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CASE REPORT

Botulism in the ICU: Nursing care plan☆

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KEYWORDS
Botulism;
Nerve block;
Critical care;
Nursing care

Abstract
Introduction and case evaluation: Botulism is a rare disease in Europe, caused by the bacterium *Clostridium botulinum*, notifiable, non-transmissible person-to-person and potentially fatal (between 5% and 10%) if not treated quickly. The favorable opinion of the Clinical Research Ethics Committee was obtained. We present the nursing care plan of a 49-year-old man with a diagnosis of bacterial intoxication caused by *Clostridium botulinum*, secondary to ingestion of beans in poor condition, who was admitted to the ICU for a total of 35 days.
Diagnosis and planning: Holistic nursing evaluation during the first 24 h, with prioritisation of the systems that were deteriorating fastest: neurological and respiratory. Nine diagnoses were prioritised according to the NANDA taxonomy: risk for allergy response, ineffective breathing pattern, impaired oral mucous membrane, impaired physical mobility, risk for disuse syndrome, risk for dysfunctional gastrointestinal motility, impaired urinary elimination, risk for acute confusion and risk for caregiver role strain.
Discussion: The nursing care plan, standardised and organised with the NANDA taxonomy and prioritised with the outcome-present state-test (OPT) model, guaranteed the best care based on evidence, as the NOC scores improvement demonstrated. It was impossible to compare the nursing intervention with other case reports.

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PALABRAS CLAVE
Botulismo;
Bloqueo nervioso;
Cuidados críticos;
Atención de Enfermería

Botulismo en la UCI: proceso de cuidados

Resumen
Introducción y valoración del caso: El botulismo es una enfermedad poco frecuente en Europa, causada por la bacteria *Clostridium botulinum*, de declaración obligatoria, no transmisible de persona a persona y potencialmente mortal (entre un 5 y 10%) si no se trata rápidamente. Se obtuvo el dictamen favorable del Comité de Ética de Investigación Clínica. Se presenta el proceso de cuidados enfermero de un varón de 49 años con diagnóstico de intoxicación bacteriana por *Clostridium botulinum*, secundario a la ingesta de alubias en mal estado, que estuvo ingresado en la UCI un total de 35 días.
Diagnósticos y planificación: Valoración enfermera de forma holística durante las primeras 24 h, con priorización de los sistemas que presentaron un deterioro más rápido: el neurológico y el respiratorio. Se priorizaron 9 diagnósticos según la taxonomía NANDA: riesgo de respuesta alérgica, patrón respiratorio ineficaz, deterioro de la mucosa oral, deterioro de la movilidad física, riesgo de síndrome de desuso, riesgo de motilidad gastrointestinal disfuncional, deterioro de la eliminación urinaria, riesgo de confusión aguda y riesgo de cansancio del rol del cuidador.
Discusión: El proceso de cuidados enfermero, estandarizado y organizado con la taxonomía NANDA y priorizado con el método sistemático AREA, garantizó los mejores cuidados basados en la evidencia y prueba de ello fue la mejoría de las puntuaciones de los indicadores de resultado NOC. Resultó imposible comparar la actuación enfermera con la de otros casos documentados.

Introduction

Botulism is a disease caused by *Clostridium botulinum*, an anaerobic gram-positive bacillus formed by spores that produce a powerful neurotoxin.[1] It is notifiable, not transmissible person-to-person and potentially fatal (between 5% and 10%) if it is not treated promptly.[2]

The spores produced by the *C. botulinum* bacteria, which have been found in green beans, spinach, mushrooms, ham, sausages, tinned tuna and fish (fermented, salted and smoked[2]), germinate in anaerobic environments, and when they grow in certain environmental conditions create neurotoxins.[1,2] They are heat resistant (they can survive at more than 100 °C for 5 h or more, but if they are exposed to 120 °C for 5 min they are destroyed[1]). They do not develop in acid media (although a pH < 4.6 will not degrade an already existing neurotoxin[1]) and a low temperature and salt content can prevent their growth.[2]

C. botulinum is found all over the world and its growth depends on environmental factors.[3] Van Ermengem isolated the bacteria in 1897 from a badly-cured ham. Leuchs, in 1910, demonstrated that 2 strains of *C. botulinum* would produce toxins with different antigenicities and in 1919 Burke named them as type A and B, thus establishing their current alphabetical designations. Subsequently, 5 further types of toxins were discovered (C, D, E, F and G), some with dual toxicities.[4] Types A, B, E and occasionally F can cause human botulism; A is used cosmetically.[1–3]

