



MACROSCOPIC AND AUTOPSY APPEARANCE OF SUDDEN DEATH BY SARS-COV2 COVID-19: ABOUT CASES OF CEREBRAL AND CORONARY THROMBOEMBOLIC COMPLICATIONS IN YOUNG SUBJECTS

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SUMMARY

Covid-19 is the cause of a global pandemic that has caused millions of deaths around the world; the mechanism of death from this disease may be unknown, especially among young people. The forensic autopsy is a valuable tool for understanding the mechanism of death. The aim of this autopsy description is to include an Algerian contribution in the descriptive studies of cases which have been published worldwide to describe the process of death by this disease. The objective of this work is an autopsy description, we only studied the clinical and macroscopic results of 03 autopsy cases of patients who died from Coronavirus COVID-19, young subjects aged 31, 41 and 51 years. Our patients are all young, without major risk factors apart from the 1st case who presents obesity, contrary to what is described in the literature on the association of risk factors with death from covid-19. Our clinical observation also shows that the deaths studied are unvaccinated subjects, hence the importance of vaccination in prevention and in the occurrence of complications. A thromboembolic complication having affected the cerebral venous system in the three cases which is associated with damage to the anterior interventricular coronary artery in two cases. It should be noted that the mild symptoms of Coronavirus cases must be managed with caution because they could suddenly decompensate and cause sudden death.

KEYWORDS: Autopsy, Coronavirus, Sudden Death, Venous Sinus, Thrombosis.

INTRODUCTION

The coronavirus is the cause of a disease that has ravaged the world, killing more than 2 million people worldwide, according to the World Health Organization. Algeria, a North African country, has also not escaped this deadly wave, exacerbated by very low vaccination rates. Of the 40 million population, only 7 million have received the first dose, 5 million have received the second dose and less than 30,000 have received the third dose. This brings the proportion of vaccinated subjects in Algeria to 13.2%, compared to 52.5% in the world.^[1]

Most studies and publications on COVID-19 coronavirus pathology have focused on subjects of advanced age and have often identified well-defined risk factors as the cause of fatal decompensation.^[2] Our work therefore focused on young subjects aged 31, 41 and 51 years old, presenting mild symptoms, without major risk factors which suddenly decompensated.

The autopsy is a valuable tool for understanding the mechanism of death. The aim of this autopsy description

is to include an Algerian contribution in the descriptive studies of cases which have been published on a global scale and also to raise awareness in this wave on the particularity of the variant in certain affected subjects who presented a simple influenza syndrome. but with sudden thromboembolic decompensation to the point that the medical profession doubted the origin of death by registering it on the death certificate as undetermined death. The autopsy was requested by the public prosecutor's office in reference to the death report established, in order to resolve a medico-legal problem in the face of these cases of sudden death by coronavirus COVID-19.

PROCEDURE

In response to the pandemic spread of SARS-CoV-2, in Algeria, the medical profession is taking advantage of scientific autopsy exploration in cases of undetermined death in which coronavirus infection is suspected, because it is very difficult or even impossible to arrange a scientific autopsy in the face of a natural death from coronavirus COVID-19, whether for the consent of the

family or the authorization of a scientific autopsy which cannot see the light of day in Algeria. The regulation of scientific autopsy in Algeria is not yet finalized, delayed by legal and ethical complexity. For this, we are taking the opportunity of this new phenomenon of sudden death by Coronavirus COVID-19 to establish a careful scientific study on the acute complications of COVID-19 with each medico-legal request for autopsy.

Faced with any suspicion of a covid-19 infection, a SARS-Cov-2 PCR test is performed post-mortem since our cases were not tested ante-mortem. Clinical information was collected by interviewing the family. The three cases presented were autopsied in a meticulous manner with a complete autopsy, photographs were taken after having autopsied all the organs, samples were taken for possible anatomopathological expertise. Our case study focuses exclusively on the macroscopic aspect of the lesions caused by COVID-19.

A SARS-Cov-2 PCR test, an external examination of the corpse, an autopsy and a biological and tissue sample were carried out in the three cases in accordance with the recent recommendation of the Ministry of Health, namely the use of FFP2 mask, combination, double gloves... etc.

