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Research Article

Role and knowledge of critical care nurses in the assessment and management of hypophosphataemia and refeeding syndrome. A descriptive exploratory study

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ABSTRACT

Objective: To assess the perceived and actual role of critical care nurses in nutritional care, and their knowledge regarding the identification and management of hypophosphataemia and refeeding syndrome.

Design and methods: Data were collected in one intensive care unit in Israel, from a self-administered questionnaire completed by 42 critical care nurses. The questionnaire was designed to assess their perceived and actual roles in the administration of nutritional care, and knowledge regarding electrolyte monitoring, hypophosphataemia and refeeding syndrome, including risk factors, consequences, and treatment.

Results: The majority participants that dieticians are solely responsible for nutrition care and follow-up. Most agreed that the measurement of phosphate levels was not important and that patients should receive full nutrition upon admission, while important risk factors for the development of refeeding syndrome were not recognised or considered. This informed their actual practice. A correlation was found between nurses' knowledge and their actual practice so that the greater the nurses' knowledge, the more they adhered to current nutrition guidelines ($p < 0.05$).

Conclusions: This study revealed critical care nurses' lack of clarity of their role and lack of knowledge regarding nutrition care. We suggest that this complex task is best managed by a multidisciplinary team, including nurses and dieticians, with clear role definitions.

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Implications for clinical practice

- The role of the nursing staff as an integral part of a multidisciplinary team in nutrition care needs to be clarified.
- Educational programmes to improve the knowledge of the nursing staff regarding the identification and management of hypophosphataemia and refeeding syndrome need to be implemented.
- A nurse-guided protocol, based on current nutrition guidelines, should be introduced to optimise nutrition care.

Introduction

Hypophosphataemia (HP), which is categorised as mild (0.6–0.85 mmols/L), moderate (0.3–0.6 mmols/L), or severe (<0.3 mmols/L), is a common finding in the critical care units setting, with a prevalence varying between 34% and 52 (Coşkun et al., 2014; Crook, 2014). One of the more common causes is refeeding

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syndrome (RS), which is defined as the potentially fatal shift in fluids and electrolytes that may occur in malnourished patients receiving artificial refeeding, whether enterally or parenterally (Friedli et al., 2018). The syndrome is diagnosed by the finding of new onset HP occurring within 72 hours of the initiation of artificial nutrition and in a recent study was reported to occur in 124 (36.8%) of 337 enrolled patients (Olthof et al., 2018). The manifestations of the syndrome are largely related to the development of HP and may be so severe as to result in significant morbidity and even death (Wang et al., 2019; Zhang et al., 2019). Apart from being a consequence of RS, moderately or significantly low prefeeding levels of phosphorus may also identify patients at risk for developing the syndrome. As a precautionary measure, international guidelines recommend that enteral nutrition be gradually increased over 24–48 hours in patients who are at high nutrition risk or severely malnourished (McClave et al., 2016).

Nurses play an essential role in the assessment, monitoring, and follow-up of many complex processes in the critical care unit. One such process is the administration of artificial nutrition, which has become an integral component of the bundle of care designed to optimize patient outcomes. However, deterioration in patient status often fails to be detected in time due to lack of knowledge, lack of communication, or failure to report (Liaw et al., 2011). This emphasizes the importance of knowledge-based care and of defining clear roles for those involved in managing such complex processes. Studies show (Jaafr and Al-Jubouri, 2020; Ncube, 2019) that critical care nurses do not always have up-to-date knowledge and an evidence-based approach that includes ongoing practice, knowledge, and recognized observed outcomes in some clinical areas. An evidence-based approach is vital for the goal of providing optimal patient care. Changes in clinical guidelines and education for nursing practice are needed for adequate quality of care (Jaafr and Al-Jubouri, 2020). Critical thinking associated with good or favorable thinking and successful solutions (Johnson and Hamby, 2015; Ünsar and Engin, 2013) can lead to better management of critical situations. Increased attention to critical thinking in knowledge management can shape new organizational strategies and staff practice programs (Indrašienė et al., 2021).

The aim of the present study was to assess critical care nurses perceived and actual roles in the provision of nutritional care, and their knowledge regarding the identification and management of HP and RS.

