

Original Article**Weaning from Mechanical Ventilation Driven by non-Physician Professionals Versus Physicians****Emine Arici, RN**

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Abstract

Background: Mechanical ventilation (MV) is a mainstay treatment in intensive care units (ICU). Studies have shown that applying algorithms to weaning procedure shortens the duration of MV. Whether weaning of patients by non-physician health care professionals (nurse, physiotherapist) improves or worsens outcomes remains an unresolved issue. The aim of the study was to evaluate studies comparing outcomes after weaning driven-by non-physician health professionals vs. physicians.

Methods: Search engines of Pubmed, CINAHL and Cochrane Library were searched using keywords 'mechanical ventilation', 'weaning', 'physician', 'non-physician', 'nurse', 'driven' without date limitation. 58 articles were identified during our initial literature search. We excluded duplicate articles selected different search engines, those not in-English, without abstracts and not comparing studies weaning driven-by non-physician health professionals vs. physicians. Finally, nine relevant studies were retrieved and included in the systematic review.

Results: Four of the studies were randomized controlled trials, another three studies were non-randomized controlled trials and two were cohort studies. Seven of these studies concluded that weaning driven by non-physician health care professionals decreases the duration of MV provided they adhere to weaning protocols ($p < 0.05$). Other two studies showed no difference between the two groups. No statistically significant differences between the groups were observed in terms of hospital stay, re-intubation, and mortality.

Conclusion: During the weaning of patients from the MV, it was suggested to use protocols developed by a multidisciplinary team who considers differences between ICUs and individuality of the patients. This systematic review revealed the current evidence regarding weaning from mechanical ventilation driven by non-physician professionals versus physicians. It was founded that weaning from MV is more effective and reliable when it is adhered to a protocol developed according to the properties of patient population and intensive care than when it is driven according to experiences and personal differences.

Key words: Mechanical Ventilation; Weaning; Physicians; Non-Physician Health Care Professionals; Systematic Review

Introduction

Mechanical Ventilation (MV) is the process of carrying out respiration artificially with the help of a device (Demir & Ilce Ozcan, 2009). In intensive care units (ICU), MV is an important treatment method (Chaiwat, et al., 2010). When the medical condition that requires MV stabilizes, health team focuses on whether to wean the patient from the MV or not (Demir & Ilce Ozcan, 2009). Weaning from MV is to lessen mechanical support gradually and transfer the respiratory process to the patient (Hornst, et al., 1998; Demir & Ilce Ozcan, 2009).

Although being a life-saving method, MV has disadvantages in terms of being invasive, expensive, and possibility to result with many complications related with ventilation (Marellich, et al., 2000). Delay in weaning from MV may cause increases in the complications related with MV (trauma in air-ways, aspiration, pneumonia, etc.), in staying time in ICU, and in cost of hospitalization (Demir & Ilce Ozcan, 2009). On the other hand, early weaning from the MV may result with unsuccessful extubation, nosocomial pneumonia, and mortality (Chaiwat, et al., 2010).

There are many different methods in the literature about weaning from the MV; besides, there is an ongoing debate about existence of the best method (Hornst, et al., 1998). Weaning from the MV is done, on the one side, traditionally by physicians by using their experiences and personal choices, and on the other side, by non-physician health professionals like nurses, respiratory physiotherapists etc. by adhering protocols (Blackwood, et al., 2006; Chaiwat, et al., 2010). Traditionally, in weaning driven by physicians, the weaning process is usually done gradually and sometimes this causes delays in extubation and some complications (Ely, et al., 2001). There are studies about non-physician health professionals taking part in weaning process with developing protocols. According to these studies, when non-physician health professionals drive weaning process by adhering protocols, weaning time was decreased. In addition, in these studies it was proved that the weaning process driven by non-physician health professionals by

adhering protocols was effective and reliable (Hornst, et al., 1998; Marellich, et al., 2000; Kollef, et al., 1997; Tonnelier, et al., 2005; Demir & Ilce Ozcan, 2009). Nevertheless, using protocols cannot replace clinical decision making about weaning process but simplify the decision making and guide patient care. In addition, the protocols must not be considered as solid rules but must be considered as dynamic evaluation tools that can be developed in any problem that may emerge during application of them.

