Nursing care plan on gas exchange impairment due to SARS-CoV-2: case report

Plan de cuidados de enfermería sobre deterioro del intercambio gaseoso por SARS-CoV-2: reporte de caso

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Abstract

INTRODUCTION: Over the years, mankind has been in contact with several viruses, which have threatened human existence by becoming pandemics such as influenza in 1918. However, in January 2020, the Chinese Centre for Disease Control and Prevention identified SARS-CoV-2 as the etiological agent of the 2019 coronavirus. So far it is known that 5% of patients with severe COVID-19 will require attention in intensive care units. To this end, critical care nursing staff use the nursing care process to prioritize the care of the critically ill patient. OBJECTIVE: To develop a nursing care plan by analyzing a clinical case of an adult patient with a diagnosis of COVID-19. METHODOLOGY: The case of a patient with a diagnosis of COVID-19 was analyzed to develop a nursing care process using the taxonomies of the North Diagnosis American Nursing Association, Nursing Outcomes Interventions Classification and Nursing Classification. Documentary research was carried out through a literature search in databases such as: Scielo, Medicgraphic, Google Scholar and PubMed. RESULTS: Three real nursing diagnoses and seven risk diagnoses were identified. The priority nursing diagnostic label based on Maslow's pyramid of needs was deterioration of related gas exchange. CONCLUSIONS: The critical care nurse takes a leading role in the care of patients with a diagnosis of COVID-19, the development of the nursing care process contributes to providing quality care focused on the well-being of the user.

Resumen

INTRODUCCIÓN: A lo largo de los años la humanidad ha estado en contacto con diversos virus, los cuales han amenazado la existencia del ser humano al convertirse en pandemia como el de la influenza en 1918. Sin embargo, en enero de 2020 el Centro Chino para el Control y la Prevención de Enfermedades identificó al SARS-CoV-2 como el agente etiológico del coronavirus 2019. Hasta el momento se sabe que el 5% de los pacientes con COVID-19 grave requerirán de cuidados en las unidades de cuidados intensivos. Para ello el personal de enfermería en cuidado crítico utiliza el proceso cuidado enfermero para priorizar la atención del paciente crítico. OBJETIVO: Elaborar un plan de cuidados de enfermería mediante el análisis de un caso clínico de paciente adulto con diagnóstico de COVID-19. METODOLOGÍA: Se analizó el caso de un paciente con diagnóstico de COVID-19 para el desarrollo de un proceso cuidado enfermero implementado las taxonomías de la North American Nursing Diagnosis Association, Nursing Interventions Classification y Nursing Outcomes Classification. Se realizó investigación documental mediante una búsqueda bibliográfica en bases de datos como: Scielo, Medicgraphic, Google académico y PubMed. RESULTADOS: Se identificaron tres diagnósticos de enfermería reales y siete de riesgo. La etiqueta diagnóstica de enfermería prioritaria con base a la pirámide de las necesidades de Maslow fue deterioro del intercambio de gases relacionado CONCLUSIONES: La enfermera en cuidado critico se posiciona como líder en el cuidado de pacientes con diagnóstico de COVID-19, el desarrollo del proceso cuidado enfermero contribuye para brindar una atención de calidad enfocada en el bienestar del usuario.

COVID-19, intervections

COVID-19, Intervenciones

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Coronaviruses (CoV) are a family of viruses that can cause multiple conditions, ranging cold from the common to different complications such as those caused by SARS-CoV-1 (Severe Acute Respiratory Syndrome Coronavirus 1) (Rossi, Sacco, Mancino, Cristiani, Midulla, 2020). However, during 2019, the SARS-CoV-2 virus that causes disease 2019 (COVID-19) coronavirus which is different from emerged, the coronaviruses that commonly cause mild human illness, as it is suggested that SARS-CoV-2 may evade the immune system more effectively than SARS-CoV-1 and thus cause pneumonia whose main feature on Computer Axial Tomography (CAT) is ground-glass opacity (Rossi et al, 2020), (Wiersinga, Rhodes, Cheng, Peacock, Prescott, 2019).

On December 31st 2019, a cluster of pneumonia cases with unknown etiology was reported in Wuhan, the capital of the Hubei province, China. On 9 January 2020, the Chinese Centre for Disease Control and Prevention identified the novel SARS-CoV-2 coronavirus as the causative agent of this outbreak. On 30 January 2020, the Director-General of the World Health Organization (WHO) declared the outbreak to be a public health emergency of international concern (Carvalho, Krammer, Iwasaki, 2021).