Methods

Research design

A descriptive, exploratory study using purposive sampling.

Setting

This study took place in a single 18-bed general critical care department at a tertiary level teaching hospital in Israel where artificial nutrition, either enteral or parenteral, is administered to all critically ill patients unless a contraindication exists.

Sample

All registered nurses who were permanently employed in the critical care unit were included in the study (n = 45). Thereafter, a set of self-administered questionnaires were personally distributed to the 45 nurses over a period of two weeks from November 2017. Participation was voluntary, and the questionnaires, which were anonymous, were completed in a dedicated area in the unit set aside for this purpose. Participants were requested not to discuss their responses with one another.

Instruments and measurements

The questionnaire was developed by the researchers and divided into three sections. The first section included sociodemographic data, the second section includes 19 statements focusing on the nurses' perception of their role in the administration of nutritional care, knowledge regarding the importance of electrolyte monitoring before the initiation of artificial nutrition, and knowledge regarding HP and the RS, including risk factors, consequences, and treatment. Participants were requested to respond on a 3-point Likert scale (agree, disagree, or don't know) for each statement. The third second section included 10 questions relating to the nurses' actual practice in the administration and monitoring of nutritional care. Participants were requested to respond on a 5-point Likert scale, from 1 -strongly disagree to 5 – strongly agree.

Data collection

Data collected included sociodemographic data (age, gender, professional education, current role, and seniority). Participants were requested to return the questionnaires within 48 hours of receiving them to a locked drop- box in the critical care unit designated specifically for the study.

Ethics statement

The authors followed all ethical requirements of research involving human participants. Participants signed a consent form prior to their enrolment in the study. The procedures for this study were approved by the local Ethics Committees (IRB: 0711–17 RMC).

Statistical analysis

Descriptive and inferential statistics were used to test the research hypotheses. To test the differences in the study variables according to background variables, *t*-tests were conducted for independent samples, and chi-square tests, Pearson test, and one-way variance analysis were also employed. The level of significance was set as < 0.05. Data were analysed using SPSS 25 (IBM, US).

Validity and reliability

The questionnaire was face validated by two nursing master's degree students and two nurses from the academic staff in the nursing department who were requested to comment on each question on a sliding scale from 1 - not clear, to 10, a clear statement. Some items were altered in the light of their comments, prior to their being distributed to the study population. The results demonstrated good internal consistency in this present research: Cronbach's $\alpha = 0.76$ for nurse nutrition knowledge and early diagnosis of HP and RS; Cronbach's $\alpha = 0.78$ for nurse following global nutrition guidelines.

Findings

Participant characteristics

Completed questionnaires were received from 45 nurses (100% response rate). Three nurses did not complete the full questionnaire so that their data were excluded and results from 42 nurses were considered in the final statistical analyses. Sociodemographic characteristics of the participants are presented in Table 1. Most

Table 1
Participants demographics (N = 42).

Variable	Categories	Frequency	(%) Percentage
Sex	Male	13	28.90%
	Female	29	64.40%
	Missing data	3	6.70%
Education	Student	1	2.20%
	RN	2	4.40%
	BA + RN	36	80%
	RN + Master's degree	6	13.30%
Basic Nutrition Studies in Nursing	Yes	28	62.20%
	No	13	28.90%
	Don't remember	4	8.90%
Role in ICU	Head of Staff	3	6.70%
	Assistant	4	8.90%
	Clinical Instructor	2	4.40%
	Team Leader	1	2.20%
	Regular Nurse	34	75.60%
	Student	1	2.20%

Table 2
Nurses' perceived role in nutrition administration.