The debate about non-physician health professionals to decide extubation of patient by using protocols still continues in the literature. It is seen that studies are concentrating on this issue for three decades. There are two studies that systematically review studies related with this issue at the beginning of 2000s (Ely, et al., 2001; Price, 2001). In these studies, it was emphasized that the duration of MV was shorter in weaning process driven by non-physician health professionals by adhering protocols; besides, that these studies were not enough to construct evidences. In a meta-analysis study by Blackwood et al. (2011), staying times in intensive care and duration of MV has been shorten in the protocol group (Blackwood, et al., 2011). In a systematic review study by White et al. (2011), protocols developed by multi-disciplinary team have shown to shorten the duration of MV (White, Currey, & Botti, 2011). However in these studies, it was emphasized that there was a needs for randomized, controlled trials. Lately, in the literature, it was seen studies having evidences with high levels about this issue (Chaiwat, et al., 2010; Dankers, et al., 2012; Plani, Becker, & van Aswegen, 2013).

The aim of our study is to investigate systematically the studies that compare the effect of decision making given by physicians and non-physician health professionals on outcomes of weaning in weaning the patient from MV. Especially without having time boundaries, it was targeted to place results of the studies according to their evidence levels by systematically reviewing all studies in the field. It was thought that the results of this systematic review may guide clinicians and

decision makers in usage of protocols in weaning the patient from MV in ICU.

Methods

Search strategy

Three data bases (Pubmed, CINAHL, Cochrane Library) were investigated in this systematic review. The data bases were scanned by keywords “mechanical ventilation”, “weaning”, “physician driven”, “non-physician driven”, “nurse driven”, “nurse-led”. All the studies published until February 12, 2013 was included without any time boundary. Initially, 58 articles were determined by using EndNote X4. Duplicates and non-English articles were removed.

Headings and summaries of remaining 37 articles were investigated independently by three researchers. In addition, reference lists of scanned articles were reviewed to determine any other articles related with the issue. At the end, a total of nine articles were included in the study (Figure 1); full-texts were obtained. There was no conflict between researchers.

Inclusion Criteria

The studies that compare effects of traditional weaning methods of physicians and weaning driven by non-physician health professionals by adhering protocols, published in English language, and contain adult patients as sample group were included in the study. There were no limitations for evidence levels and all articles that satisfy inclusion criteria were included in the systematic review.

Data Analysis

To obtain a summary of the data, a data summary form was developed by using common properties of the studies that were reviewed and the data were investigated according to this form. Each researcher evaluated the studies according to the data summary form independently. Then, the summaries were compared; a consensus was formed among researchers. The data summary form contained the design of the study, number of the participants, the ICU where the participants were treated, duration of MV of the patients, mortality rates of hospitals and intensive care units, re-

intubation rates of the patients, staying times in hospitals and ICUs, and pneumonia rates related with ventilation. A meta-analysis was not realized because of common heterogeneity in terms of properties of the participants, intervention, and measurement methods within the studies included into the systematic review.

Results

Table 1 included evidence levels, number of patients and ICUs evaluated in 9 studies included in the systematic review. According to this, four of the studies were randomized controlled trials with an evidence level of IIa; three of them were non-randomized controlled trials with an evidence level of IIb; and two of them were cohort studies with an evidence level of IV (Polit, & Beck, 2012). A total of 2676 patients were involved in these studies. The ICUs investigated in these studies were surgery, internal medicine, and trauma ICUs. The findings of the studies included in the systematic review were investigated under the headings of duration of MV, re-intubation rates, pneumonia rates related with ventilation, mortality rates of hospitals and intensive care, staying time in intensive care, and staying time in hospitals. In this study, the expression of ‘protocol group’ was used for the groups where non-physician health professionals apply weaning the patients from MV by adhering protocols and ‘control group’ was used for groups where physicians drive weaning from MV by traditional approach.