On 11 February 2020, the WHO officially named the disease COVID-19. In this abbreviation COVID-19, "CO" stands for "corona", "VI" for "virus" and "D" for "disease". Previously, the way to refer to this disease was "new coronavirus 2019" or "2019nCoV"(Parlakpinar, Gunata, 2021). By March 2020, the epidemic is classified as a pandemic (Megna, 2020).

SARS-CoV-2 Transmission of is primarily respiratory-mediated, i.e. it is spread by virions suspended in large droplets (>5µm) or sprays ($<5\mu m$) that are expelled from the primary patient's respiratory tract by talking, coughing or sneezing (Meyerowitz, Richterman, Gandhi, 2021), (Greenhalgh et al, 2021). Although the evidence suggesting transmission by direct contact or fomites is inconclusive, transmission can occur due to poor hand hygiene by touching surfaces viral particles and containing direct conjunctival inoculation or contact with the respiratory mucosa (Heneghan et al, 2021), (Karia, Gupta, Khandait, Yadav, Yadav, 2020).

For all these reasons, it is a virus with a high rate of contagiousness and lethality, especially in older adults (>65 years). This lethality may be due to the comorbidities of the patients, the pathogenicity of the virus, the immunity of the population and the host's response to infection; it should be mentioned that depending on the country, this lethality rate may be modified (Piroth, Cottenet, Mariet, 2021). It is known that some of the comorbidities that increase the risk of death due to the development of hypoxemia generated by SARS-CoV-2 are arterial hypertension, obesity and diabetes (Fernández-Rojas, et al 2021).

Among the main complications that COVID-19 patients develop is severe acute respiratory distress syndrome, which is considered a major predictor of intensive care unit (ICU) admission, mechanical ventilation and death (Bickler, Feiner, Lipnick, McKleroy, 2021). Intrapulmonary derivation and ventilation/perfusion imbalance are the main causes of impaired gas exchange leading to hypoxemia in patients with COVID-19, if not resolved with supplemental oxygen it indicates that the deterioration has progressed beyond ventilation/perfusion mismatch, (Bickler. Feiner, Lipnick, McKleroy, 2021),(Dhont, Derom, Van Braeckel, Depuydt, Lambrecht, 2020), (Diehl, Peron, Chocron, 2020); approximately 50-85% of patients with ICU admission developed hypoxemia or respiratory exhaustion, (Haouzi, Zamir, Villarreal-Fernandez, 2020), (Ouyang L, Yu M, Zhu Y, Gong, 2021).

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Evidence from other countries estimates that 5% of patients who develop severe COVID-19 will require ICU care, consequently, this has led to critical care nurses becoming more skilled in recognizing, preventing and intensifying care in a holistic manner for patients with this condition (Carter, Notter, 2020). Nursing staff, compared to other healthcare professionals, spend more time in contact with patients and therefore play a key role in their care and attention (Bayih, Ayalew, Belay, 2021).

This care provided by nurses is based on the nursing care process, which is a practical tool that guides the critical thinking of these professionals for the development of Nursing Care Plans (NCP) (Bayih, Ayalew, Belay, 2021). For all of the above reasons, an NCP was developed in the present study, which focuses on a clinical case of an adult patient with a diagnosis of COVID-19, who was hospitalized in an ICU and whose priority nursing diagnosis was deterioration of gas exchange.

Methodology

A clinical case was identified of a patient with a diagnosis of COVID-19 who was hospitalized in an ICU in a private hospital in the city of San Luis Potosí, Mexico. Subsequently, a nursing assessment was carried out using Marjory Gordon's functional patterns, which made it possible to identify the main nursing diagnoses according to the taxonomy of the North American Nursing Diagnosis Association (NANDA), (Kamitsuru, Herdman, 2018) and the diagnoses were prioritized based on Maslow's pyramid of needs (Desmet P, Fokkinga, 2020) in order to plan nursing interventions through the Nursing Interventions Classification (NIC), (Butcher, Bulechek, Dochterman, 2018) and the expected results were established according to the Nursing Outcomes Classification (NOC) (Moorhead, 2018).

The analysis and substantiation of the clinical case was carried out by consulting the literature through the review of various articles in indexed, refereed journals and *Journal Citation Reports*. The literature search was carried out in databases such as: Sciense Direct, Scielo, Medicgraphic, Medic Latina, Clinical Key, Elsevier, Google Scholar and PubMed. The characteristics of the articles consulted were no less than three years old in English and Spanish.

Results

Clinical findings

The following is the nursing assessment data obtained from the clinical case patient using Marjory Gordon's functional patterns:

Health perception and health management.

