POST-OPERATIVE VENTILATORY NURSING REGIME OF CORONARY ARTERY BYPASS GRAFT PATIENTS

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ABSTRACT

The nurse working in the intensive care unit functions as an independent practitioner under the Nursing Act and arising SANC regulations. The liability of the nurse is dependent upon her abilities, authority and skills. Abilities also imply knowledge and dexterity in connection with the patient and his condition, in this case ventilatory nursing regime.

The purpose of this research is to determine the influence of a pre-operative bloodgas analysis on the post-operative ventilatory nursing regime of a coronary artery bypass graft patient.

A nil hypothesis was set, namely:
The determination of a pre-operative bloodgas analysis will have no influence on the post-operative ventilatory nursing regime of the coronary artery bypass graft patient.

Two chosen hospital institutions, in the same geographical area, were used for selecting 99 patients. The post-operative ventilatory nursing regime of one institution was determined according to standard criteria, while the other institution made use of pre-operative bloodgas analysis.

A control list was developed to set standard normal bloodgas values and correct nursing action with reference to bloodgas analysis for ventilatory nursing. Further, the ventilatory nursing regime was measured against:
- period of mechanical ventilation;
- financial implications;
- nursing actions with reference to bloodgas analysis.

The researcher used a retrospective ex-post facto correlation method.

Through analysis of data it was found that the pre-operative bloodgas analysis results in shorter mechanical ventilation and lower financial expenditure. It also results in better individual nursing planning. With reference to this, the researcher rejects the nil hypothesis and accepts the alternative hypothesis.

The primary recommendation of the research is that bloodgas analysis must be included in the pre-operative preparation package of the coronary artery bypass patient.

OPSOMMING

Die doel van hierdie navorsing is om die invloed van 'n pre-operatiewe bloedgasanalise op die post-operatiewe ventilatoriese verplegingsregime van 'n koronëre vatomleidingspasiënt te bepaal.

'n Nul hipotese was gestel naamlik:
Die bepaling van 'n pre-operatiewe bloedgasanalise het geen invloed op die post-operatiewe ventilatoriese verplegingsregime van 'n koronëre vatomleidingspasiÎnt nie.

Twee hospitale, in dieselfde geografiese area, is gekies. Die steekproef het uit 99 pasiënte bestaan. Die post-operatiewe ventilatoriese verplegingsregime van die een hospitaal was volgens dié hospitaal se standaard kriteria bepaal, terwyl die ander hospitaal pre-operatiewe bloedgasanalise gebruik het.

'n Kontrole lys om standaarde van normale bloedgaswaardes en die korrekte verpleegaksies volgens die bloedgasanalises daar te stel, was ontwikkel. Die ventilatoriese verplegingsregime was gemeet teen:
- periode van meganiese ventilasie
- finansiële implikasies
- verplegingsaksies met verwysing na bloedgasanalises.

Die navorser het 'n retrospektiewe ex-post facto korrelasie metode gebruik.

Die analise van die data het getoon dat pre-operatiewe bloedgasanalise 'n korter meganiese ventilasie met laer finansiële implikasies tot gevolg het. Dit verbeter ook individuele verplegingsplanne. Die navorser verwerp dus die nul hipotese.

'n Aanbeveling word gemaak dat bloedgasanalise moet by die pre-operatiewe verpleging van 'n koronÍre vatomleidingspasiënt ingesluit word.

INTRODUCTION

Maintaining sufficient ventilation and oxygenation for the post-operative cardiac patient is essential. One of the most accurate methods to determine the adequacy of ventilation, is by means of an arterial bloodgas analysis. This determines the hydrogen-ion concentration (pH), the parsial arterial oxygen pressure (PaO2) and carbon dioxide (PaCO2) in the patient's blood. These measurements determine the ventilatory needs of respiratory speed, tidal volume and oxygen concentration (Clochesy et al. 1998:510; Schuch, 1987:4).