Duration of MV of Patients

The primary measure of results evaluated among the studies included in this systematic review was duration of MV. In protocol groups of the six studies, the duration of MVs were meaningfully lower ($p < 0.05$) than the control groups (Table 2) (Kollef, et al., 1997; Hornst, et al., 1998; Marelich, et al., 2000; Tonnelier, et al., 2005; Chaiwat, et al., 2010; Dankers, et al., 2012). In two of the studies, there were no differences between the groups in duration of MV (Chan, et al., 2001; Krishnan, et al., 2004). In Plani et. al. (2012), the duration of MV was 1.9 hours lower in protocol group (the duration of MV was 14.4 hours in protocol group compared to 16.3 hours in

the group controlled by physicians) although complication development risk depending on ventilation (Plani, et al., 2013). being not statistically meaningful. This duration of time was reported as clinically meaningful from the point of view of

Figure 1. Flow Diagram for Selection Process of the Studies

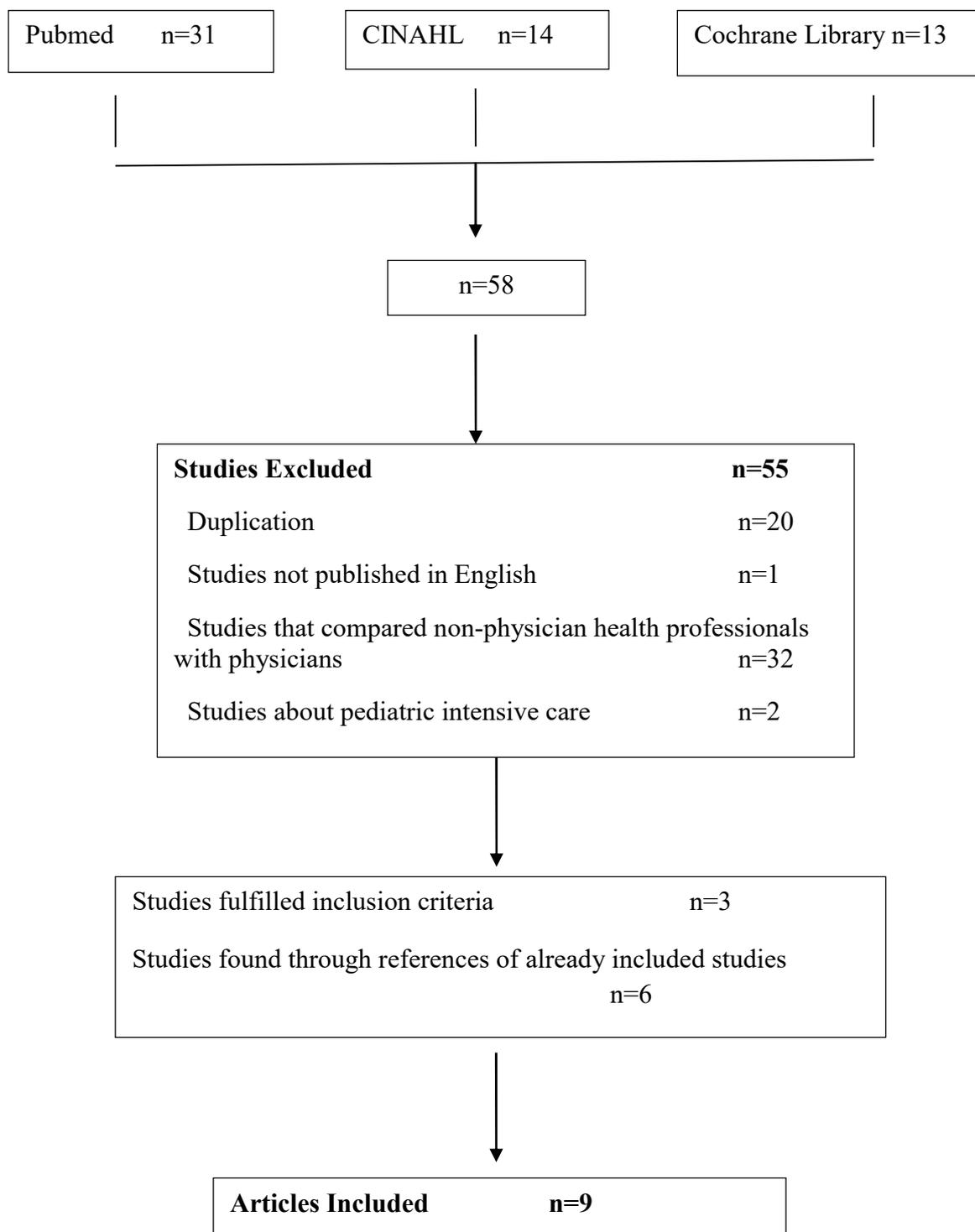


Table 1. Distribution of the Studies Included In the Systematic Review According To Their Properties

Author, year of the study	Type of the study and its progress in time	Sample	Type of intensive care
Kollef et al. 1997	RCT Prospective	n=357	Medical ICU Surgery ICU
Hornst et al. 1998	NRCT Prospective	n=893	Surgery ICU
Marelich et al. 2000	RCT Prospective	n=335	Medical ICU Surgery ICU
Chan et al. 2001	NRCT Prospective	n=230	Medical ICU Surgery ICU
Tonnelier et al. 2003	Cohort Prospective	n=208	Medical ICU Surgery ICU Neurosurgical Surgery ICU