Patient with a diagnosis of diabetes mellitus and arterial hypertension (the time of evolution of both pathologies is unknown) with pharmacological treatment. A CAT scan was performed (Figure 1).



Figure 1 Lung CAT scan of the patient with a diagnosis of COVID-19. The image shows in both lungs the main characteristic of this pathology, which is ground-glass opacity in both lungs *Source: Own elaboration*

Nutrition and metabolism

Dry oral mucosa, pale gums, weight 105 kg, height 165 cm and body mass index of 38,5. On admission with fever of 38.4° C and dysthermia. Laboratory studies at the time of initial evaluation showed some data out of normal ranges: blood biometry: leukocytes 13,23 k/µL, lymphocytes 8%, segmented neutrophils 90%; blood chemistry: blood glucose 336 mg/dl and urea in blood 79,18 mg/dl.

Elimination

Urinary catheter is installed to shunt, managing a urine output of 0.6 ml/kg/h, diuresis is observed concentrated with slight sediment. The patient is diaphoretic, with a balance in turn of -412 ml; without defecation in the last 48 hours.

Activity-exercise

Hypotensive patient with blood pressure of 90/50 mmHg with BPM (76 mmHg), tachycardic (121x'1), eupneic (20x'1), oxygen saturation 77% by pulse oximetry, pulmonary auscultation reveals hypoventilation, capillary filling of 3 secs, distal and peribuccal cyanosis. Patient on invasive mechanical ventilation with the following programming: A/C mode, pressure management with a frequency of 20 l/min. PEEP 14, pressure support of 16 and a sensitivity of 2 l/min. His acid-base balance was monitored (**Figure 2**).

Parameters	Admission	Before MV	Post MV	Normal parameters
pН	7,441	7,460	7,378	7,32-7,43
PaCO ₂	31,1	34,5	40	35-48
(mmHg)				
PaO ₂ (mmHg)	31,3	31	42	83-108
HCO ₃	21,2	24,5	23,6	21-28
(mmol/L)				
StO ₂	63,9%	60%	77%	94-98%

Figure 2. Blood gas parameters of the patient with a diagnosis of COVID-19. The difference between the patient's blood gas parameters on admission to the ICU before mechanical ventilation (MV) and after MV can be seen

Cognitive-perceptual

Under sedoanalgesia with fentanyl and midazolam (200ml of 0.9% saline + 200mg of midazolam + 2gr of fentanyl), with -4 RASS (Richmond Agitation-Sedation Scale) points, normoreflexic isochoric pupils.

Roles and relationships

Relatives at home, but in constant communication to be informed about the patient's health status.

Values and beliefs

In his unit he has a religious image.

Main nursing diagnoses in the patient

Ten nursing diagnoses were identified in the patient with a diagnosis of COVID19 (Table 1) of which seven are risk and three are actual.

Functional health patterns	NANDA Domain	Туре	Nursing diagnosis
Nutritional Metabolic	2. Nutrition	4. Metabolism	(00179) Risk of blood glucose level r/f physical health condition.
Nutritional Metabolic	2. Nutrition	5. Hydration	(00028) Risk of fluid volume deficit r/f (risk factor) situation affecting access, intake or absorption of liquids.
Elimination	3. Eliminatio n	4.Respiratory function	(00030) Impaired gas exchange r/t (related to) alveolar capillary membrane changes s/b' (shown by) abnormal skin color, diaphoresis, abnormal gasometry, hypoxemia, hypoxia, tachycardia
Activity	4. Activity/	4.Cardiovascular/pulmonary	(00200) Risk of decreased cardiac
Nutritional Metabolic	11. Safety protection	6. Thermoregulation	(00007) Hyperthermia r/t disease s/b hypotension, tachycardia, warm skii to touch
Nutritional Metabolic	 Safety protection 	2. Physical injury	(00045) Deterioration of oral mucosa r/f dehydration s/b gum paleness.
Nutritional Metabolic	 Safety protection 	2. Physical injury	(00047) Risk of deterioration of skin integrity r/f hyperthermia, humidity, alteration in fluid volume.
Activity Exercise	 Safety protection 	2. Physical injury	(00205) Risk of shock r/t systemic inflammation response syndrome.
Activity Exercise	11. Safety protection	2. Physical injury	(00206) Risk of bleeding r/f therapeutic regimen s/b hypotension, hypovolemia, hypoxemia, hypoxia, systemic inflammatory response syndrome.
Nutritional Metabolic	11. Safety protectio n	2. Physical injury	(00249) Risk of pressure sore r/f dehydration, hyperthermia, skin moisture, decreased mobility.