Patients with or without lung conditions, smokers as well as non-smokers, go for coronary artery bypass graft surgery and are mechanically ventilated post-operatively. Respiratory complications could occur after any surgery and factors such as the effect of cardiopulmonary bypass and previous lung pathology is of additional importance in cardiac surgery (Freeman & Gould, 1987:22; Clochesy et al. 1998:425; Moghissi, 1986:41-42). If no individual pre-operative bloodgas analysis was obtained from each individual patient, mechanical ventilatory support will be applied and terminated post-operatively according to standard normal criteria. It results in a lack of individual nursing therapy.

The question arises if it is in any way possible to optimally ventilate if no pre-operative bloodgas analysis of the patient is available. The use of standard normal bloodgas criteria could possible lead to hypo- or hyperventilation of patients, and could result in extended periods of mechanical ventilatory support. The lack of pre-operative bloodgas criteria makes it difficult to determine if the patient's condition has deteriorated extraordinarily post-operatively.

THEORETICAL SUPPORT

The nursing specialist working in the intensive care unit functions as an independent practitioner within the legal-ethical framework of nursing practice. She is accountable for her own actions and omissions.

According to Bergman (1982:8) there are three prerequisites that must be adhered to before accountability can be considered, namely skills, responsibility and authority. Once these prerequisites have been adhered to, the nursing specialist could accept responsibility.

Intensive care nursing

In the intensive care unit, the nursing specialist forms the bridge between technology and psychology. This ensures that the one concerned, namely the patient, is not left unnoticed (Fôlscher, 1983:2; Abels, 1979:3).

The core of the intensive care nursing concept lies in the decision-making process of the nursing specialist and the willingness to act according to a decision. She searches for the rational basis of all her interpretations and actions, evaluates the outcome of a given intervention and follows with applicable nursing actions (Murchison **et al**. 1989:148; Nel, 1993:68).

Prerequisites for accountability

Rebecca Bergman (1982:4-9) describes certain prerequisites for accountability. Each prerequisite forms the basis for the next prerequisite. Each prerequisite should therefore be adhered to before accountability becomes applicable.

Abilities

The first prerequisite is ability. This includes knowledge, skills and values.

Knowledge

The skilful assessment of a patient's health condition requires the nursing specialist to have an extensive understanding of specific health problems. The nursing specialist has to assess, plan, implement and determine the effect of these nursing interventions with a fair amount of accuracy (Mayers, 1983:370).

According to Nel (1993:52) the medical history forms an important part of assessment and contributes to the knowledge of the intensive care nursing specialist in the identification of the patient's problems and the formulation of a nursing diagnosis. Base-line laboratory data should also be obtained.

The nursing specialist involved in the post-operative nursing of coronary artery bypass graft patients, should have knowledge of various factors in the specific ventilatory nursing regime, namely:

- The advantages and disadvantages of mechanical ventilation in post-operative coronary artery bypass graft patients, as well as the necessity for the patient to be extubated as soon as possible, due to the disadvantages of mechanical ventilation.
- The implications of extra-corporal circulation during the intra-operative phase on the post-operative ventilatory phase, for example atelactation, changing cardiac working due to hypothermia.
- The hemodynamics of arterial bloodgasses, especially the hydrogen-ion concentration, parsial arterial carbon dioxide pressure and parsial arterial oxygen pressure.
- The mechanical ventilatory adjustments according to the arterial bloodgas analysis, especially oxygen concentration administering, respiratory speed and tidal volume and positive and expiratory pressure.
- Extubation of the patient and his readiness for extubation.

Skills

The nursing specialist should subsequently have the necessary skills regarding the ventilatory nursing regime.

The nursing specialist working in the intensive care unit, must be a skilled problem-solver. She should have the ability to analyse, sort data obtained, and correctly identify existing problems. The effective statement of problems, expected results and thorough planning and implementation of re-

levant nursing actions demand intellectual and practical skills regarding the scientific process and up to date knowledge of the principles of therapeutic intervention (Mayers, 1983:371).

Values

Professional ethics is the moral dimension of attitudes and behaviour, based on the values, judgement, responsibility and accountability the nursing specialist takes into consideration when she considers consequences of her professional actions.

It is important for the intensive care nursing specialist to objectively maintain values and keep them in perspective. Her values should also abide by the law (Nel, 1993:79).