Organ biopsies for microscopic study are taken from the organs of each case in the pathological areas which are chosen during the macroscopic examination, these samples are fixed in formalin, labeled and kept for possible anatomopathological expertise. Samples of biological fluids are also systematically taken and sent to the forensic laboratory in Algiers to eliminate any deaths of toxic origin.

At the end of our mission, a medico-legal autopsy report is submitted to the public prosecutor's office to first resolve the medico-legal problem of the undetermined death which would be confirmed as a natural death. Our scientific study would be carried out in parallel with the forensic analysis.

RESULTS

Our autopsies were carried out in accordance with the guidelines of the Algerian Ministry of Health (3). Nasopharyngeal swabs for COVID-19 are carried out by tests for detection of SARS Cov2 virus RNA by RT-PCR by "SARS-Cov-2 Molecular Diagnosis Laboratory Coordinator At The College Of Medicine Mouloud Maammero Of Tizi-Ouzou, Algeria".

Psychological Autopsy

A 31-year-old woman reportedly presented ten days previously with a mild fever with slight fatigue which did not require a medical consultation and an occasional dose of doliprane to calm her low-grade fever. In the early morning around 6 a.m., she presented acute respiratory distress, evacuated to the local hospital where death was noted after resuscitation maneuvers were

unsuccessful. The doctor on duty has the notion of an undetermined death on the death certificate.

We noted no medical-surgical, toxic or psychiatric history. Noted that the deceased never received a vaccine against COVID-19.

External Examination of the Corpse

This is the body of a woman who corresponds to her age of 31 years, her height is 143 cm, of a strong corpulence (BMI 32), the cadaveric lividities are red-dark posterior site with cyanosis of the face, ears, shoulders and distal extremities of the limbs. Furthermore, resuscitation patches were observed on the thorax.

Opening of Cavities

At head level

The detachment of the scalp is congestive on its internal side, it does not present hemorrhagic contusions, the temporal muscles are congestive. The cranial vault does not show any fracture.

The meninges are congestive and are not the site of subarachnoid hemorrhage. Furthermore, dissection of the superior longitudinal sinus reveals a large, extensive thrombus (Figure 1A). The WILLIS polygon is non-atheromatous and permeable.

The brain and cerebellum are edematous and congestive with signs of engagement of the cerebellar tonsils in the foramen magnum. The brain is edematous (weighs 1500 grams), seat of thrombus in all the cortical veins of the brain "Figure 1B", the section of the brain with CHARCOT sections does not present any visible macroscopic anomaly.

After removal of the dura mater, there is no fracture line at the base of the skull. The pituitary gland explored on site, it is not hemorrhagic. Endocranial palpation of the first cervical vertebrae (cervical sensation) does not reveal any abnormal mobility of them.

At the neck

Dissection of the different cutaneous-muscular planes of the neck revealed no hemorrhagic infiltration. Furthermore, there are multiple lymphadenopathies measuring 01 to 05 cm in diameter at the bilateral submaxillary and parajugular level. The thyroid gland is of normal size. Careful dissection of the laryngeal system revealed no fracture. Furthermore, there is tonsillar hypertrophy. The tongue does not show any bite marks. The cervical esophagus is pale, without abnormalities. The trachea is congestive and free. The vascular-nervous bundles are integrated into macroscopic exploration. The common carotid arteries and jugular veins are patent and non-atheromatous. The cervical spine is free from any traumatic injury.

At the level of the thorax

The opening of the thoracic cavity is without abnormality, the integuments and muscles of the chest wall are without abnormality. Furthermore, the fat panicle is 05 cm in relation to obesity. The sterno-costal plastron does not show any fracture.

The parietal and visceral pleura are not adherent. There is no pleural effusion. The lungs are of normal volume and weight, the section edge releases a foamy liquid suggestive of acute pulmonary edema (APO). The main bronchi and the lobar and segmental bronchi are filled with foam.