There are 6 types of human botulism[1,2]: food-borne (through ingestion of foods contaminated during their preparation, processing or packaging[1–3]), infant (through ingestion of the spores that colonise the intestinal tract and release the toxin[1–3]), wound (generally due to injection of black tar heroin[1–3]), adult intestinal colonisation (the toxin is produced *in vivo* in the infected intestinal tract[1]), inhalation (very rare, as an act of bioterrorism[1,2]) and iatrogenic (through incorrect treatment[1]).

Between 2007 and 2015, cases of food botulism were notified in some countries in Europe and North America. According to the World Health Organisation, approximately 35% were serious, with a mortality rate of 15%, and the disease lasted from 5 to 180 days. The age mode was 50 (minimum age of 4 and maximum of 88) and 48% were males.[5] In Spain, according to the Carlos III Health Institute, the autonomous communities with the highest incidence of food botulism were Castile and Leon, Andalusia and Madrid, with 20, 15 and 10 cases, respectively, although they do not specify the severity.[6]

In food botulism the neurotoxins, created by the digestive enzymes after *C. botulinum* has been ingested, pass into the blood stream and interrupt the release of acetylcholine, causing a nerve block[1,2] and descending flaccid paralysis develops in the motor and autonomic nerves.[2] Symptoms appear between 12 and 36 h after ingestion and are principally neurological[2] and gastrointestinal[1,2]: fatigue,[2] neck muscle,[2] respiratory muscle[1,2] and lower limb weakness,[2] vertigo,[2] blurred vision,[1,2] diplopia,[1] drooping eyelids,[1] photophobia,[3] symmetric cranial neuropathy[2] (speech and swallowing difficulty and dry mouth), vomiting, diarrhoea, constipation and abdominal inflammation.[2]

Diagnosis is based on clinical history, physical examination[1] and confirmed by samples (faeces or wound, blood or food[2,3]). There will be no alterations in consciousness[1] or haemodynamic alterations, fever or sensory deficit.[2] Differential diagnosis will consider

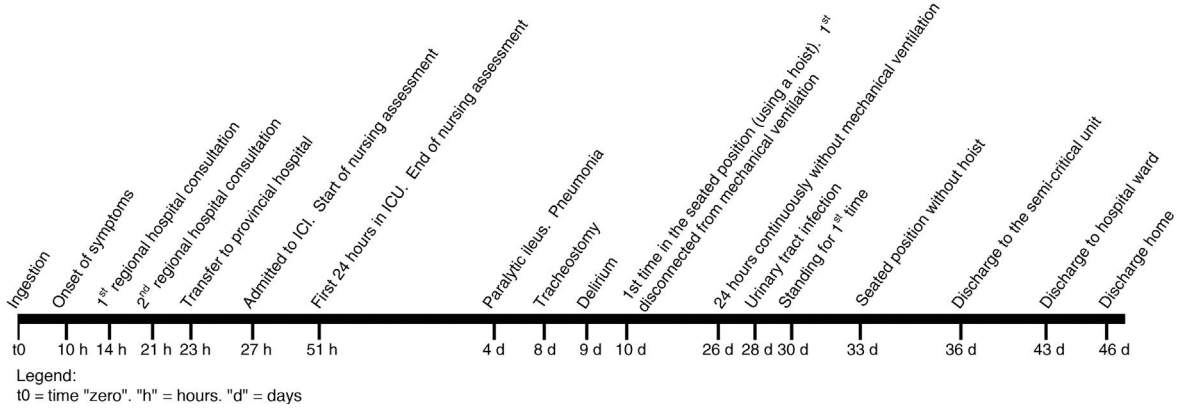

Figure 1 Time frame of progress from ingestion until discharge home.

Guillain-Barré syndrome,[1,2] myasthenia gravis[1,2] and cerebral vascular accident.[2]

Treatment consists of administering the botulin antitoxin as promptly as possible,[1–3] monitoring for signs of hypersensitivity because it is equine-derived,[1] and overcoming the neuromuscular complications caused by the poisoning (respiratory failure is the primary cause of death[1]). Antibiotherapy is only indicated for wound botulism.[1–3]

Description of the case

A 49-year-old male, 1.72 m tall, weighing 75.9 kg (body mass index 25.66 kg/m^2). Allergic to pyrazolones, active smoker (1 pack/day). No medical history. Self-employed (Barthel Index 100).