Responsibility

The second prerequisite is responsibility.

Responsibility is based on the standards and values of the individual or the specific group. It entails the commitment to accept trust and accountability for own actions. This power is given to her according to a specific Act, as well as the organisational policy.

Power refers to the right to act in a specific manner or make a specific decision. Should the principle be applied that each professional nursing specialist has full authority of her own practice, there would be no question as to the position of responsibility and accountability (Nel, 1993:167).

Accountability

The last aspect is accountability. Accountability demands freedom of choice. Freedom in the professional sense is the

right to think creatively and independently about the problems concerning the career and the patient, and the right to act responsibly (Searle, 1987:282).

Accountability means responsibility and accountability for your own actions and the consequences thereof (Mayers, 1983:384; Nel, 1993:170). The legal-ethical framework the nursing specialist functions in, guides her actions. Her knowledge, skills, ability and sense of responsibility enable her to be accountable for her actions.

OBJECTIVES, HYPOTHESIS AND OPERATIONAL DEFINITIONS

Objective of the study

The objective of this study is to determine the influence of pre-operative arterial bloodgas analysis on the post-operative nursing regime of ventilated coronary arterial bypass graft patients.

The following nil hypothesis is stated from an empirical approach:
The determination of a pre-operative arterial bloodgas analysis will have no influence on the post-operative ventilatory nursing regime of coronary artery bypass graft patients.

Operational definitions

Arterial bloodgas analysis

Is the taking of an arterial blood sample for the determination of bloodgasses, namely hydrogen-ion concentration (pH), the parsial arterial pressure of oxygen (PaO2) and carbon dioxide (PaCO2).

Pre-operative bloodgas analysis

Is the taking of an arterial blood sample to determine bloodgasses, together with the taking of routine pre-operative blood tests during preparation for coronary artery bypass graft surgery. No medication that can suppress lung functions is present.

Ventilatory nursing regime

Is the assessment of optimal ventilation of patients by taking the following into consideration:

- Ventilatory parameters such as respiratory speed, tidal volume and oxygen concentration;
- Arterial bloodgas analysis;
- Period from commencement of post-operative mechanical ventilation with admission in unit until extubation;
- Financial implications of mechanical ventilation, namely use of the ventilator, assessment of bloodgas analyses, as well as oxygen use.

Admission

Return from theatre post-operatively, with immediate commencement of mechanical ventilation in the intensive care unit.

Weaning

Reduction of mechanical ventilatory support due to arterial bloodgas analyses, with the objective to terminate mechanical ventilation. It can include reduction of respiratory speed, tidal volume or oxygen concentration.

Extubation

Removal of endotrageal tube and termination of mechanical ventilation.

METHOD OF STUDY

Research design

A retrospective ex-post facto correlation study is conducted to determine the influence of a pre-operative arterial bloodgas analysis on the post-operative ventilatory nursing regime of coronary artery bypass graft patients, namely:

Retrospective

The researcher uses recorded data of patients who have already had coronary artery bypass graft surgery over a 12-month period.

Ex-post facto

The manipulative action, namely pre-operative arterial bloodgas analysis, takes place without interference from the

researcher as routine preparation for coronary artery bypass graft surgery.

Correlation
The post-operative ventilatory nursing regime of two private hospital institutions is compared.

The research design can schematically be presented as follows:

	Post-operative bloodgas analysis	Admission and ventilation	Extubation	Bloodgas analyses up to one hour post-extubation
C		O_1	O_2	O_3
E	X	O_4	O_5	O_6

C = Control group
E = Experimental group
X = Pre-operative arterial bloodgas analysis
O1 and O4 = Commencement of mechanical ventilation, arterial bloodgas analysis and period to extubation
O2 and O5 = Extubation, arterial bloodgas analysis and period
O3 and O6 = Arterial bloodgas analysis within one hour post-extubation

The following variables were identified:
- the post-operative ventilatory nursing regime as the dependant variable;
- the pre-operative arterial bloodgas analysis as the independent variable.

Analysis units

Patients who have received coronary artery bypass graft surgery during a 12-month period were involved in the study. These patients underwent surgery in two chosen units on the Witwatersrand.