		Agree (%)	Frequency (N)	Disagree (%)	Frequency (N)
1	The dietician and not the nursing staff is solely responsible for dietary care and follow-up	91.1	38	8.1	3
2	Daily monitoring of electrolyte levels is the responsibility of the nurse	77.8	33	22.1	9
3	The nurse's role is to inform the physician of any abnormality in the patient's electrolyte level	93.3	39	6.7	3
4	Electrolyte levels should be monitored prior to feeding	84.4	35	15.6	7
5	Phosphate levels are not important to monitor before commencing feeding	75.6	32	17.6	7
6	Hypophosphatemia is a rare condition in ICU patients	68.9	29	31.1	13
7	Generally, the patient should be fed immediately upon admission to the ward according to resting energy expenditure (REE) measurements.	64.4	27	35.6	15
8	There is a connection between phosphate levels and respiratory weaning	37.8	16	62.2	26
9.	Phosphate levels are associated with patient mortality	44.4	19	48.9	21
10	Phosphate levels are linked to the number of hospitalization days	37.8	16	62.2	26
11	Patients with low phosphate levels are at reduced risk of developing refeeding syndrome	31.1	13	68.9	29
15.	Patients with a low BMI are at risk of developing refeeding syndrome	60	25	40	17
17.	Patients who receive a significant amount of IV fluid for a prolonged period are at risk of developing the refeeding syndrome	35.6	15	62.2	26
18.	Patients with metastatic cancer are at risk of developing refeeding syndrome	47.7	20	52.3	22
19.	Patients who have developed refeeding syndrome will show normal blood potassium levels	40.9	17	59.1	25

were Jewish (77.8%) reflecting the distribution in the general Israeli public. All participants had received their nursing education in Israel. The majority (36%) had a BA degree in addition to the basic nursing degree, while 13.3% held a master's degree. Sixty-two percent had attended a basic course in nutrition during their primary nursing studies.

Nurses' perceived role in nutrition administration and knowledge regarding HP and RS

The results of this part of the questionnaire are shown in Table 2. Most participants agreed that dieticians were solely responsible for dietary care and follow- up (91.1%), and that daily monitoring of electrolyte levels is the responsibility of the nurse (77.8%), while the nurse's role is to inform the physician of any abnormalities in electrolytes (93.3%). Regarding knowledge of HP and RS, the majority agreed that monitoring phosphate levels prior to commencing feeding was not important (75.6%), that HP was rare in critical care patients (68.9%), and that patients should be fed maximally on admission to the critical care unit (64.4%). Regarding complications of HP and RS, most disagreed that they were associated with prolonged ventilation (62.2%) and mortality (48.9% vs 44.4% who agreed).

Table 3
Actual practice of the nurses in the ICU.

Question	Strongly Disagree 1 (%/N)	Disagree 2 (%/N)	Neutral 3 (%/N)	Agree 4 (%/N)	Strongly Agree 5 (%/N)	Mean
1. Do the nurses monitor the patient's nutritional status?	–	–	24 /10	52 /22	24/ 10	4.00
2. Is the dietitian solely responsible for nutritional care?	4/2	4/2	16/7	27/11	49/21	4.11
3. Do patients receive full nutrition therapy on admission to the ICU?	–	4/2	20/8	36/15	40/17	4.11
4. Do patients with hypophosphatemia receive full nutrition therapy?	–	–	18/8	30/13	52/22	4.30
5. Are blood glucose levels monitored continuously?	2/1	–	9/4	16/7	73/31	4.6
6. Are blood electrolyte levels checked before feeding the patient?	–	2/1	11/5	40/17	47/20	4.3
7. Are blood electrolyte levels monitored daily?	–	–	7/3	18/8	75/32	4.6
8. Is the patient's weight assessed prior to feeding?	–	–	7/3	25/11	68/29	4.6
9. Is there an awareness of the Refeeding Syndrome?	12/5	23/10	28/12	25/11	12/5	3
10. Is nutritional information discussed amongst staff members?	–	4/2	11/5	30/13	55/23	4.3