The pericardial sac was intact. 30 milliliters of clear pericardial fluid is noted. The heart is of normal volume. Its dimensions, expressed in centimeters, are as follows

- Height 10;
- Width 10;
- Thickness of the right ventricle 0.4;
- Thickness of the interventricular septum 01;
- Thickness of the left ventricle 1.1;
- The tricuspid valve 08;
- The mitral valve 09;
- The Aortic valve 04;
- The pulmonary valve 04;

The coronary arteries are the site of a thrombus extending to the entire anterior interventricular coronary artery (Figure 1 C-D) with no focus of myocardial infarction visible macroscopically at this stage.

At the level of the abdomen

Once the cutaneous-muscular walls have reclined and after opening the peritoneum, we confirm the absence of peritoneal fluid effusion. The fat panicle is 10 cm away. The small intestinal loops and the colon are congestive. The pancreas is congestive. The stomach contains 50 milliliters of digested food porridge, after washing, its mucous membrane is congestive. The liver is of

increased volume, a hepatic arrow at 21 cm, its section reveals steatosis of its parenchyma. The gallbladder is alithiatic and full of bile. The spleen is enlarged and congestive. The kidneys have a congestive appearance, the section shows good cortico-medullary differentiation with free and alithiatic urinary tract. The adrenal glands explored on site, they are not hemorrhagic.

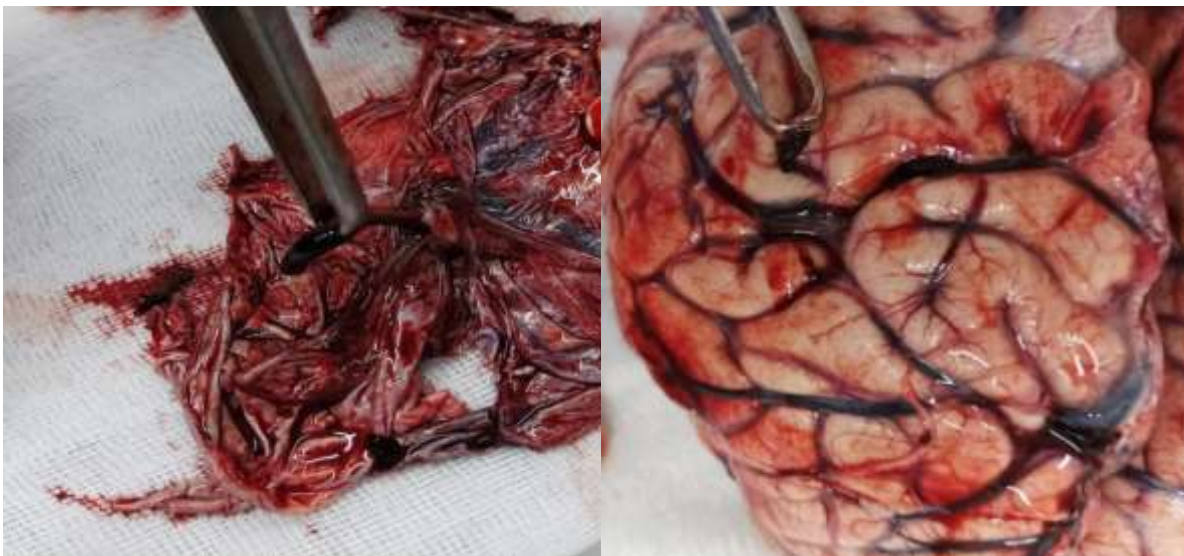
The bladder contains 50 milliliters of clear urine. The psoas muscles are not infiltrated. The thoracolumbar spine and the small pelvis do not present any macroscopically visible traumatic lesion.

DISCUSSION

From the comparison of these autopsy data with the data from the interrogation and biological analyses, it results that the cause of death is a thromboembolic complication described in patients with corona COVID-19.^[2,4,5] with this particularity damage to the cerebral venous network, namely the longitudinal sinus and the cortical veins as well as the anterior interventricular coronary artery which was the cause of death from cardiac arrhythmia.

Our clinical vignette shows that despite the young age of our patient, no history of chronic illness, no significant flu symptoms, our patient decompensated suddenly following a cerebral and coronary thromboembolic disorder.

Several studies have analyzed the influence of obesity on mortality, this study also found that ((2)67%) of the deaths analyzed presented organic damage due to ischemic processes following the development of a thrombopathy associated with COVID-19 but cerebral thromboses are rarely described.^[6] unlike pulmonary thromboses which have been widely described^[7] even less for thromboembolic disorders with damage to the coronary arteries.^[8] The latter is the cause of a sudden death rarely described in the literature.