The patient attended his regional hospital with dizziness, blurred vision, unstable gait and frontal headache, of 4-h onset. He mentioned having eaten an uncertain amount of beans in poor condition 14 h previously. On examination his blood pressure (BP) was 160/100 mmHg. After 3 h he was discharged diagnosed with bacterial food poisoning (International Classification of Disease [ICD] 005.9). Fig. 1 shows the time frame of the progression of the disease from ingestion to discharge.

He attended the emergency apartment again with drooping eyelids in addition to the abovementioned symptoms. The patient had a dry mouth, mydriatic pupils with slow photomotor reflex, bilateral drooping eyelids, and full loss of eye motion. BP 156/99 mmHg. Arterial blood gases (ABG): SaO_2 96.6%, pO_2 78.7 mmHg. There were no alterations in consciousness, cutaneo-plantar and osteotendinous reflexes or on the electrocardiogram.

The patient was transferred to the emergency department of the provincial hospital with suspected *C. botulinum* food poisoning (ICD 005.1). The patient now had mild dysarthria in addition to his previous symptoms. BP 139/98 mmHg. ABG: SaO_2 96.4%, pCO_2 34 mmHg, pO_2 82 mmHg. Peak expiratory flow (PEF, indicator of lung function, measured by spirometer) 450 l/min (expected value for his height, age and sex: 601 ± 48 l/min[7]). Oxygen therapy was started through nasal cannula and 3 h later he was admitted to the intensive care unit (ICU). He was given a first dose of the trivalent botulin antitoxin (A, B, E) by continuous infusion through a single line, and for 4 h.

Nursing assessment

During the first 24 h in ICU a holistic assessment was made of the patient that highlighted the neurological and respiratory system alterations. Bilateral facial paralysis was identified, neck muscle alteration, proximal upper limb weakness and increased dysarthria. The impact of the neuromuscular block on the respiratory system required orotracheal intubation and mechanical ventilation, due to dyspnoea and increased respiratory effort. The PaO_2/FiO_2 ratio, indicator of pulmonary oxygen diffusion calculated by ABG, considers there to be acute lung injury below 300 mmHg[8]: in only 5 h it had dropped from 300 mmHg to 220 mmHg and the PEF fell from 220 l/min to 130 l/min.

In addition to the neurological and respiratory alterations, and after having administered a total of 2 doses of the antidote, the patient was distressed and nauseous (with preserved peristalsis). A nasogastric tube was passed, and a urinary catheter inserted which revealed oliguria (<400 ml/24 h) and a central jugular venous catheter to administer vasoactive drugs, analgesia, sedation and saline.

Over the subsequent 34 days, the patient presented complications associated with intoxication and his stay in ICU. He was diagnosed with unspecified hypotension (ICD 458.9), pneumonia caused by other gram-negative bacteria (ICD 482.83), urinary tract infection, site not specified (CIE 599.0) and paralytic ileus (ICD 560.1). An early tracheostomy was performed after 7 days to enable weaning and start rehabilitation.

The patient was in ICU for a total of 35 days, 7 in a semi-critical unit and 3 on the hospital ward.

Diagnoses and care planning (NANDA-NOC-NIC)

The main problem was approached by employing the OPT model of clinical reasoning,[9] focussing intervention on outcomes and not on the health problems identified. The nursing objective was to anticipate the problems of progression of the patient's neuromuscular paralysis that was found on assessment. Fig. 2 shows the nursing clinical reasoning

