours or unplanned reintubation within 5 days and the mortality. The incidence of postoperative respiratory failure was 16% in the infected compared to 7% in the uninfected ($p = 0.001$). Infected patients also demonstrated higher 30-day mortality OR 3.5 (95% CI: 1.4-9.1). Detection of SARS-CoV-2 infection within 4 weeks before or 5 days after surgery is associated with increased odds of PORF and postoperative mortality.²²

A multicenter study all the patients undergoing elective surgery at 170 Veterans Health Administration hospitals in the United States of America were included, 61,097 patients were taken in, and cases with postoperative complications that occurred 30 days after surgery were identified. Positive COVID-19 cases were confirmed by mortality and respiratory failure, characterized by inability to extubate for ≥ 24 hours or unplanned reintubation and mortality within 5 days. The incidence of postoperative respiratory failure was 16% in the quantitative RT-PCR detection test and clinical evaluation 30 days before and 30 days after surgery. The patients were divided into 3 groups. The first group of 60,477 patients with negative detection of COVID-19, before and after surgery. The second group of 310 patients with positive detection in the preoperative and negative in the postoperative. The third group of 310 patients with negative detection in the preoperative and positive in the postoperative. Of the patients where postoperative COVID was detected, 128 (41.2%) had no complications, 182 (58.8%) had complications that included respiratory failure, pneumonia, difficulty breathing, heart

failure, sepsis, thrombosis, and pulmonary thromboembolia. In addition to this, there was an increase in mortality, days of hospital stay, surgical reinterventions and hospital readmissions. There is a high incidence of complications in patients with positive COVID detection in the postoperative period in elective surgery, 8.4 times more risk of pulmonary complications and 3 times more risk of major complications (including cardiac and thrombosis) and 2.6 for other complications compared to the group where the screening tests were negative in the pre and postoperative. There was no significant difference between groups 1 and 3. The risk factors found were: female gender, end-stage renal disease, chronic obstructive pulmonary disease, congestive heart failure, cancer, and cirrhosis.²³

Liposuction and abdominoplasty are the aesthetic procedures with the highest risk of thrombosis. The authors present 37 patients who underwent lipo-abdominoplasty, 13 of whom had had COVID-19; 4 patients of the entire group (10.18%) presented postoperative thrombosis, all of them had a history of COVID (3 mild and 1 severe). The condition developed between day 5 and 14. The rate of occurrence of thrombosis in patients with COVID-19 was 30.7%, much higher than the world rate. Additional precautions should be taken to monitor patients seeking cosmetic surgery with a prior history of COVID-19 infection closely, particularly for higher-risk procedures.²⁴

Comments and recommendations:
**¹⁻²⁴ level of evidence I-III, grade
of recommendation A-C**

There are few publications on complications related to COVID-19 infection in elective plastic surgery procedures; however, there are enough reports from other specialties. Plastic surgery safety recommendations will be based primarily on experiences reported by other surgical specialties until we can create our own evidence. Patients who have had COVID-19 and who are planning elective surgery should be considered in two large groups. The first will include those patients who were asymptomatic

or had a mild degree that have no sequelae; the second group includes those who had the most severe cases and who evolved with inflammatory, thrombotic, cardiogenic, or respiratory sequelae. The first group can be operated on safely after a few weeks of testing positive. The second requires a longer period of time, even up to several months, before the procedure can be performed safely.

One of the biggest problems we face is that the patient has COVID-19 in the postoperative period; either because the screening tests were false negatives, because the disease was in the incubation phase or the possibility of having been infected after surgery. It has been published those complications increase considerably in patients who inadvertently become infected with COVID-19 in the immediate postoperative period. The main complications reported are respiratory failure characterized by pneumonia and the inability to extubate or reintubate patients. Other frequent alterations are heart failure and thrombosis, which leads to a longer hospital stay, more admissions to Intensive Care Units, a higher number of readmissions and a higher mortality rate.

A negative test in the preoperative period does not guarantee that the patient is exempt from getting infected in the postoperative period. Risk factors increase the incidence and severity of complications.

WHAT COVID-19 SCREENING TESTS SHOULD I PERFORM ON MY PATIENTS PRIOR TO ELECTIVE SURGERY?