The target group is people who underwent coronary artery bypass graft surgery. The reachable population is people who underwent coronary artery bypass graft surgery in two specific institutions on the Witwatersrand, and who could be post-operatively extubated.

Convenient test sampling is applied regarding the institutions, since these institutions were accessible to the researchers, and situated in the same geographic area. The selection of patient data was done chronologically according to admission dates, where the first 50 patients in every institution were considered.

Control group
Patients who underwent coronary artery bypass graft surgery in an institution where no pre-operative arterial bloodgas analysis was done (n=50).

Experimental group
Patients who underwent coronary artery bypass graft surgery in an institution where pre-operative arterial bloodgas analyses were done as routine pre-operative preparation (n = 50).

Measuring instrument

The measuring instrument consisted of two control lists namely:

Control list 1

This control list consists of the various ventilatory nursing actions a nursing specialist would execute if the assessment of a bloodgas analysis is taken into consideration.

Development of control list
Criteria were stated according to the semi-Delphi technique over two phases:

- **Development phase**

Criteria, as identified in the literature, were stated. The criteria were evaluated by domain experts in practice, namely 14 registered nursing specialists with intensive care qualifications, working in an intensive care unit where coronary artery bypass graft patients are nursed. Individual judgement was done over a period of one week, with the aim at criteria-refinement to strengthen the content validity within South African context.

The researcher made a change after the first round, especially regarding the normal values of PaCO2.

These changes were given to the group. Five experts however, fell out. Only nine experts confirmed their willingness to participate further. After the second round, which lasted three days, further changes regarding oxygen-administering criteria were made.

- **Confirmation phase**

All changes were passed on to the experts for confirmation and accepted by them.

Content division
The control list exists of two subdivisions:

- PaCO2 and pH as indicators:

Firstly PaCO2 and pH are used as indicators in the nursing action. Evaluation aspect: Which ventilatory adaptations will be made if the pH and/or PaCO2 increase, decrease or remain normal?

- PaO2 as indicator:

In the second subdivision the PaO2 was used as indicator for the nursing action. This section was divided into two groups, namely patients over 60 years and patients under 60 years.

Evaluation aspect: Here, it is indicated if the administered oxygen concentration should be increased, decreased or remain the same in reaction to the PaO2-value of an arterial bloodgas analysis.

Application
The researcher, in co-operation with an intensive nursing specialist with a Masters degree, evaluated all nursing actions regarding the post-operative ventilatory nursing regime by means of consensus decision-making. In the case of the experimental group the pre-operative bloodgas analysis was taken into account.

Control list 2

Control list 2 considers the post-operative ventilatory nursing regime in totality with specific attention to the following aspects:

Period
The ventilation period is measured in hours. Two periods are taken into account, namely the period from admission in the unit up to the commencement of weaning, as well as the period from commencement of weaning up to extubation.

Financial implications
The use of mechanical ventilators, the use of oxygen and the financial expenditure of the number of bloodgas analyses executed, are considered.

Results of nursing action
The number of actions until weaning, inclusive of the number of correct actions according to the pre-operative bloodgas analysis (only applicable to the experimental group) are considered. The number of correct actions from weaning until extubation is similarly observed.

Surgical intervention
The same surgical intervention, namely coronary artery bypass, was applied to all patients involved.

Ventilators
Positive pressure ventilator, where administered tidal volume, respiratory speed and oxygen concentration can be controlled, was post-operatively used in both units for mechanical ventilation.

Analgesic
Both institutions used barbiturates and narcotic analgesics for post-operative pain relief.

FINDINGS OF THE STUDY

The researcher and an intensive nursing specialist closely scrutinised the completed control lists. The control lists were coded and the coded data was analysed by a programmer. A statistical computer program (SPSS-X) was used to do the factor analysis and the BMDP3D-program was used for the Ho-count's T2-test. The researcher accepted a 0,05 indication level as criterion.

One patient unit in the control group, who had to follow another treatment regime due to complications, was identified as an ejector and on recommendation of the statistic consultant withdrew from the group.