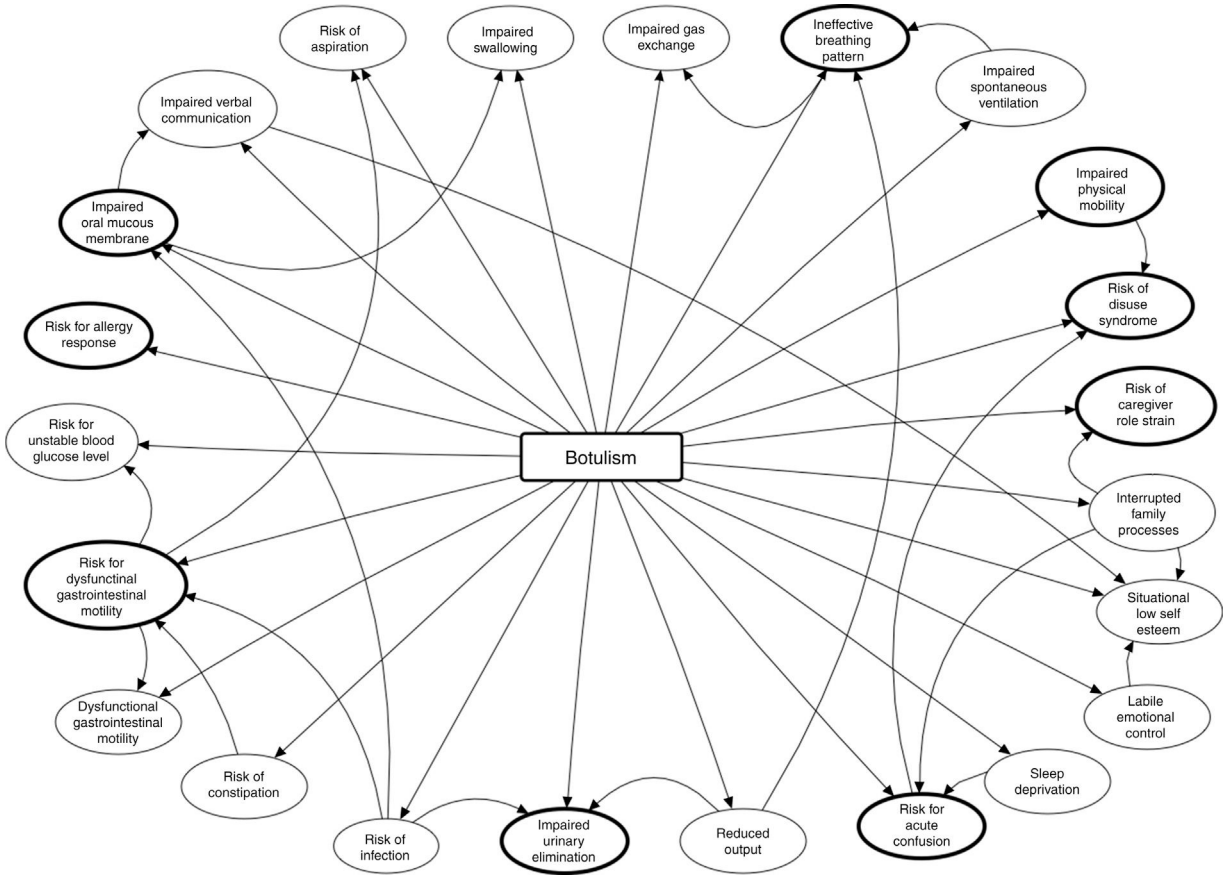

Figure 2 Nursing clinical reasoning net, according to the OPT model.

net, as created by Pesut and Herman in 1999.[9] It shows the main problem, the nursing diagnoses (ND) initially identified and their interrelations. Note that 9 of them are those that eventually formed the care process (Table 1): these are the most important because if not resolved, the other 14 would persist (except for the risk of allergy, which derived directly from administration of the antidote).

Table 1 combines the ND (NANDA[10]), outcomes (NOC[10]) and nursing interventions (NIC[10]), with their respective outcome and activity indicators. Table 2 shows the assessment scales of the different outcome indicators.[10]

Assessment of outcomes

Bearing in mind the natural course of the disease, outcome indicators (NOC) with deficient scores were inevitable. The thorough neurological monitoring, the deterioration in breathing over the first 24 h, the early tracheostomy and the persistent nursing action on rehabilitation were noteworthy.

Discussion

The case we present confirms the need for good coordination between practitioners, in terms of communication, intervention and recording, since the patient made good progress thanks to the rapid action of the multidisciplinary team.

The nursing care process comprised a holistic assessment that flagged up the involvement of the neurological and respiratory systems, and action based on strict monitoring of the course of the disease and the constant moral and physical support of the patient.

The use of standardised language (NANDA-NOC-NIC) and systematic use of the OPT model of clinical reasoning enabled the nursing intervention to be organised and prioritised, ensuring the best care based on current scientific evidence. We found no literature relating to the nursing care of patients with botulism in ICU; therefore it is impossible to compare our action with that of other authors.