1. Diagnosis by clinical picture. Every patient who is going to have elective surgery must undergo a clinical study looking for signs of COVID-19 and determine the risk of infection. It is important to recognize that asymptomatic or mild cases occur in 80-90% of cases, the severe cases in 10%, and those in critical condition in only 5% of cases, which is why it is possible for us to be in contact with completely asymptomatic patients who have the disease. There are several questionnaires to detect COVID-19, some of them with electronic access.^{25,26} The most identified symptoms are: fever,

dry cough, myalgia, general malaise and, in severe cases, pneumonia and dyspnea. Less common symptoms are headache, diarrhea, conjunctivitis, sore throat, hemoptysis, nasal congestion, productive cough, anosmia and ageusia, skin rashes, and acrocyanosis.²⁷⁻³⁰ It is worth mentioning that any patient with evidence of respiratory infection should be considered potentially infected with SARS-CoV-2.^{27,28}

- 2. Routine laboratory tests.** Laboratory findings are generally not specific. The white blood cell count is usually normal or low. Lymphopenia is associated with severe disease. The platelet count is usually normal or slightly low. C-Reactive Protein and Erythrocyte Sedimentation Rate are elevated and procalcitonin normal. When procalcitonin is elevated it indicates a bacterial co-infection. COVID-19 disease is associated with a hypercoagulable state. Some of the laboratory tests that are useful to determine the severity of the disease are: D-dimer, lactic dehydrogenase, creatinine phosphokinase (CPK), glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GTP) and ferritin.²⁷⁻³¹
- 3. Genetic material detection tests.** The PCR technique (Polymerase Chain Reaction) is used. It is considered the gold standard for similar viral infections, such as SARS. The sensitivity of this test ranges from 40 to 90%. Nasopharyngeal samples have a sensitivity of less than 40% and become more sensitive when taken from the lower respiratory tract. Those obtained from a bronchial lavage have a sensitivity greater than 90%. The presence of the virus decreases rapidly during the first week of the disease, after which the test tends to become negative.³²⁻⁴⁰
- 4. Detection of the virus as an individual entity or detection of antigens.** Also called Rapid Antigen Detection Tests (RADTs) are a way of detecting different structural proteins of SARS-CoV-2, which is based on test strips that, when in contact with the target substance to be detected, lead to a generally visual change (color change). The advantages are: speed, affordable cost, massive scope and it

does not require a complex technique or specialized personnel. The disadvantage is its low sensitivity.³⁵⁻⁴⁵

5. **Detection of antibodies from the infected host organism: serological test.** These tests identify the presence of IgM and IgG antibodies, specific against the SARS-CoV-2 virus. A sample of blood, serum or plasma obtained from the person under study is required. Its identification guides us to the stages of the disease: IgM represents the acute infection process, and IgG indicates previous infection or as a response to secondary infections. The time of appearance of the antibodies is a personal response. They can be detected around the 7th day and, in some cases, several weeks after the onset of symptoms. The durability of IgG against SARS-CoV-2 can persist up to 40 days from the first appearance of the symptoms. The detection of IgG is not a guarantee of lasting immunity. It has a sensitivity of 88.66% and a specificity of 63%. The advantage of this type of test is its speed: 5-15 minutes between the time the sample is taken and its results.³⁸⁻⁴⁵
6. **Quantification of antibodies after infection or application of vaccines.** They are very useful tests to find out if, after an infection or the application of vaccines, patients have developed antibodies against the SARS-CoV-2 virus for the use of convalescent patient's plasma in the treatment of severe disease in the acute phase and to determine the efficacy of vaccination.⁴⁶
7. **Diagnosis by imaging studies.** Chest radiography (CXR) has little diagnostic value in the early stages, it can become normal. In the intermediate or advanced stage, it generally shows bilateral infiltrates, with a progression characteristic of acute respiratory distress syndrome.^{27,28,47} Simple chest tomography (CT) is very useful for identifying pulmonary alterations in COVID-19 disease. With the experience that has been gained, findings have increased, and classifications have been established. Aside from this, it is useful to identify myocarditis and pulmonary thromboembolism. This study has been

reported to have a sensitivity of 98% and that it is valuable in cases of false negative RT-PCR results. Chest CT is of important not only for diagnosing COVID-19, but also for monitoring disease progression and evaluating therapeutic efficacy.⁴⁷⁻⁵²

WHAT ARE THE PREOPERATIVE SAFETY RECOMMENDATIONS DURING THE COVID-19 PANDEMIC?