Table 1: Compiled table of period in hours

Patient groups	N	X total time	S.A.	Range	X time admission to weaning	S.A.	Range	X time weaning to extubation	S.A.	Range
Control	49	25,47	15,	15,3	6,7	6,7	29	10,1	11,0	48
Experimental	50	16,2 (p 0,00002)	3,2	10,6 (p 0,000)	2,9	2,9	15	5,6 (p 0,0081)	2,9	13

Control of external variables

Period
Patients who underwent coronary artery bypass graft surgery during the same period, were included in the study.

Unit
The two accessible chosen units are homogeneous regarding the type of unit, type of patients, staff qualifications and post-operative nursing of patients.

These units are geographically situated in the same area,

which results in the level above sea level being a constant factor.

There were therefore 49 cases in the control group and 50 cases in the experimental group. The analysis and discussion of the items are according to the layout in the control lists.

Ventilation period (Table 1)

Statistical indication was done for the total period of mechanical ventilation. It indicates that the experimental group, where pre-operative arterial bloodgas analyses during mechanical ventilation were taken into consideration, ventilated marginally for a shorted period than the control group, where no pre-operative bloodgas analyses were available.

Statistical indication is indicated from period of admission to weaning: the control group was ventilated marginally longer that the experimental group before weaning could commence.

There is statistical indication of period from commencement of weaning to extubation. The control group took longer to be weaned from the ventilator than the experimental group. The maximum period of weaning for the two groups differed substantially, namely 50 hours for the control group, compared to only 16 hours for the experimental group.

Financial implications (Table 2)

Table 2: Combined table of total financial expenditure, oxygen use and bloodgas analysis

Patient groups	X total financial expenditure	S.A.	Range	X oxygen use	S.A.	Range	X bloodgas analyses	S.A.	Range
Control (N49)	658,1	206,3	655,3	116,8	54,1	231,9	473,3	182,4	729,6
Experimental (N50)	673,8 (p0,7398)	120,6	916,5	89,5 (p 0,0049)	38,4	218,2	489,2 (p0,5972)	104,0	614,4

Total financial expenditure
The total financial expenditure of mechanical ventilation involved the use of:
- Mechanical ventilator
- Oxygen
- Bloodgas analyses

No statistical indication for the total financial expenditure is indicated. It therefore indicates that both groups of patients marginally had the same financial expenditure for mechanical ventilation.

Table 3: Sum totals: Total amount and correct number of nursing actions of the control group according to control list 1 and the experimental group according to pre-operative bloodgas analysis.

	CONTROL GROUP			EXPERIMENTAL GROUP			
	Total number of actions	Correct actions (Control list 1)	% correct actions	Total number of actions	Correct actions (Bloodgas)	% Correct actions	P
Admission to weaning	352	392	83,2%	353	314	89,0%	P 0,5011
Weaning to extubation	249	200	80,3%	245	205	83,7%	P 0,9702
Total period	601	493	82,0%	598	519	86,8%	

Financial expenditure: mechanical ventilation used
Both institutions determined one constant amount of R95,00. There was no difference between the groups regarding this expense.

Financial expenditure: oxygen use
Statistical indication is indicated. The control group's financial expenditure towards oxygen use was higher than that of the experimental group, due to longer ventilatory support.

Financial expenditure: bloodgas analyses
No statistical indicators are indicated. The financial expens es for bloodgas analysis are marginally the same for both groups. The total time frame of the experimental group was shorter than that of the control group. Should the frequency of bloodgas analyses be brought in relation with the period, it indicates that the experimental group determined bloodgas analyses more often.

Nursing actions according to bloodgas analyses

The nursing actions of the control group was evaluated according to control list 1, over the whole period 82,0% cor rect nursing actions were executed accordingly. From admission to weaning 83,2% and from weaning to extubation 80,3% correct nursing actions according to control list 1 were executed.

The experimental group's nursing actions were measured according to each patient's pre-operative bloodgas analysis and a total correct number of nursing actions of 86,8% were executed accordingly, 89,0% from admission to weaning and 83,7% from weaning to extubation.