A

B



Figure 1: Photographs of: A-thrombus of the superior longitudinal sinus. B- coronary vein thrombus. C and D-thrombus of the anterior interventricular coronary artery.

Psychological Autopsy

A 41-year-old woman reportedly had a toothache with fever and a slight cough for 13 days which did not require medical consultation. She would have felt unwell at home, evacuated to the nearby hospital where she was pronounced dead. The doctor also noted the notion of an undetermined death on the death certificate.

We noted no medical-surgical, toxic or psychiatric history declared by the family. No concept of vaccination against COVID-19.

External Examination of the Corpse

This is the body of a woman who corresponds to her age of 41 years, her height is 163 cm, of average corpulence, the cadaveric lividities are purplish-red at the posterior site with cyanosis of the face and distal ends of the limbs. Furthermore, abdominal swelling and edema of the lower limbs were noted.

Opening of Cavities

At head level

The detachment of the scalp finds its pale inner face, it does not present any hemorrhagic contusions, the temporal muscles are also pale. The cranial vault does not show any fracture.

The meninges are pale and are not the site of a subarachnoid hemorrhage. Furthermore, we noted the presence of a diffuse thrombus throughout the superior longitudinal sinus (Figure 2A) extending to the posterior torn hole at the base of the skull (Figure 2B). The WILLIS polygon is permeable.

The brain and cerebellum are enlarged without signs of engagement of the cerebellar tonsils in the foramen magnum. The brain is the site of thrombus in all the cortical veins of the brain "Figure 2B", the section of the brain with CHARCOT cuts finds hemorrhagic spots.

The remainder of the head examination was unremarkable.

At the neck

Dissection of the different cutaneous-muscular planes of the neck revealed no hemorrhagic infiltration. The thyroid gland is of normal volume, polycystic and pale. Careful dissection of the laryngeal system revealed no fracture. The tongue does not show any bite marks. The cervical esophagus is pale, without abnormalities. The trachea is lined with foam. The vascular-nervous bundles are integrated into macroscopic exploration. The jugular veins are completely thrombosed on the right and left. The cervical spine is free from any traumatic injury.

At the level of the thorax

The opening of the thoracic cavity is without abnormality, the integuments and the muscles of the chest wall are without abnormality with a fat panicle of 0.5 cm.

The parietal and visceral pleura are not adherent. There is a 100 milliliter pleural effusion on the right. The lungs are heterogeneous in color with an appearance of fibrosis in areas, the section edge releases a foamy liquid suggestive of acute lung edema (APO). The pericardial sac was intact. 20 milliliters of clear pericardial fluid is noted. The heart is of normal volume. Its dimensions, expressed in centimeters, are as follows:

- Height 15;
- Width 13;
- Thickness of the right ventricle 0.3;
- Thickness of the interventricular septum 1.5;
- Thickness of the left ventricle 1;
- The tricuspid valve 04;
- Mitral valve 12;
- The Aortic valve 06;
- The pulmonary valve 06;

The coronary arteries are the site of a fine thrombosis (Figure 2D) of the anterior interventricular coronary artery (IVA) without a focus of myocardial infarction visible macroscopically at this stage.