Table 1 Nursing diagnoses identified in the patient with

 COVID-2019 diagnosis

Priority nursing care process on the deterioration of gas exchange in a patient with a diagnosis of COVID-19

Table 2 shows the NCP of the deterioration of gas exchange in the patient diagnosed with COVID-19, which was prioritized according to Maslow's pyramid, in the section of physiological needs in which we can include the respiratory aspect.

D011101100001	Type:		Expected	result	
Elimination	0004 Respir				
	atory functio				
Nursing Diag	nosis	Result (NOC)	Indicator	Measureme	Target score
(NANDA Label (Problem) ((P)	Mechanical	Respiratory	nt scale 1. Grave	Maintain: 3
(00030) Detenorati exchange	ion of gas	response: adult	rate in expected range	2.Substantia	Increase: 4 Result: 5
Related factors (c (E)	auses)	(0411)	(040301) Breathing	3.Moderate 4.Mild	
Capillary alveolari changes	membrane		depth (040303)	5.None	
(Signs and Sympt	oms)				
diaphoresis, abnor	or, nal blood				
gas, nypoxemia, ny tachycardia.	poxia,				
		Respiratory status:	Absence of		Maintaine 2
		ventilation (0410)	muscles use	1.Extremely	Manitani: 2
			Absence of	2.Substantia lly	Increase: 3
			Absence of	y	Result: 5
			(041002)	5.Not	
			rate in the	d	
			(041004)		Maintaine 2
		Vital signs status	movement out	1.Extremely	Maintain: 2
		(0802)	of airway (041006)	2.Substantia lly	Increase: 4
			Temperature	3.Moderate 4.Mild	Result: 5
			(080201) Apical pulse	5.No deviation	
			rate (080202) Respiratory		
			rate (080204) Systolic blood		
			pressure (080205)		
Nursi Respira	ng intervent atory monitor	ion (NIC) ring (3350)	Nurs	sing intervention 1 to avoid aspiration	(NIC) on (3200)
- Placeme	Activities ent of con	tinuous non-invasive	- Keep h	Activities: nead of bed elevate	ed 30-45 degrees.
oxygen system.	sensors, with	an appropriate alarm	- Keep e - Keep a	endotracheal tube aspiration equipme	balloon inflated. ent available.
 Continu saturation 	ous monit on levels.	oring of oxygen	- Check	NG tube placeme gastric residue be	nt. fore starting
- Ausculta areas of	decreased ve	iratory sounds, noting entilation and presence	feeding	g.	
 of adver Determi 	ntitious sound ning if th	ls. ere is a need for			
aspiratio Monitor	on by auscult ing and r	ation. ecording mechanical			
- Observi	or readings. ng changes	in arterial blood gas			
- values. - Frequen	t monitorir	ig of the patient's			
- Follow u	ory status. up on radiolo	gy reports.			
Nursin Management of	ng intervent mechanical	ion (NIC) ventilation: invasive	Nur	sing intervention	(NIC)
			Managem	ent of artificial air	ways (3180)
Activities:	(3300)		Activities:	ent of artificial air	ways (3180)
Activities: - Consulting on ventilato	(3300) with other he r mode selec	ealthcare professionals tion.	Activities: - Wash hand - Use unive	ent of artificial air ds. rsal precautions.	ways (3180)
Activities: - Consulting on ventilato - Make sure v - Routinely c	(3300) with other he or mode select ventilator ala sheck ventila	ealthcare professionals tion. rms are turned on. tor settings, including	Activities: - Wash han - Use unive - Correct an gear.	ent of artificial air ds. rsal precautions. Id complete use of	ways (3180) f personal protective
Activities: - Consulting on ventilato - Make sure v - Routinely c temperature - Regularly cl	(3300) with other he or mode select ventilator ala theck ventila and humidif heck all vent	ealthcare professionals tion. mrs are turned on. tor settings, including Teation of inhaled air. ilator connections.	Activities: - Wash hand - Use unive - Correct and gear. - Provide 10 - Inflate ET	ent of artificial air ds. rsal precautions. dd complete use of 00% humidificatio balloon using a	ways (3180) f personal protective m. minimally occlusive
Activities: - Consulting on ventilato - Make sure v - Routinely c temperature - Regularly cl - Observe for an increase	(3300) with other ho r mode select ventilator ala sheck ventila and humidif heck all vent r a decrease i in inspirator	ealthcare professionals tion. ms are turned on. tor settings, including ication of inhaled air. ilator connections. n exhaled volume and p pressure.	Activities: - Wash hand - Use unive - Correct and gear. - Provide II - Inflate ET technique - Keep ET	ent of artificial air ds. rsal precautions. Id complete use of balloon using a or minimal leak to balloon inflated	ways (3180) f personal protective on. minimally occlusive schnique. 1 to 15-20 mmHg
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Activities: - Consulting on ventilato: Make sure v - Routinely c temperature - Regularly cl - Observe for an increase - Administer sedatives an - Control - consumptio	(3300) with other ha r mode select ventilator ala heck ventila a and humidii heck all vent r a decrease i in inspirator appropriate ad narcotic an activities n (fever, chil	ealthcare professionals tion. ms are turned on. tor settings, including faction of inhalded air. ilator connections. n exhaled volume and y pressure. 2 muscle relaxants, salgesics. that increase O2 lis, pain, basic nursing	Activities: Wash han Use unive Correct an gear. Provide II Inflate ET technique Keep ET during me Check b handling t	ent of artificial air ds. rsal precautions. d complete use of balloon using a or minimal leak tu balloon inflatec balloon inflatec balloon pressure he ET balloon. reference in cm or	ways (3180) f personal protective m. minimally occlusive chnique. 1 to 15-20 mmHg m. immediately after t the ET to check for
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	Nursing intervention (NIC)	
Management of basic acid balance: respiratory alkalosis (1914)		
Activities:		
-	Keep airway permeable.	
-	Monitor respiratory status.	
-	Keep IV access permeable.	
-	Reduce oxygen consumption.	
-	Manage sedation to reduce hyperventilation.	
-	Monitor venous blood gas trends to determine efficacy of interventions.	
-	Monitor for worsening symptoms of respiratory alkalosis.	
-	Obtain samples for laboratory analysis of basic acid balance.	
-	Place the patient to facilitate adequate ventilation.	
-	Water balance.	
-	Monitor for the presence of cardiopulmonary manifestations of respiratory alkalosis (arrhythmias, decreased	
	cardiac output).	
-	Facilitate stress reduction.	
-	Provide frequent oral hygiene.	