Ethical responsibilities

Protection of people and animals. The authors declare that the research was carried out according to the ethical standards set by the responsible human experimentation committee, the World Medical Association and the Helsinki Declaration.

Data confidentiality. The authors declare that they have followed the protocols of their centre of work regarding the publication of patient data.

Right to privacy and informed consent. The authors have obtained the informed consent of the patients and/or sub-

Table 1 Diagnosis, outcome objectives, interventions and nursing activities according to NANDA-NOC-NIC.

Diagnosis (NANDA)	Outcome objectives (NOC)	Nursing interventions (NIC)
00217 Risk for allergy response, associated with exposure to allergens (equine-derived botulism antitoxin)	0707 Immune hypersensitivity response	6680 Vital signs monitoring
	070703 allergic reactions (5, scale n)	Monitor blood pressure, pulse, temperature and respiratory status, as appropriate
		6410 allergy management
		Identify known allergies (medication, food, insect, environmental) and usual reaction
		Monitor patient for reactions to new medications, formulas, foods, latex and/or test dyes
		Monitor the patient after exposure to agents known to cause allergic responses for signs of generalised flush, angioedema, urticaria, paroxysmal coughing, severe anxiety, dyspnoea, wheezing, orthopnoea, vomiting, cyanosis or shock
		3350 Respiratory monitoring
		Monitor for noisy respirations such as crowing or snoring
		Monitor rate, rhythm, depth and effort of respirations
00032 ineffective breathing pattern, related to neuromuscular impairment and respiratory muscle fatigue, manifested by reduced vital capacity	0415 Respiratory status	3350 Respiratory monitoring
	041503 Depth of inspiration (2, scale b)	Monitor oxygen saturation levels continuously in sedated patients (SaO2) per agency policy and as indicated
	041509 Pulmonary function tests (1, scale b)	Monitor results of pulmonary function tests, particularly vital capacity, maximal inspiratory force, forced expiratory volume in 1 s (FEV1), and FEV monitor 1/FVC, as available
		Monitor for dyspnoea and events that improve and worsen it
		3320 Oxygen therapy
		Administer supplemental oxygen as ordered
		Monitor the effectiveness of oxygen therapy (pulse oximetry, ABGs), as appropriate
	0402 Respiratory status: gas exchange	5820 Anxiety reduction
	040203 Dyspnoea at rest (3, scale n)	Monitor the patient's anxiety in relation for the need for oxygen therapy
	040205 Restlessness (3, scale n)	
	040208 Partial pressure of oxygen in arterial blood (PaO2) (4, scale b)	
	0008 Fatigue: Disruptive Effects	3120 Airway Insertion and Stabilisation
	0803 Reduced Energy (2, scale n)	Assist with insertion of an endotracheal tube by gathering necessary intubation and emergency equipment, positioning patient, administering medications as ordered, and monitoring the patient for complications during insertion
		Instruct patient and family about the intubation procedure
		Monitor mechanical ventilator readings, noting increases in inspiratory pressures and decreases in tidal volume, as appropriate
		3180 Artificial Airway Management
		Maintain inflation of the endotracheal/tracheostomy cuff at 15–25 mmHg during mechanical ventilation and during and after feeding
		Institute endotracheal suctioning, as appropriate
		Monitor secretions colour, amount, and consistency
		Institute measures to prevent spontaneous decannulation: secure artificial airway with tape or ties, administer sedation and muscle paralysing agent, use arm restraints, as appropriate
00045 Impaired oral mucous membrane, related to reduced salivation and manifested by dry mouth	1100 Oral hygiene	1730 Oral Health Restoration
	110010 Moisture of oral mucosa and tongue (2, scale a)	Monitor condition of the patient's mouth (tongue, mucous membranes), including character of abnormalities
		Administer mouthwash (antibacterial solution)
		Apply lubricant to moisten lips and oral mucosa, as needed
		1720 Provide oral care for unconscious patient using appropriate precautions
		Encourage and assist patient to rinse mouth
00085 Impaired physical mobility related to neuromuscular involvement, as manifested by limited ability to perform gross and fine motor skills	0208 Mobility	0226 Exercise therapy: muscle control
	020802 body positioning performance (4, scale a)	Assist patient to sitting/standing position for exercise protocol, as appropriate
	020803 Muscle movement (4, scale a)	Encourage the patient to self-exercise
	020809 Coordination (4, scale a)	Monitor the emotional, cardiovascular and functional response of the patient to the exercise protocol
		Provide positive reinforcement for patient's efforts in exercise and physical activity
		Assist patient to participate in stretching exercises when lying, sitting, or standing
		Assist patient to move to sitting position, stabilise trunk with arms placed at the side on bed/chair, and rock trunk over supporting arm
	0212 Coordinated movement	0224 Exercise therapy: joint mobility
	021203 Speed of movement (2, scale a)	Assist patient to optimal body position for passive/active joint movement
	021204 Smooth movement (2, scale a)	Perform passive or assisted range of movement exercises
	021205 Control of movement (2, scale a)	Encourage to sit in bed, on side of bed, or in chair
	021207 Balanced movement (4, scale a)	Provide positive reinforcement for performing joint exercises
	0210 Transfer performance	1806 Self-care assistance: transfer
	021001 Transfer from bed to chair (1, scale a)	Determine current ability of patient to transfer self (e.g., mobility level, limitations of movement, endurance, ability to stand and bear weight, medical or orthopaedic instability)