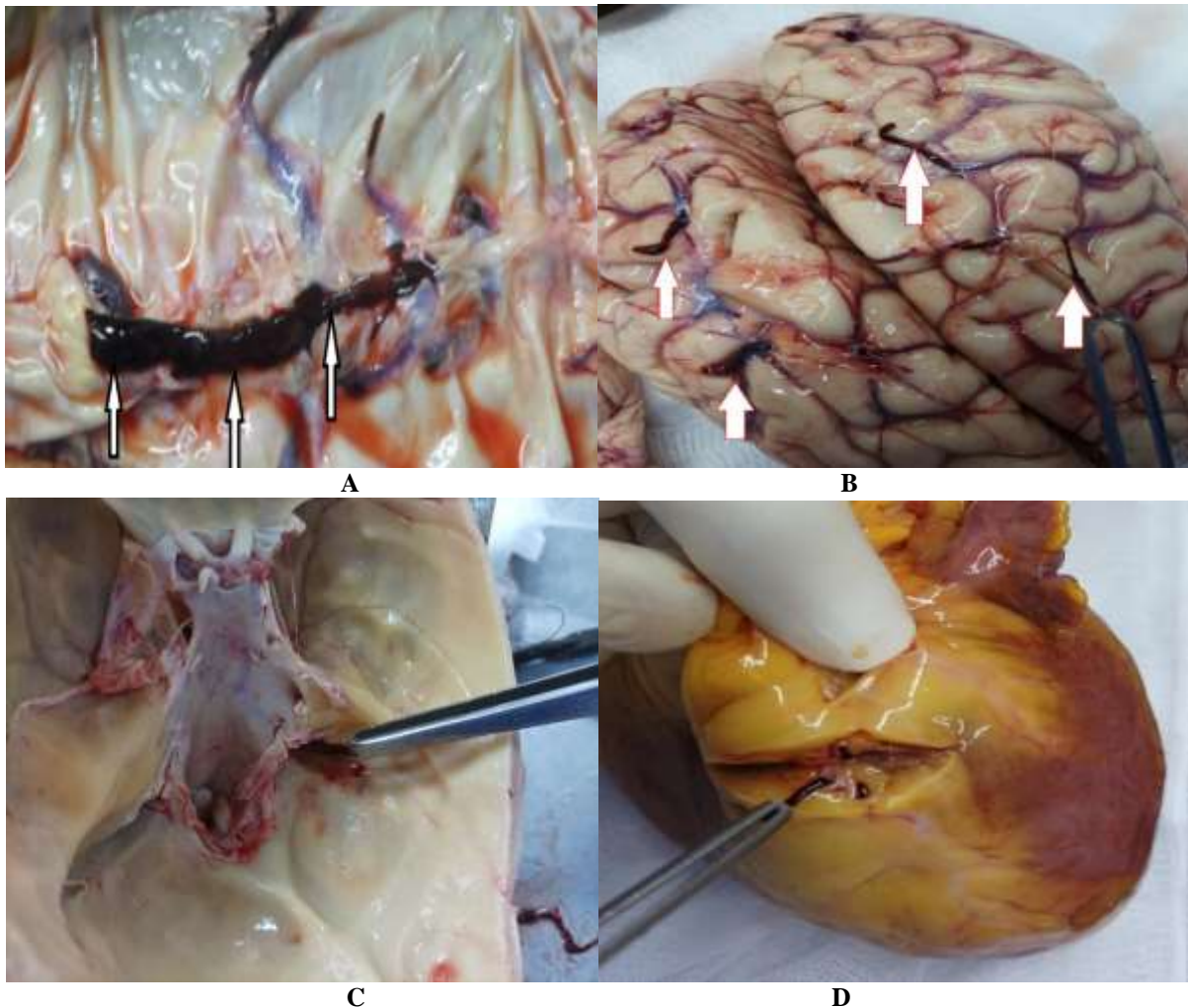
At the level of the abdomen

Once the cutaneous-muscular walls have reclined and after opening the peritoneum, we confirm the absence of peritoneal fluid effusion. The fat panicle is 1 cm away. The small intestinal loops and the colon are pale. The pancreas is pale. The stomach has no abnormality, its mucosa is pale. The liver is of normal volume, its section reveals a coagulopathy originating from its small vessels (Figure 2E). The abdominal aorta is free. The uterus is the site of a large fibroid weighing 04 kg causing abdominal swelling. The rest of the examination is without abnormality.

DISCUSSION

From all of these autopsy findings, it results that the clinical symptoms presented by the deceased have no

relationship with dental rabies, that it is a COVID-19 coronavirus infection confirmed by PCR test in post. mortem. It also results that the cause of death is a thromboembolic complication described in patients with COVID-19 coronavirus (2,4,5) with this particularity of affecting the cerebral venous network in all the cases studied, namely the longitudinal sinuses. , the cortical veins, the jugular veins which gives a coagulopathy of the entire venous vascularization of the brain complicated by a thrombosis of the arterial vascularization namely the anterior interventricular coronary artery and the hepatic network and the abdominal aorta which was obstructed by a large embolus. The final cause of death was due to a cardiac arrhythmia caused by thrombus of the anterior descending coronary artery. In the two cases cited, the pulmonary arteries were intact, contrary to case studies which show the high rate of death from pulmonary embolism.^[9]





E

Figure 2: Photographs of: A-thrombus of the superior longitudinal sinus. B- coronary vein thrombus. C-thrombus at the torn hole. D- anterior descending coronary artery thrombus. E- thrombosis of the hepatic vasculature.