Table 2 NCP of the deterioration of gas exchange in the patient diagnosed with COVID-19

Despite providing continuous care, the evolution of the disease was not satisfactory as in the following days the patient presented a progressive deterioration in his health condition which led to his death; this coincides with different studies showing that people with COVID-19 with comorbidities are more at risk of developing complications which end in a fatal outcome.

Discussion

Alteration of gas exchange was one of the most frequent nursing diagnoses in patients with SARS-CoV-2, and at the beginning of the pandemic it caused a large percentage of deaths, a situation that has currently changed since its frequency has decreased thanks to vaccination.

Globally, as of May 2023, approximately a total of 13,350,487,934 vaccine doses have been administered and 765,903,278 confirmed cases of COVID-19 have been reported and of which 6,927,378 correspond to deaths, as reported by the WHO (World Health Organization, 2023).

However, it is important to mention that in addition to vaccination, a series of actions have contributed not only to prevention, but also to providing care to the population during the pandemic through the training of nursing staff in: use of medical equipment. protection, techniques for the care of critical patients, in addition to collaborating in the reconversion of COVID-19 hospitals, participating in the communication of patients with their families through electronic devices, courses for the development of resilience, to mention a few.

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However, even now there are areas of opportunity relation post-COVID in to conditions in patients and health personnel who present Bournot syndrome, these becoming new of opportunity.to implement health areas strategies, and thus continue providing quality care to users (Danesh, Garosi, Golmohamadpour, 2021), (Roberts, Kelly, Lippiett, Ray, Welch, 2021).

The current challenges derived from the pandemic are the physical and emotional rehabilitation of patients with long COVID or post-COVID-19 syndrome, as well as health personnel and the restructuring of health services to be prepared for a future pandemic, as well as reduce barriers to access to health (Bauer S, Eglseer D, Hödl, 2020), (Løkke, F. B, et al, 2023), (Pujolar G, Oliver-Anglès A, Vargas I, Vázquez, 2022), (Yong,2021), (Zhang, 2023).

Conclusion

When the patient with a diagnosis of COVID-19 is admitted to the ICU, the critical care nurse specialist becomes a leader in providing care. Thus she plays a very important role in patient management, therefore putting her theoretical practical knowledge and on trial, the management of a critically ill patient involves specialized care whose objective is to provide care aimed at improving quality and maintaining health. The implementation of NCP, such as the one developed in this study, allows improvement in the planning of nursing care to be provided to critically ill patients with a diagnosis of deterioration of gas exchange due to SARS-CoV-2.

Conflict of interest

The authors have no conflicts of interest to declare.

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None.

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