Table 4: Total amount and correct number of nursing actions of experimental group according to pre-operative bloodgas analyses, compared to those of control list 1.

Control Group						
	Total number of actions	Correct actions		% Correct actions		P
		Bloodgas	Control list 1	% Bloodgas	Control list 1	
Admission to weaning	353	314	234	89,0%	66,2%	0,000
Weaning to extubation	245	205	103	83,7%	42,0%	0,000
Total period	598	519	337	86,8%	65,4%	

In table 3 the two group's number of correct nursing actions are indicated. No statistical indication is indicated.

Afterwards the experimental group's nursing actions were measured according to control list 1 (table 4). A statistical indication difference is indicated between nursing actions executed in various ways for the same group. It clearly indicates that the individual approach of the experimental group allows the nursing specialist to make more correct adaptations to the ventilatory nursing regime.

CONCLUSIONS

Period

Statistically there is an indicative difference in the total period as well as the various periods (admission to weaning to extubation) between the two groups, where the experimental group was mechanically ventilated for a shorter period. The use of pre-operative bloodgas analysis therefore contributed to, by means of individual ventilatory assessment, direct nursing actions to the extent that optimal ventilation could be achieved sooner. The shortened mechanical ventilation period lessens the possibility of complications such as suppression of cardiac discarding and increased request for sedation (Hinds, 1982:178-180).

Financial implications

Due to standardised payment tariffs for ventilator use, as well as the number of bloodgas analyses executed, which was the same for both groups, the financial expenditure was in agreement.

The experimental group however, indicated a lower financial expense for oxygen use, since their use thereof was over a shorter period. By using pre-operative bloodgas analysis for evaluation, oxygen use was limited. Not only was it financially beneficial, but it also lessened the possibility of side effects. Morganroth (1988:141) indicates that extended use of oxygen could lead to suppression of ventilation and car diac discarding, absorption-atelactation and oxygen oxidity.

Nursing actions

Both groups maintained a high standard regarding nursing actions for adaptation of the ventilatory parameters. Here the experimental group executed 86,8% correct actions according to pre-operative bloodgas analysis and the control group 82,0% with the assistance of standard criteria. If the experimental group's nursing actions are evaluated in comparison to stated standard criteria, the measure of correctness drops from 30,5% to 56,4%.

The implications hereof indicate that:

- nursing actions can be executed correctly, as in the case of the control group, but negation of individual parameters (pre-operative bloodgas analysis) could decrease the measure of individual scientific nursing planning.
- Individual nursing planning is enabled by nursing actions by taking into consideration the base-line data (pre-operative bloodgas analysis) of each patient individually.

SUMMARISING CONCLUSION

Shortened mechanical ventilatory periods, as well as shortened oxygen use, can lead to shortened hospital stay. It lessens the possibility of post-operative complications, for example infection, atelactation, and psychological dependency.

The researcher therefore discards the nil hypothesis, namely that the determination of a pre-operative bloodgas analysis will have no influence on the post-operative ventilatory nursing regime of coronary artery bypass graft patients.

An alternative hypothesis is accepted, namely:
The determination of a pre-operative bloodgas analysis has a positive influence on the post-operative ventilatory nursing regime of coronary artery bypass graft patients regarding period on ventilator, finances and correct execution of nursing actions.

RECOMMENDATIONS

Based on the conclusions, the researcher recommends the following:

- The determination of pre-operative bloodgas analysis ensures individual nursing planning and must be included in the routine pre-operative preparation package of the coronary artery bypass graft patient.
- The use of standard criteria for the determination of the post-operative nursing regime limits individual nursing planning and therefore the pre-operative bloodgas analysis as base-line data for nursing action is recommended. The possibility of continued education of personnel should also be re-evaluated.

SUMMARY

The determination of a pre-operative arterial bloodgas analysis results in the patient being mechanically ventilated for a shorter period, being less exposed to additional oxygen provision and results in lower financial expenditure. It also leads to improved individual nursing planning.

It can therefore be recommended that pre-operative bloodgas analysis is essential for base-line data for individual nursing planning, and the staff should receive continued education regarding a post-operative ventilatory nursing regime.

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