Psychological Autopsy

A 51-year-old woman who would have presented with a simple flu syndrome for 04 days under antibiotic treatment (Augmentin 1 gram three times a day) and an antipyretic (Paracetamol 1 gram twice a day), following this symptomatology, a test (2019- nCOV Ag Rapid Detection Kit) was performed and returned negative on the 4th day of symptoms. Suddenly, she felt unwell, evacuated to the local university hospital center where the death was noted with mention of undetermined death on her death certificate as well as the notion of a medico-legal obstacle to burial. The public prosecutor ordered a medico-legal autopsy to determine the exact cause of death.

In his history, no medical-surgical pathology was noted. Furthermore, the absence of vaccination against COVID-19 was noted.

External Examination of the Corpse

This is the body of a woman who corresponds to her age of 51 years, her height is 165 cm, of an Average build with a normal BMI, the cadaveric lividities are red-purple at the posterior site with an asphyxial syndrome marked by cyanosis of the face, ears and distal extremities of the limbs.

The absence of any trace of violence on the entire body was noted.

Opening of Cavities

At the level of the head and neck

The scalp is congestive on its inner side. The cranium is intact in its entirety, the meninges are intact, their objective exploration of the venous sinuses of the brain thrombosed in their entirety (Figure 3A) up to the torn holes. The central nervous system is increased in volume, softened and friable when cut, preventing any medico-legal findings. Furthermore, the cortical veins are thrombosed (Figure 3B).

The superficial and deep planes of the neck are free from any lesions. The aero-digestive junction and the trachea are free, the trachea is lined with food liquid, its mucosa is congestive. The vascular-nervous bundle is intact, but the jugular vein is the site of thrombus. The hyoid bone and thyroid cartilage are intact.

At the level of the thorax

The underlying planes are intact, adipose panicle is 01 centimeter. The ribs and the chondro-sternal plate are intact. The lungs are enlarged, crackling, presenting emphysema at the tops, their section allows a sero-hematic fluid to emerge. The heart is eutrophic and its coronary arteries are free. The pulmonary arteries are permeable. The aorta is intact and permeable.

At the level of the abdomen

Once the cutaneous-muscular walls have reclined and after opening the peritoneum, we confirm the absence of peritoneal fluid effusion. The fat panicle is 1 cm away. The stomach is empty, its lining is congestive. The liver is heterogeneous, its section allows a sero-hematic fluid to emerge through congestion. The spleen is eutrophic, in place. The kidneys are in place and well differentiated. The pancreas is congestive. The bladder is empty. The intestines are free of abnormalities as is the mesenteric circulation. The aorta and its bronchi are intact and free. The vermicular appendix is in place. The uterus is in place, non-gravid and intact.

DISCUSSION

All of our autopsy findings and investigations carried out on the corpse allow us to say that the cause of death is also a thromboembolic complication which invaded the entire cerebral and jugular venous vascularization which will be directly responsible for the death. This is still a sudden death of neurological origin following decompensation of an infectious disease caused by Coronavirus COVID-19 with mild symptoms, not worrying for the patient but with sudden decompensation having caused sudden death and the very origin of a medico-legal obstacle to burial.