Krishnan et al. 2004	RCT Prospective	n=299	Medical ICU
Chaiwat et al. 2010	RCT Prospective	n=100	Surgery ICU
Dankers et al. 2012	NRCT Prospective	n=202	Medical ICU Surgery ICU
Plani et al. 2012	Cohort Prospective or Retrospective	n=52	Medical ICU Surgery ICU Trauma ICU

RCT: Randomized Controlled Trials, NRCT: Non-randomized controlled trials, ICU: Intensive care unit

Table 2. Findings That Compare Protocol and Control Groups

Author, year of the study	Study groups	n	Duration of MV (hour) or (day)	Re-intubation rate n (%)	VAP %	Duration of hospital stay (hour) or (day)	Duration of intensive care stay (hour) or (day)	Hospital* or ICU** mortality rates n (%)
Kollef et al. 1997	PG	179	69.4 hrs	23 (12.8)	–	12.7 days	–	40 (22.3)*
	CG	178	102 hrs	18 (10.1)	–	14.2 days	–	42 (23.6)*
			p=.029	p=.417		p=.517		p=.779
Hornst et al. 1998	PG	515	112.6 hrs	2 (0.3)	–	–	–	63 (5.6)**
	CG	378	170.6 hrs	6 (1.5)	–	–	–	55 (5.6)**
			p<0.001	p=0.09	–	–	–	p=0.31
Marelich et al. 2000	PG	166	68 hrs	–	11 (7)	–	–	17 (10)*
	CG	169	124 hrs	–	20 (12)	–	–	10 (6)*
			p=0.001	–	p=0.10	–	–	p=0.146
Chan et al. 2001	PG	47	6.7day	5 (10.6)	–	–	9.3 day	–
	CG	183	6.2 day	23 (17.4)	–	–	7.2 day	–
			p> 0.05	p>0.05	–	–	p>0.05	–
Tonnelier et al. 2003 [8]	PG	104	16.6 day	33 (31)	21 (20)	–	21.6 (day)	7 (7)**
	CG	104	22.5 day	37(35)	33 (31)	–	27.6 (day)	5 (5)**
			p=0.02	p=0.81	p=0.12	–	p=0.02	p=0.92
Krishnan et al. 2004 [16]	PG	154	60.4 hrs	16 (10.3)	–	115 hrs	–	–
	CG	145	68.4 hrs	13 (8.9)	–	146 hrs	–	–
			p=0.61	p=0.23		p= 0.1		