In times of pandemic, elective surgery must be performed in a responsible and safe manner. Carrying out some practices without being careful will increase the risk of contagion and complications. The COVID-19 virus is known to be transmitted from symptomatic and asymptomatic individuals. Everyone should be considered ill with COVID-19 until otherwise ruled out by existing diagnostic resources. To prevent an elective surgery patient from developing an infection in the postoperative stage, self-isolation for several days prior to surgery and COVID-19 screening tests performed immediately after admission. Only those patients with negative tests are to be considered. Another source of contagion is the health personnel who are members of the surgical team. They should be periodically Test for COVID-19 should be carried out periodically to each member of the team. High-risk personnel or those under suspicion of being infected should not be involved in patients' care.^{5-18,25,53-58}

All patients who suffered from COVID-19 should undergo an assessment to rule out thrombotic conditions, cardiovascular conditions, respiratory problems, and conditions in other organs. It should start by an electrocardiogram, chest X-Ray or, better yet, a simple chest tomography, D-dimer, and general examinations. Patients with cardiac involvement should have troponins and pro-BNP (brain natriuretic peptide, reflecting heart failure) ordered and must have a complete evaluation done by a cardiologist. If they present pneumonia or dyspnea for different reasons, they may develop pulmonary fibrosis or other severe alterations. The assessment should include spirometry and a simple chest tomography. A pneumologist should be

requested to set the safest time to perform the surgery.^{16-18,21,25-29,59,60} Some chronic diseases elevate the risk of complications. The main ones are: sleep apnea, insulin-dependent diabetes and positive smoking. More than three comorbidities contribute to the severity of complications.^{15,19} Post-COVID-19 patients may have residual symptoms; such as: fatigue, dyspnea, and joint and chest pain, even two months after diagnosis, and long-term cardiovascular problems. Even without COVID-19, evidence indicates that a respiratory infection in the month prior to surgery is a risk factor for postoperative pulmonary complications and postoperative complications.⁵⁸

Most authors consider that surgery can be carried out safely if an appropriate evaluation is carried out and adequate perioperative protocols are followed. It is important to classify patients and schedule surgeries according to the degree of risk, with a risk-benefit analysis. This strategy will help us reduce the spread of the virus, decrease complications, and maximize medical care resources.^{16-20,25,61,62} During the pandemic, the prioritization of surgeries does not imply the cancellation of elective procedures. A stratification of procedures and risks are the basis for surgeries to be performed safely and to optimize resources.⁶⁰⁻⁶⁸ Various guidelines for risk stratification and safety recommendations have been proposed. Stahel proposes a risk stratification based on the urgency of surgical care, giving several examples for each category: emergent, urgent, elective urgent, essential elective and discretionary elective.⁶²

Surgical procedures should be classified into two large groups: the first, those that are aerosol producers and the second, those that do not generate aerosols. The main means of disease transmission are aerosols. Physicians and other health care workers involved in examinations and procedures in the head and neck, upper GI, and respiratory regions have a particularly high risk of infection from aerosol and droplet exposure and contamination.^{25,68-70}

Larochelle⁷⁰ carries out a contagion risk classification based on the comorbidities of health workers, the type of work and contact with patients, and the degree of risk is based on safety recommendations.

**Safety comments and recommendations,^{5-21,25-29,53-68}
level of evidence I-III, grade of recommendation A-C (Infographic 1).**

Complications in elective surgery procedures in times of pandemic have increased considerably. The main risk factors are the sequelae of COVID-19 that were not detected and treated in the preoperative evaluation, and the development of a COVID-19 infection in the postoperative period. The possibility of contagion in the current pandemic tends to decrease with the appearance of vaccines and with the massive infection caused by variant strains of initial virus, which has favored herd immunity; however, we are not exempt from new variants or the appearance of other viruses. Based on the experience we obtained with the current contingency, we have learned to take care of ourselves to avoid contagion and to use security protocols to avoid complications in our patients. The preventive recommendations will remain in force and will only be modified to be improved.⁷⁰