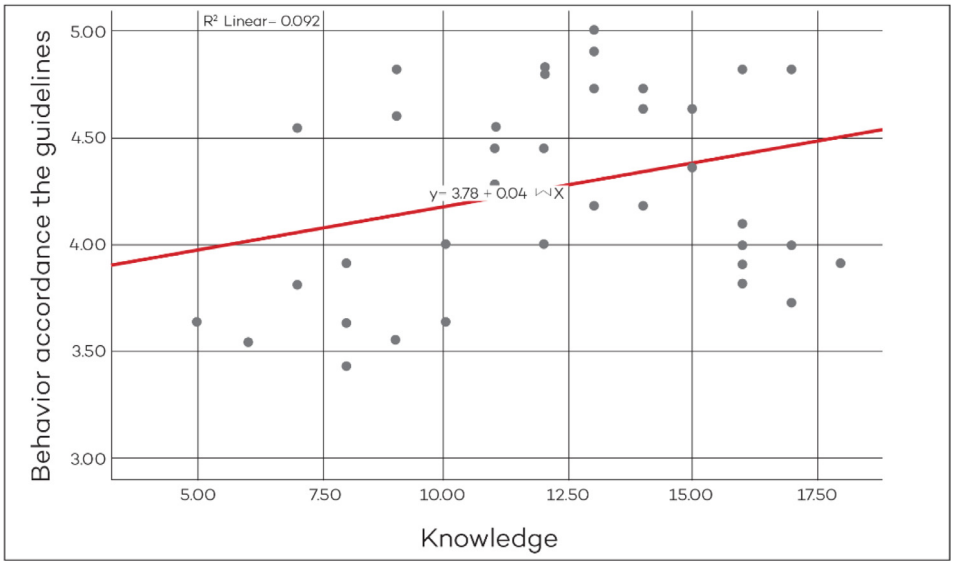

Fig. 1. Relationship between knowledge and actual practice. x-Axis shows the scores given to each respondent (n = 42) out of 19 for each response designated correct by the authors to their knowledge statement in table 1. The y-axis shows a score out of 5 for their actual practice according to accepted guidelines (table 2, questions 3, 4, 5,6 and 7). (r_p = 0.303, p < 0.05).

Nurses' actual practice regarding nutrition care.

The relevant results are shown in Table 3. A minority expressed strong agreement that nurses monitor nutritional status (24%), while the majority strongly agreed that the dietician is solely responsible for nutritional care (49%), and that electrolyte levels are monitored daily by the nursing staff (75%). Regarding HP and RS, most strongly agreed that electrolyte levels were checked before feeding was commenced (47%), and that full nutritional care would be commenced despite the presence of HP (52%). Finally, only 55% strongly agreed that the nutritional status of patients is discussed amongst all staff members.

Relationship between knowledge and actual practice according to guidelines

The relative results are presented in Fig. 1. Each statement in Table 1 and Table 2 was assigned a "correct" answer as determined by the researchers. Thereafter, a score out of 19 was assigned to each participants regarding their knowledge (Table 1), and out of 5 regarding their actual behavior according to accepted guidelines (Table 2, questions 3, 4, 5, 6, and 7). The Pearson test revealed a statistically significant correlation between the nurses' level of knowledge and actual practice according to guidelines (p < 0.05), such that the greater the nurses' knowledge, the more they adhered to the current nutrition guidelines (r_p = 0.303, p < 0.05). The effect size of 0.303 is considered as moderately strong (Cohen, 1988).

Discussion

The study revealed that nurses in Israel lack clarity regarding their own role related to their patients' nutritional status. Significant gaps in the perception of knowledge regarding the identification and management of HP and RS were also evident. Importantly, the results demonstrated a direct relationship between the nurses' knowledge and their implementation of current nutrition guidelines

Nutrition is an interdisciplinary process (Tappenden et al., 2013) and one of 13 domains in nursing practice (Herdman, 2012). During the period of 1950–1970, the nursing curriculum in the US shifted to an integrated approach and the mandatory required educational hours in basic nutrition and diet therapy for registered nursing licensure were eliminated (Englert et al., 1986). In this regard, in 2014, DiMaria-Ghalili et al recommended that nutrition should be integrated throughout a nurse's professional career, and the interactions with registered dietitians and other nutrition professionals should be more clearly defined (DiMaria-Ghalili et al., 2014). Our small study suggests that this lack of clarity regarding the role of the nurse as a member of a multidisciplinary team responsible for nutrition in the critical care unit, remains. Thus, 91.1% of nurses in our study did not consider nutritional care and follow-up to be their responsibility, but rather to belonging solely to the dietician. This perception was widely held even though a dedicated dietician was present in the critical care unit for only 12 hours a week an inevitable hiatus in follow-up. The resultant hiatus in ongoing care by the dietician may have contributed to the findings of a recent survey performed in the critical care unit, which revealed that 34% of patients developed significant HP while continuing to receive nutrition care (unpublished data). While 93% of nurses agreed that their role is to inform a physician of abnormal electrolyte results, only 55% agreed strongly that this was actual practice.