Chaiwat et al. 2010 [2]	PG	51	40 hrs	2 (3.9)	–	–	–	–
	CG	49	72 hrs	3 (6.1)	–	–	–	–
			p=0.001	p=0.61				
Dankers et al. 2012 [12]	PG	102	2 (day)	9.8%	3.9	15 day	5 day	15.7%*
	CG	100	4 (day)	10.0%	7.0	18 day	7 day	17%*
			p=.001	p=1.00	p=.37	p=.32	p=.01	p=.85
Plani et al. 2012 [13]	PG	28	14.4 (day)	3 (10.7)	–	–	21 day	–
	CG	24	16.3 (day)	4 (16.7)	–	–	20.8 day	–
			p= 0.3	p=0.5	–		p=0.9	

PG, Protocol Group; CG, Control Group; hrs, hours; ICU, Intensive Care Unit; VAP, Ventilator-Associated Pneumonia

Re-intubation Rate

The re-intubation rates were evaluated in the eight studies (Kollef, et al., 1997; Hornst, et al., 1998; Chan, et al., 2001; Krishnan, et al., 2004; Tonnelier, et al., 2005; Chaiwat, et al., 2010; Dankers, et al., 2012; Plani, et al., 2013). The rate of re-intubation ranged between 0.3-31% in the protocol group, while 1.5-35% in the control group. But, in all these studies, there were no meaningful differences in re-intubation rates between protocol and control groups.

Ventilator-Associated Pneumonia Rate

Ventilator-Associated Pneumonia (VAP) was investigated in the three studies (Marelich, et al., 2000; Tonnelier, et al., 2005; Dankers, et al., 2012). In these studies, pneumonia development rates were changing between 3.9-20.0% in protocol groups and 7-31% in control groups. In each of the three studies, although pneumonia rates were lower in protocol groups than control groups, differences were not statistically meaningful (Marelich, et al.,

2000; Tonnelier, et al., 2005; Dankers, et al., 2012).

Length of stay in intensive care unit

Shorter duration of MVs also shortens duration of intensive care stays of patients. In this systematic review, staying times in intensive cares were compared in four studies (Chan, et al., 2001; Tonnelier, et al., 2005; Dankers, et al., 2012; Plani, et al., 2013). In the study by Tonnelier et al. (2005), staying time in intensive care was 21.6 days in protocol group and 27.6 days in control group; the difference was not statistically meaningful (p=0.02) (Tonnelier, et al., 2005). In study by Danker et al. (2012), it was stated that protocol group stayed in intensive care two days more than the control group (p=0.01) (Dankers, et al., 2012). On the other hand, in the studies by Chan et al. (2001) and Plani et al. (2012), there were no statistically meaningful differences between two groups in terms of staying times in intensive care (Plani, et al., 2013; Chan, et al., 2001).

Length of stay in hospital

Length of stay in hospital was evaluated in the three studies (Kollef, et al., 1997; Krishnan, et al., 2004; Dankers, et al., 2012). Duration of hospital stay were higher the protocol group than control group (115 hours to 15 day; 146 hours to 18 day respectively). But, in these studies, there were no statistically meaningful differences between the groups in terms of duration of hospital stay.