1. Carry out a careful preoperative evaluation to rule out COVID-19, its sequelae and identify risk factors.
2. Answer a clinical questionnaire for the detection of the disease and its sequelae.
3. Carry out tests to detect the disease days before or, better yet, on the day of admission to hospital. Allow only those patients who test negative.
4. Self-isolate several days prior to surgery.
5. It is highly recommended to operate elective plastic surgery procedures in COVID-free operating rooms and hospitals where the entire surgical team and the accompanying family member be screened. Maintain strict safety protocols to prevent contagion.
6. Greater consideration must be given to safety care to prevent thrombotic, respiratory, cardiac, and infectious complications.
7. Use safety protocols to reduce postoperative complications.
8. Complication risk stratification should be carried out based on the following considerations:

- a. Presence or not of the disease in the acute phase or previously
 - b. Functional sequelae caused by the disease
 - c. Time of evolution of the disease
 - d. Complexity of the surgery, calculated duration time and number of procedures to be performed.
9. It is suggested that during the COVID-19 pandemic, surgeries should not be performed with multiple procedures or combined with surgeries from other specialties.^{25,70-72}
 10. Avoid inadvertent infections in the postoperative period, for which self-isolation prior to surgery is recommended, COVID-19 detection tests on the day of surgery, for the patient and his or her accompanying family member and perform elective surgery in hospitals free of COVID. The personnel who will participate in the surgery must have negative screening tests.
 11. Prepare an informed consent letter, which includes the risk of complications associated with the consequences of COVID and vaccines, as well as the risk of a postoperative infection that can aggravate complications.

When should I operate on a post-COVID patient?

Morbidity and mortality are higher when patients are operated on in the first 2 weeks after infection and up to 6 weeks after surgery. After 7 weeks there are no significant differences with patients who did not suffer from the disease. There are differences between the different authors regarding the time recommended to perform elective surgery in patients who have had COVID-19. The time has been determined based on several factors: severity of the infection, patient comorbidities, degree of complexity and aggression of the procedures: minor surgery and major surgery, to the degree of risk of the procedures: minimal, moderate, high and very high risk, and the sequelae left by the disease (*Infographic 2*).^{13,16-22,58,60,73,74}

Safety comments and recommendations:^{13,16-22,58,60,73,74} level of evidence I-III, grade of recommendation A-C (*Infographic 2*).

1. In patients with comorbidities, the waiting time should be increased before undergoing an elective procedure.
2. In patients who had COVID-19, the degree of severity must be determined. Patients who had the most severe cases will have to wait more than 7 weeks to be able to be operated on.
3. Identify the sequelae left by the disease, mainly respiratory, cardiac, and thrombotic. In case the patient has an important sequel, he or she should be sent to the corresponding specialist. Surgery may be performed when the specialist authorizes it and with the recommendations indicated.
4. Stratify the risk of postoperative complications based on the aforementioned factors. When in doubt, it is advisable to have the assessment of the pneumologist, cardiologist or internist. It is advisable to defer the procedure for a time longer than 8 weeks.
5. High and very high-risk elective surgical procedures should be deferred until the patients have fully recovered from the disease or until they have the authorization and indications of the cardiologist and/or the pneumologist.
6. The use of an algorithm will help us to decide the time to wait to carry out an elective procedure safely (*Infographic 2*).

DOES THE APPLICATION OF VACCINES VS. COVID PRODUCE ANY ALTERATION THAT COULD AFFECT THE EVOLUTION OF AN ELECTIVE SURGERY PATIENT?

The evidence suggests that all vaccines are effective to prevent COVID-19 and some variants such as Omicron. Another benefit obtained by the population vaccinated is the reduction of illness severity, hospitalization, admission to intensive care units and mortality.⁷⁵⁻⁷⁷ On the other hand, vaccines are not exempt from complications. There are also some publications that report complications

in patients who underwent an aesthetic procedure, associated with the application of vaccines against COVID-19.⁷⁸⁻⁸³