It seems apparent that a clearer definition of roles is very necessary. In particular the role of the nurse, who is present for 24 h of care, and the importance of timely reporting of any abnormalities to a defined authority, whether the attending physician or dietician, should be emphasised. Effective management of patients with RS clearly requires a multidisciplinary approach, which involves coordinating health care services to meet the needs of individuals with complex care needs. The clear definition of roles and responsibilities is essential, and should include dietitians, nurses, and physicians who regularly discuss the dynamic nutritional care of patients(Tappenden et al., 2013). Such teams bring together expertise and skills of different professionals to assess, plan, and manage care jointly.

Implicit in effective monitoring and follow up of complex tasks, such as nutritional care, is the requirement for appropriate knowledge. Our study revealed significant gaps in knowledge regarding HP and RS. Thus, while most agreed that daily monitoring of elec-

trolyte levels was important, the majority (75%) did not consider that phosphate levels should be monitored prior to commencing nutritional care. In fact, 69% considered HP to be a rare condition in the critical care unit. Importantly, and possibly contributing to the lack of importance assigned to HP, was the fact that most participants did not associate HP with the possible development of severe complications, including prolonged ventilation, prolonged critical care unit stay, and increased mortality (Alsumrain et al., 2010; Zhao et al., 2016). In this regard. Coşkun and colleagues identified RS in 52.14% of 117 critical care patients, and this was associated with a higher mortality rate and increased duration of critical care unit stay (Coşkun et al., 2014). In addition, potential risk factors for the development of RS, such as patients receiving significant amounts of dextrose-containing fluids or those with metastatic cancer, were not recognized by most participants. This lack of knowledge was manifested in actual practice in the critical care unit where full nutrition is begun on patient admission to the critical care unit, irrespective of the presence of HP. In this regard, current guidelines recommend the gradual implementation of nutrition in patients at risk for RS and that feeding be restricted once the condition is diagnosed (Berger et al., 2019; McClave et al., 2016). Indeed, a randomised controlled trial found that a restricted caloric intake in a critically ill patient with risk factors for RS significantly reduced both complications and the mortality rate (Doig et al., 2015). This course of action was not prevalent in our study.

The importance of providing ongoing education regarding updated guidelines for patient nutrition was clear in this study. Thus, the study demonstrated the existence of a direct relationship between nurses' knowledge and the implementation of nutrition guidelines, which may likely link to improved outcomes. Currently, there is no obligatory number of educational hours in basic nutrition for the Bachelor of Science in nursing programmes. Hence, not surprisingly, a study found that only 50% of nursing students feel satisfied with their nutrition studies (Jefferies et al., 2011; Stotts et al., 1987).

Our study has demonstrated a need to implement best practice recommendations regarding the administration of nutrition care in the critical care units In this regard, previous studies have shown that the introduction of nurse-guided protocol may improve patient outcomes as well as providing the nursing staff with a sense of autonomy and empowerment (Barto, 2019; Hansen and Severinsson, 2007; Tang, 2003).

Limitations

The study is limited by the small sample size. Only a single critical care unit in one hospital was sampled, so that the results cannot be generalised to other institutions.

Conclusions

This study revealed a lack of clarity of the role of the critical care nurse within one Isreali ICU regarding the administration of nutrition care. In addition, significant gaps in knowledge of the nurses regarding HP and RS were evident and informed actual practice in the critical care units, with many deviations from current best practice nutrition guidelines.

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Author contributions

M Theilla, and H Ben-Tovim, contributed to the conception and design of the research and to the acquisition, analysis, or interpretation of the data. Contributed to the interpretation of the data. And all authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

Ethical statement

The Research Data approved by hospital involved in the study and Tel Aviv University Ethical committee. (Reference Number 0711–17).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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