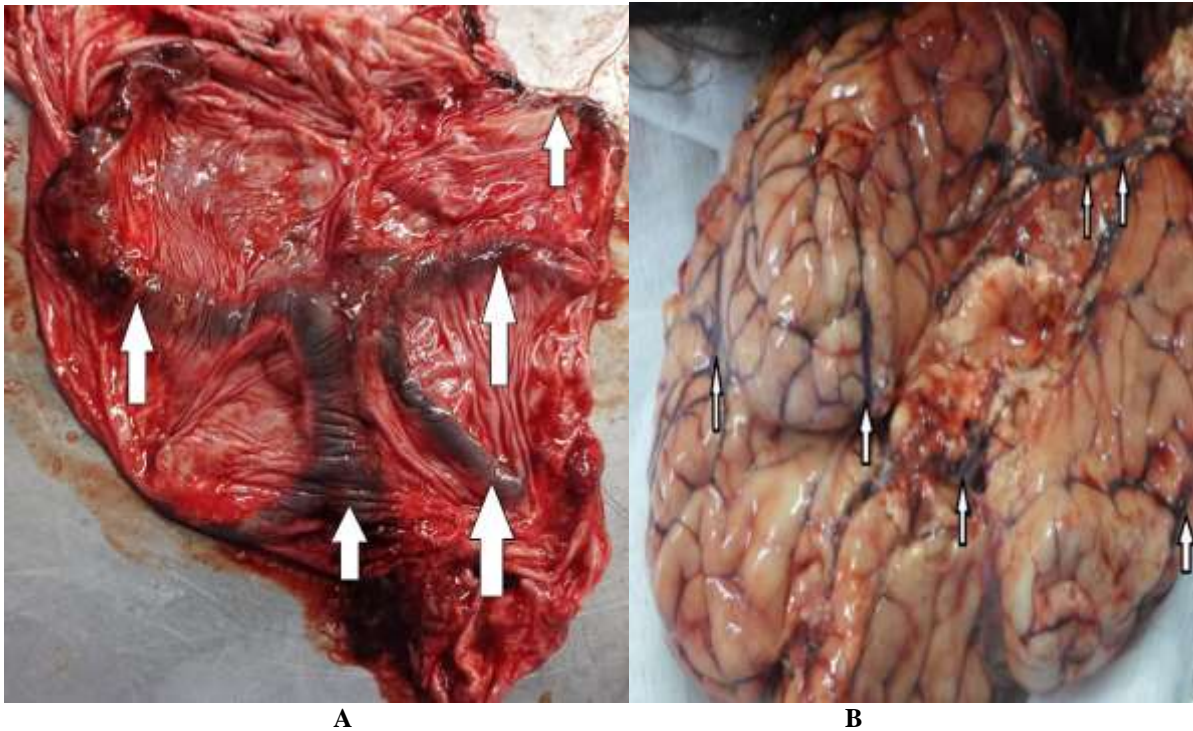


Figure 3: Photographs of: A-thrombus of the superior longitudinal sinus. B- coronary vein thrombus.

CONCLUSION

In this autopsy description, we only studied the clinical and macroscopic results of 03 autopsy cases of patients who died from Coronavirus COVID-19 in young subjects aged 31, 41 and 51 years. Our patients are all young, with no major risk factors apart from the 1st case who only presents obesity. Contrary to what is described in the literature on the association of risk factors in death from covid-19. Studies have concluded that severe patients or patients in intensive care have relatively higher mortality because of their advanced age and their comorbidities which are risk factors for poor prognosis,^[10] which is not our case.

Public Health England, the British government's public health agency, estimates that around 84,600 deaths and 23 million infections have been prevented thanks to the Covid-19 vaccination campaign in England,^[11] This study is in agreement with our clinical cases which show that the three deaths studied were unvaccinated subjects, hence the importance of vaccination in prevention and in the occurrence of complications.

It should be noted the pathological particularity of this finding, namely a thromboembolic complication having affected the cerebral venous system in the three cases which is associated in the first two cases with damage to the anterior descending coronary artery.

The chronology of the opening of the cavities during the autopsy means that the head is explored first, for this, we recommend that forensic doctors evoke the Coronavirus COVID-19 infection in front of an autopsy picture marked by cerebral venous thrombosis of the opening the

head and immediately performing a postmortem PCR before continuing to open the other cavities, this PCR examination is recommended during the autopsy to guide the continuation of the opening of the cavities.

It is also worth noting and sounding the alarm for clinicians and treating doctors to take into careful consideration even cases of Coronavirus COVID-19 with mild symptoms which could suddenly decompensate and cause sudden death. We also advise all patients with even bearable flu symptoms to contact COVID-19 treatment centers in order to avoid any sudden decompensation.

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