One of the adverse events associated with the post-COVID vaccination that have been made known and have been published are myocarditis in children and adults, characterized by chest pain, confirmed by laboratory studies and magnetic resonance imaging. No fatal cases are reported. There are also cases of thrombotic thrombocytopenia and cerebral sinus thrombosis and one case of thrombosis of the splenic artery. The authors consider that the adverse events of the vaccine's vs COVID are very rare and the cases reported do not have sufficient foundation to determine the cause. They recommend that all vaccinated patients maintain strict surveillance for these, and other adverse events associated with vaccines vs COVID.⁷⁸⁻⁸³

There are several reports of complications in patients who underwent an aesthetic procedure associated with COVID vaccination. The complications identified in patients who are carriers of breast implants are: seromas, capsular contractures, mastitis, and axillary lymphadenopathy. The mammary inflammatory process occurred after vaccination. The authors ruled out other etiologies of these complications. The capsule surrounding the implant is populated by a rich variety of cells. The application of the COVID-19 vaccine produces specific and non-specific activation of the immune system, including immunologically active cells such as macrophages, T lymphocytes and myofibroblasts found around breast implants, with inflammatory reactions.⁸⁴⁻⁸⁷

Late inflammatory reactions to hyaluronic acid soft tissue fillers are uncommon and generally self-limiting, with frequent spontaneous resolution. Dermal fillers or any foreign material can cause a reaction when the immune system is activated. COVID-19 vaccines can activate the inflammatory response, the proposed mechanism is the binding and blocking of angiotensin-converting enzyme 2 receptors by the protein (S) of the virus, which favors the inflammatory cascade, which acts by increasing inflammation in the residual granulomas that formed around the injected hyaluronic acid. Considering the ongoing pandemic and global demand for

COVID-19 vaccines, aesthetic professionals should be aware of the risks posed by the interaction of such vaccines in patients who have previously received or are seeking soft tissue filler injections with hyaluronic acid.⁸⁸⁻⁹¹

**Comments and recommendations:⁷⁸⁻⁹¹
level of evidence II-IV, grade
of recommendation B-D**

There is sufficient evidence to show that COVID-19 vaccines are effective in preventing severe disease and complications, including fatal ones. However, there are several reports of adverse effects associated with the application of vaccines that may contraindicate elective surgical procedures or contribute to postoperative complications. Although there are insufficient grounds, surgeons should consider this possibility in patients who have been recently vaccinated who require surgery. We found no reports regarding the impact of vaccines on elective surgery. However, there are several reports of adverse effects of vaccines such as thrombosis and myocarditis, this should alert surgeons to the possibility that postoperative patients may present some complication related to vaccines:

1. Patients who are going to undergo an elective procedure must have a complete vaccination scheme, or if they have had the disease, they must have a laboratory test that shows that the patient has high titers of antibodies against the disease.
2. In patients who have received a vaccine in days close to the date of surgery, neurological, cardiac, and thrombotic alterations should be ruled out.
3. It is advisable to wait up to 6 weeks after being vaccinated, before performing any elective cosmetic surgery procedure.

DISCUSSION

We found few publications on complications related to COVID-19 infection in elective plastic surgery procedures; most of the existing publications are from other specialties.

There are several publications that report a significant increase in complications in

patients who underwent elective procedures and who were infected with COVID-19 in the perioperative period. Patients who had COVID and who had persistent symptoms at the time of surgery had higher mortality than asymptomatic patients. In patients with comorbidities, postoperative complications increased. The reported disorders are respiratory failure with difficulty extubating patients within the first 24 hours after surgery, reintubation within the first 5 postoperative days, pneumonia, heart failure, sepsis, thrombosis, and pulmonary thromboembolism. In addition, there was an increase in: mortality, days of hospital stay, surgical reinterventions and hospital readmissions. Patients who acquired the disease in the postoperative period have an 8.4 times greater risk of pulmonary complications, 3 of the major complications (including cardiac and thrombosis) and 2.6 for other complications.^{4,15-23} Inadvertent COVID-19 infections predispose to postoperative complications in elective surgical procedures, including cosmetic surgery. All patients who are going to undergo an elective surgical procedure must be tested for COVID-19 as close to the date of their surgery and must be isolated to prevent contagion during or after surgery. A perioperative infection can predispose to severe complications and can be fatal.