Table 1 (*Continued*)

Diagnosis (NANDA)	Outcome objectives (NOC)	Nursing interventions (NIC)
		Provide encouragement to patient as he/she learns to transfer independently
		Determine amount and type of assistance needed
		Lift and move patient with hoist
		Evaluate patient at end of transfer for proper body alignment, nonocclusion of tubes, wrinkled linens, unnecessarily exposed skin, adequate patient level of comfort, raised side rails, and call bell within reach
	0005 Activity tolerance	0180 Energy management
	000502 Pulse rate with activity (5, scale a)	Monitor cardiorespiratory response to activity (e.g., tachycardia, other dysrhythmias, dyspnoea, diaphoresis, pallor, haemodynamic pressures, respiratory rate)
	000508 Respiratory rate with activity (4, scale a)	
00040 Risk for disuse syndrome, related to paralysis	0204 Immobility consequences: physiological	5612 Teaching: prescribe exercise
	020412 Muscle tone (1, scale a)	Inform the patient of the purpose for, and the benefits of, the prescribed exercise
		Teach the patient how to do the prescribed exercise
		Reinforce information provided by other health care team members, as appropriate
		0201 Exercise promotion: strength training
		Collaborate with family and other health professionals (e.g., activity therapist, exercise physiologist, occupational therapist, recreational therapist, physiotherapist) planning, teaching, and monitoring a muscle training programme
	0914 Neurological status: Spinal Sensory/Motor Function	2620 Neurological monitoring
	091401 Head and shoulder movement (2, scale a)	Monitor pupillary size, shape, symmetry, and reactivity
	091405 Upper body strength (2, scale a)	Monitor level of consciousness
	091406 Flaccidity (3, scale n)	Monitor level of orientation
	0912 Neurological status: consciousness	Monitor trend of Glasgow coma scale
	091201 Opens eyes to external stimuli (1, scale a)	Monitor cough and gag reflex
	91213 Delirium (2, scale n)	Monitor facial symmetry
		Monitor EOMs and gaze characteristics
		Monitor for visual disturbance: diplopia, nystagmus, visual-field cuts, blurred vision, visual acuity
00197 Risk for dysfunctional gastrointestinal motility, related to ingestion of contaminated foods	0501 Bowel elimination	2300 Medication administration
	050101 Elimination pattern (1, scale a)	Monitor patient for the therapeutic effect of the medication
	050129 Bowel sounds (2, scale a)	Document the administration of medication and the patient's response capacity, per agency protocol
		2380 Medication management
		Monitor patient for the therapeutic effect of the medication
	1015 Gastrointestinal function	1570 Vomiting management
	101501 Food tolerance (1, scale a)	Measure or estimate emesis volume
	101510 Amount of residual gastric aspirates (1, scale a)	Ensure effective antiemetic drugs are given to prevent vomiting, when possible
	101530 Gastric reflux (1, scale n)	Monitor fluid and electrolyte balance
		1874 Tube care: gastrointestinal
		Check that the tube is correctly in place monitoring for signs and symptoms of tracheal positioning, checking the colour and and/or pH of aspirate, inspecting the oral cavity and/or verify placement by X-ray, if appropriate
		Initiate and monitor delivery of enteral tube feedings, as appropriate per agency protocol
		Monitor amount, colour, and consistency of nasogastric output
		Monitor for sensations of fullness, nausea, and vomiting
		Connect tube to suction, as appropriate
		1056 Enteral tube feeding
		Check residual every 4–6 h for the first 24 h, then every 8 h during continuous feedings
		Check residual before each intermittent feeding
		Hold tube feedings if residual is greater than 150 cc or more than 110–120% of the of the hourly rate in adults
		1200 Total parenteral nutrition administration
		Encourage a gradual transition from parenteral to enteral feeding, if indicated
	2301 Medication response	1080 Gastrointestinal intubation
	230101 Expected therapeutic effects (3, scale a)	Administer medication to increase peristalsis, if indicated
00016 Impaired urinary elimination, related to sensory-motor impairment, as manifested by oliguria	0503 Urinary elimination	4120 Fluid management
	050303 Urine amount (2, scale a)	Maintain accurate intake and output record
	0601 Fluid balance	Insert urinary catheter, if appropriate
	060107 24-hour intake and output balance (3, scale a)	Administer prescribed diuretic drugs, if appropriate
		Administer prescribed I.V. therapy