Mortality in hospital and intensive care

In two (Hornst, et al., 1998; Tonnelier, et al., 2005), and another four (Kollef, et al., 1997; Marelich, et al., 2000; Krishnan, et al., 2004; Dankers, et al., 2012) of the studies placed in this systematic review, intensive care and hospital mortalities were evaluated, respectively. According to these, in all of the studies, there were no statistically meaningful differences between the groups in terms of mortality rates (Hornst, et al., 1998; Marelich, et al., 2000; Kollef, et al., 1997; Krishnan, et al., 2004; Tonnelier, et al., 2005; Dankers, et al., 2012). Nevertheless, in the study by Marelich et al. (2000), although there was no statistically meaningful difference, hospital mortality rate was 4% less in protocol group; and this was emphasized as clinically important (Marelich, et al., 2000).

Discussion

Clinical guides were developed about weaning the patient from MV at the beginning of 2000s. In these guides, it was suggested to implement weaning protocols in intensive cares and to be used by intensive care nurses and respiration physiotherapists (Chaiwat, et al., 2010). In all of the studies included in this systematic review, the duration of MV was considered as an important parameter. In most of these studies, the duration of MV was meaningfully less in protocol groups (Kollef, et al., 1997; Hornst, et al., 1998; Marelich, et al., 2000; Tonnelier, et al., 2005; Chaiwat, et al., 2010; Dankers, et al., 2012). In parallel with this, duration of intensive care stay was meaningfully shortened as stated by half of the studies that evaluated this topic; and also, PRV rate was reduced although being not statistically

meaningful (Tonnelier, et al., 2005; Dankers, et al., 2012). It is known that complications related with MV and resulting morbidity and mortality rates increase as duration of MV extends (Ceylan, et al., 2001). These problems also bring increases in costs. As a result, it can be said that weaning process driven by non-physician health professionals has positive effects on outcomes of patient care.

Another parameter in evaluation of efficiency and success of weaning process is re-intubation rates (Can et al., 2005). It was stated by the studies included in this systematic review that re-intubation rates were changing between 0.3% - 35% in different intensive care patient groups.

Besides, a statistically meaningful difference between each of the two groups was not found in any of these studies. This result shows that weaning process driven by non-physician health professionals by adhering protocols did not increase the re-intubation rates, and that weaning process was successful.

These results showed that weaning driven by health professionals by adhering protocols develops patient care outcomes and does not increase complication rates related with weaning process. But application of a standard protocol may not be suitable for each patient. For this reason, protocols must be designed according to the properties of patient groups and intensive care units even in case of using similar parameters in these protocols (Chan, et al., 2001; Demir & Ilce Ozcan, 2009, Chaiwat, et al., 2010). In this respect, it was reported that designing weaning protocols according to patient groups and intensive care units and giving education to health professionals that will use these protocols accordingly will have positive effects on patient outcomes (Chaiwat, et al., 2010).

One group of non-physician health professionals that drive weaning process by adhering protocols are intensive care nurses. They spend more time with patients and observe them closely. This gives these nurses the opportunity to notice any change on patients immediately. As a result, more active participation to weaning process is provided to the nurses by developing

protocols. This support was considered as a factor that increases the success of the weaning process (Demir & Ilce Ozcan, 2009).

Limitations of our study were not being able to do meta-analysis of the acquired data, not including articles published in another language other than English, and not being able to determine whether there exists a difference between groups in the cases of weaning processes driven by physicians and by non-physician health protocols by adhering protocols. This was mainly because of non-existence of studies that evaluate physicians and other health staff based on heterogeneity and protocols among studies included in this systematic review.

Implications for practice and health policy

It is known that early or late weaning from mechanical ventilation may result with many complications. Health professionals working with the intensive care patients should consider the evidence supporting the use of protocols for weaning from mechanical ventilation. In this systematic review it was showed that weaning from MV is more effective and reliable when it is adhered to a protocol developed according to the properties of patient population and intensive care than when it is driven according to experiences and personal differences. In our country, traditionally physicians decide for weaning process according to their experiences and personal choices. Developing application protocols that is suitable for the evaluated intensive care and have changeable algorithms according to properties of the patient, and educating health professionals accordingly about weaning the patients from MV must be realized by a multi-disciplinary team. In addition, evaluating the application according to the outcomes.

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