Patients who have been asymptomatic or who had mild COVID-19 cases can safely undergo surgery after 6 weeks of testing positive. Patients with severe disease may have thrombotic sequelae, cardiovascular conditions, respiratory problems, and conditions of other organs. In all cases, it is important to carry out a clinical, laboratory and cabinet study to rule out these disorders. Thus, it is also necessary to request evaluation by a cardiologist and pneumologist. Patients may be operated on when the specialists authorize and give the pertinent recommendations for postoperative care.^{15-19,21,25-29,59,60} Patients who have had COVID-19 who undergo lipo-abdominoplasty have an increased risk of thrombotic events. The incidence rate of thrombosis was reported in patients with COVID-19 was 10.18%, much higher than the world rate of 0.2%.²⁴ The risk of contagion tends to decrease but have increased patients

with post-COVID sequelae, which can cause severe postoperative complications in elective procedures and plastic surgery. To avoid adverse events in patients, it is necessary to increase the detection of positive cases and their sequelae. This implies a higher expense for patients but justified by the risk. Procedures can be carried out safely if a good preoperative evaluation and surgery is performed based on grade of the risk of the patients and with corresponding prophylactic care. Additional precautions should be taken to monitor patients with a prior history of COVID-19 infection seeking cosmetic surgery closely, particularly in higher-risk procedures such as lipo-abdominoplasty.

Morbidity and mortality are higher when patients are operated on in the first 2 weeks after infection and up to 6 weeks after surgery. The time recommended to perform elective surgery in patients who have had COVID-19 has been determined based on several factors: severity of the infection, patient comorbidities, degree of complexity and aggressiveness of the procedures.^{13,16-22,58,60,73,74} Patients with comorbidities or post viral sequelae should be referred to a cardiologist, pneumologist and internist. The surgery may be performed when the specialists authorize it and the patient is in stable conditions that allows the procedure to be carried out safely. Sometimes one has to wait for up to several months.

Adverse events associated with post-COVID vaccination that have been published are myocarditis, thrombotic thrombocytopenia, cerebral sinus thrombosis, and splenic artery thrombosis.⁷⁸⁻⁸³ There are several reports of complications in patients who underwent a breast augmentation procedure with implants associated with COVID vaccination. The complications identified are seromas, capsular contractures, mastitis, and axillary lymphadenopathy.⁸⁴⁻⁸⁷ There are several series of patients with inflammatory reactions to facial fillers, related to the application of anti-COVID-19 vaccines. The authors have postulated that the effect is due to the activation of the inflammatory chain through the protein S of the virus, which acts on the residual granulomas that form around the injected implants.⁸⁸⁻⁹¹ The information

available on adverse response associated with the application of anti-COVID vaccines, only includes patients with late inflammatory responses to breast implants and facial fillers. The effect is attributable to the local and systemic immune/inflammatory activation produced by the vaccines. In addition, we must consider the thrombotic effect of vaccines. Therefore, it is to be expected that these phenomena may affect patients undergoing any surgical procedure. It is recommended that patients have surgery, undergo laboratory tests looking for inflammatory and thrombotic markers and wait at least 6 weeks before surgery.

The contagion by COVID has decreased considerably; however, we are not exempt of the appearance of new strains or other viral infections with the same or greater severity than the current pandemic. Care should continue indefinitely. Also, in this period postoperative complications attributable to post viral and post-vaccine sequelae have begun to be reported.

CONCLUSIONS

Complications in elective surgery procedures of any specialty and in plastic surgery procedures in times of pandemic have increased considerably; The main risk factors are the sequelae of COVID-19 that were not detected and treated in the preoperative evaluation, the development of a COVID-19 infection in the postoperative period, and the application of the COVID-19 vaccines. Elective and plastic surgery procedures can be carried out safely if we carry out a good assessment and stratification of preoperative risks, including the assessment by the cardiologist and pneumologist, if the procedures are performed according to the comorbidities of the patients and their post viral sequelae, if we wait long enough for the patient to fully recover, and lastly, if we perform the surgery by reducing the surgical time and reducing the number of procedures performed in a single surgical time. The protocols with safety recommendations are a very useful guide to prevent complications in elective surgery procedures. They are based on the precautionary principle, with the best available medical evidence and will change when evidence with greater support appears.