Table 1 (*Continued*)

Diagnosis (NANDA)	Outcome objectives (NOC)	Nursing interventions (NIC)
		4130 Fluid monitoring Determine possible risk factors for fluid imbalance (diuretic therapy, infection) Examine skin turgor by pinching the skin gently holding it for a second and releasing (skin will fall back quickly if patient is well hydrated) Monitor serum and urine electrolyte values, as appropriate Monitor BP, heart rate, and respiratory status Keep an accurate record of intake and output (enteral intake, IV intake, antibiotics, fluids given with medications, NG tubes, vomit) Monitor colour, quantity, and specific gravity of urine
00173 Risk for acute confusion aguda, related to: – pharmacological agents – disorders of sleep-wake cycle – impaired mobility	0901 Cognitive orientation 90101 Identifies self (5, scale a) 90102 Identifies significant other (5, scale a) 90103 Identifies current space (5, scale a) 90105 Identifies correct month (5, scale a)	4820 Reality orientation Address patient by name when initiating interaction Speak to the patient in a distinct manner with an appropriate pace, volume, and tone Inform patient of person, place, and time, as needed Engage the patient in concrete ''here and now'' activities (ADL) that focus on something outside the self that is concrete and reality oriented 5270 Emotional support Discuss with the patient the emotional experience Make supportive or empathetic statements 6430 Chemical restraint Monitor the patient's response to the medication Monitor level of consciousness 5820 Anxiety reduction Provide factual information concerning diagnosis, treatment, and prognosis Identify when level of anxiety changes Help patient identify situations that precipitate anxiety Administer medications to reduce anxiety, as appropriate 7560 Visitation facilitation Determine patient's preferences for visitation and release of information Determine the need to promote visits by family and friends Encourage the family member to use touch, as well as verbal communication, as appropriate
00062 Risk for caregiver role strain, related to unpredictable illness course (applied to the family)	1803 Knowledge: disease process 180302 Characteristics of specific disease (2, scale u) 180303 Cause and contributing factors (1, scale u) 180305 Physiological effects of disease (2, scale u) 180307 Usual course of disease process (2, scale u) 180309 Potential complications of disease (3, scale u)	7040 Caregiver support Determine caregiver's level of knowledge Determine caregiver's acceptance of role Acknowledge difficulties of caregiving role Acknowledge dependency of patient on caregiver (as appropriate) Make positive statements about caregiver's effort Provide support for decisions made by caregiver Provide information about patient's condition in accordance with patient preferences Identify sources of respite care Support caregiver in setting limits and taking care of self

Taken from NNNConsult.[10]

Table 2 Likert scales to assess outcome indicators.

Scale a
Severely compromised
Substantially compromised
Moderately compromised
Mildly compromised
Not compromised
Scale b:
Severe deviation from normal range
Substantial deviation from normal range
Moderate deviation from normal range
Mild deviation from normal range
No deviation from normal range
Scale n:
Severe
Substantial
Moderate
Mild
None
Scale u
No knowledge
Limited knowledge
Moderate knowledge
Substantial knowledge
Extensive knowledge

Taken from NNNConsult.[10]

jects referred to in the article. This document is held by the corresponding author.

Conflict of interest

The authors have no conflict of interest to declare.

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