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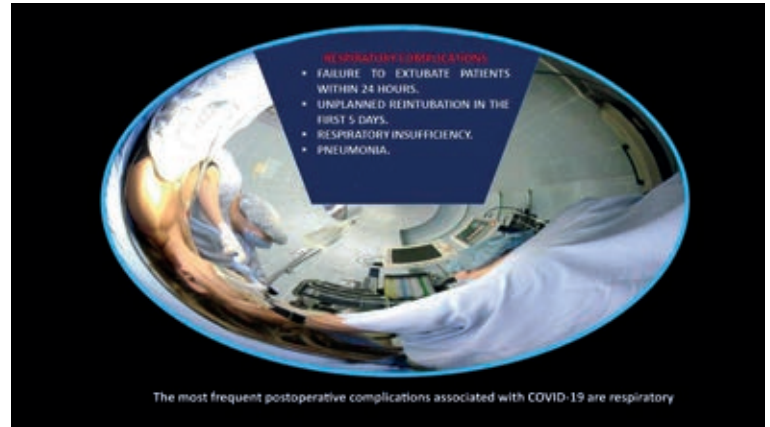
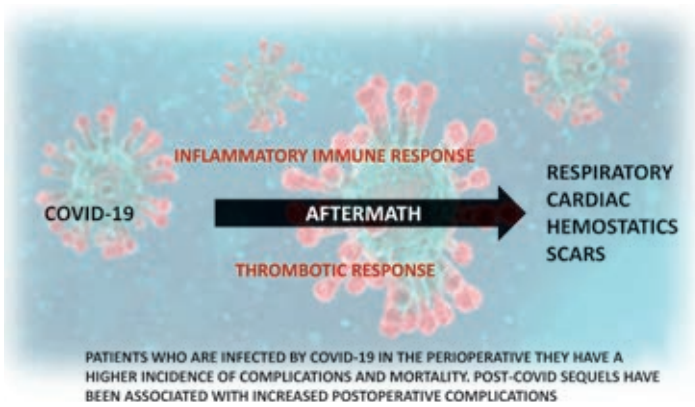
Correspondence:
Jesús Cuenca-Pardo, M.D.
 E-mail: jcuenca001@gmail.com



PLASTIC SURGERY IN TIMES OF PANDEMIC AND VACCINES. I



SAFETY RECOMMENDATIONS TO PREVENT POSTOPERATIVE COMPLICATIONS



PERIOPERATIVE COVID-19 INFECTIONS

Postoperative complications increase:

- Cardiac
- respiratory
- thrombotic

As well as increase:

- Mortality
- Hospital stay
- Readmissions
- Surgical reinterventions

REPORTED COMPLICATIONS IN AESTHETIC PROCEDURES

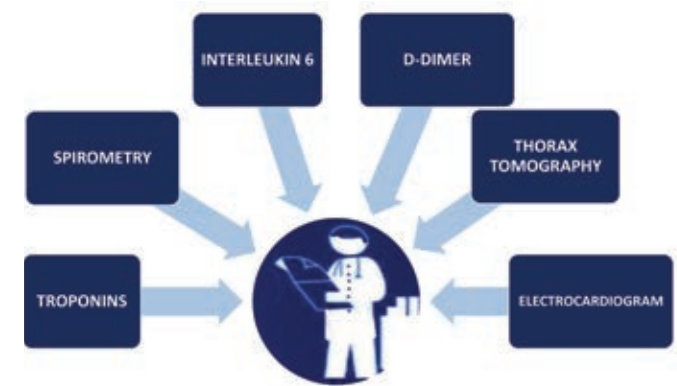
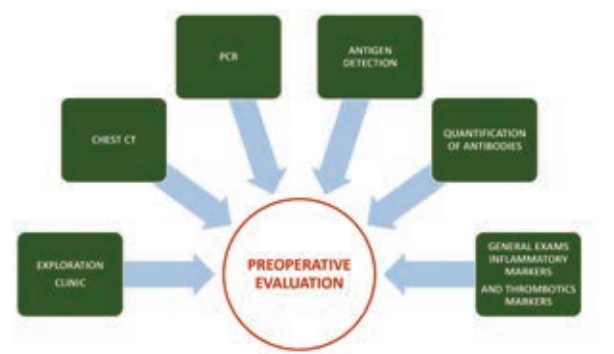
IN BREAST INCREASE WITH IMPLANTS INCREASE OF:

- SEROMA
- MASTITIS
- AXILLARY ADENOMEGALIAS
- CAPSULAR CONTRACTURE

IN LIPOUSION AND ABDOMINOPLASTY: INCREASE IN THROMBOSIS (10.18% VS 0.9%)

IN FACIAL FILLERS: LATE INFLAMMATORY PROCESSES

SARS-Cov2 viral infection and the application of vaccines against COVID-19 produce a response that activates the humoral and cellular immune system, which can produce a lymphoproliferative response, as well as a thrombotic response, which are the pathophysiological basis of the reported complications.



Patients who have suffered from COVID-19 must undergo several studies in order to rule out sequelae. Cases of severe disease should be evaluated by a cardiologist and/or a pulmonologist. The surgery will have to be deferred until the specialist authorizes it.

In the preoperative evaluation, acute infection by COVID-19 and postviral sequelae must be ruled out.



PLASTIC SURGERY IN TIMES OF PANDEMIC AND VACCINES. II



SAFETY RECOMMENDATIONS TO PREVENT POSTOPERATIVE COMPLICATIONS



- COVID-19**
 - TIME OF EVOLUTION
 - SEVERITY OF THE DISEASE
 - POSTVIRAL SEQUELS
 - INADVERTENT POSTOPERATIVE INFECTION
- SURGERY**
 - DURATION TIME
 - COMPLEXITY OF THE PROCEDURE
 - MULTIPLE OR COMBINED SURGERIES
- COMORBIDITIES**
 - OBESITY
 - DIABETES
 - PNEUMOPATHIE
 - SLEEP APNEA
 - SMOKING

STRATIFICATION OF THE RISK OF COMPLICATIONS IN AESTHETIC SURGERY PROCEDURES ASSOCIATED WITH THE EFFECTS OF COVID-19, IT IS USEFUL TO PLAN THE SURGERY



SAFETY RECOMMENDATIONS TO REDUCE THE RISK OF COMPLICATIONS ASSOCIATED WITH COVID-19

- Careful clinical evaluation
- General exams
- Inflammatory and thrombotic markers
- Thorax X-ray or tomography
- Disease detection tests for the patient and his companion. Perform the day of hospital admission
- Determination of anti-COVID antibodies
- Assessment by cardiologist and pulmonologist, in patients who had a severe infection, or present complications or have comorbidities
- Stratify risk of complications
- Use security protocols



When is advisable to operate on a patient who had COVID-19?

Morbidity and mortality is higher when patients are operated on in the first 2 weeks after infection and up to 6 weeks after surgery

RECOMMENDATIONS OF THE TIME TO WAIT BEFORE PERFORMING AN ELECTIVE SURGERY		
AUTHOR REFERENCE	TIME	CONSIDERATIONS
Reiouchi G [20]	10 to 14 days post-COVID	Following the WHO recommendations. Isolation 14 days prior to surgery
Croze (43)	Undefined time, until full recovery	Depends on the symptoms and severity of the disease
COVID Sung Collaborative [26,32]	4 weeks mild or asymptomatic cases/ 6 weeks symptomatic cases that were not hospitalized 8 to 10 weeks - Patients with symptoms or comorbidities or who were hospitalized 12 weeks - Patients with severe disease who were in intensive care	After the recommended time, postoperative mortality is low, minimal pulmonary complications. Patients with comorbidities, advanced age or ASA greater than 3, have a higher risk.
18,40 Kryatkin MC [26]	6 weeks	Preoperative SARS-CoV-2 infection before 4 weeks or 5 days after surgery is associated with increase in acute respiratory failure
42,43 AMA APS [26]	4 weeks - Mild 8 to 10 weeks - Moderate 12 weeks - Severe	Depends on the severity of the disease
2 American College of Surgeons [26]	6 to 8 weeks	It depends on hospital logistics and the experience of the surgeon. After the recommended time, respiratory complications and mortality are reduced
Royal Australian College of Surgeons 3,5 [26]	7 weeks	Mortality decreases from 4.3% to 3.6% between the second and sixth week of having tested positive. After 7 or more weeks there were no significant differences with patients who did not have the disease