A weighted simplified point score for prediction of difficult facemask ventilation – a cohort study

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Background and Goal of Study

Difficult face mask ventilation (DMV) is associated with increased risk of complications. Our aim was to 1) assess risk factors associated with DMV and 2) evaluate the diagnostic accuracy of an accumulated weighted risk score for predicting DMV.

Materials and Methods:

A cohort of 46 804 adults undergoing facemask ventilation was retrieved from the intervention group of the cluster randomized Difficult Airway Management Trial (DIFFICAIR) (1). Patients were airway assessed using 13 defined predictors for difficult airway management. The associations between DMV (2) and the 13 predictors were assessed by logistic regression and converted to a weighted simplified point score. The model was built from a population with complete data of the predictors in two consecutive steps. Initially, all the predefined variables were included in a multivariate regression analysis and the final model was derived by backward elimination at $P < 0.05$. Secondly, the regression coefficients (beta-values) of the risk factors from the final logistic regression model were converted to a clinically applicable weighed simplified point score (3). The predictive ability of both the original regression equation using the beta-values and the simplified point score was evaluated by discrimination (area under the receiver operation curve (AUC). The optimal cutoff value of the score was calculated by the Youden index (sensitivity + specificity - 1).

Table 1. Converting β -values of multivariate logistic regression model into points.

	Odds ratio	95 CI intervals	p-values	β -values	Point
Age -years					
15 = Age < 45	Ref				0
45 = Age = 60	4.2	2.7 – 6.6	< 0.0001	1.438	3
60 = Age = 80	6.0	3.9 – 9.3	< 0.0001	1.795	4
80 = Age	7.5	4.1 – 13.5	< 0.0001	2.012	4
Gender					
Female	Ref				0
Male	1.7	1.3 – 2.2	< 0.0001	0.538	1
Body Mass Index (BMI)					
BMI < 25	Ref				0
25 = BMI < 35	2.3	1.8 - 3.1	< 0.0001	0.852	2
35 = BMI	4.6	3.1 - 6.8	< 0.0001	1.528	3
Previous difficult tracheal intubation					
No	Ref				0
Possible	1.7	1.1 – 2.6	0.010	0.549	1
Yes	1.8	1.0 – 3.4	0.044	0.626	1
Thyromental distance (TMD)					
TMD > 6.5 cm	Ref				0
6.0 = TMD = 6.5 cm	1.4	1.1 – 1.9	0.010	0.361	1
TMD < 6.0 cm	2.3	1.4 – 3.7	0.001	0.824	2
Modified mallampati score (MMP)					
MMP = 1 & 2	Ref				0
MMP = 3	1.5	1.2 – 2.0	0.001	0.437	1
MMP = 4	2.1	1.3 – 3.5	0.002	0.759	2
Full beard					
No	Ref				0
Yes	2.9	2.2 – 3.8	< 0.0001	1.076	2
Snoring					
No	Ref				0
Yes	1.5	1.2 – 1.9	0.001	0.417	1
Sleep apnoea					
No	Ref				0
Yes	1.6	1.1 – 2.3	0.009	0.473	1
Neck radiation changes					
No	Ref				0
Yes	3.9	2.1 – 6.8	< 0.0001	1.342	3
Range of possible accumulated score				0 – 9.595	0 - 20
The multivariate logistic regression analysis and the final model was derived by backward elimination. Here mouth opening, neck movement and ability to extend lower jaw were all in-significant covariates excluded from the final model					

Results and Discussion:

The prevalence of DMV was 1.1% (1.0 – 1.2%, 95% CI). High age, increased body mass index, and previous radiation of the neck were especially associated with DMV (Table 1). The conversion of beta-values into points for the weighted simplified point score is presented in table 1. The weighted simplified point score range from 0 to 20 points. The diagnostic accuracy of both the accumulated point sum score and the accumulated beta-values demonstrated AUC of 0.82. The Youden index indicate a cut off value ≥ 6 , at which DMV is predicted with a sensitivity of 0.85 (0.81-089; 95% CI) and a specificity of 0.61 (0.61-0.62; 95% CI) (Table 2). These findings differ from the DIFFICAIR trial, where the individual clinicians' non-weighted prediction after assessment of the same risk-factors resulted in a sensitivity of 0.14 and a specificity of 0.99.

Conclusion(s):

The weighted point score may prove a useful tool for predicting DMV. We will validate the model in all randomized patients using multiple imputation.

Table 2. Diagnostic accuracy of a simplified point scores for difficult mask ventilation

Dichotomous cut-off level	Sens.	Spec.	Pos. LR.	Youden index.	Prev. of DMV	Odds ratio	95 % CI	p-value
Sum score = 1 points	0.99	0.11	1.1	0.100	1.2%	10.8	4.0-28.9	<0.0001
Sum score = 2 points	0.99	0.18	1.2	0.169	1.3%	15.4	6.4-37.2	<0.0001
Sum score = 3 points	0.98	0.25	1.3	0.235	1.4%	19.1	8.5-42.9	<0.0001
Sum score = 4 points	0.97	0.37	1.5	0.332	1.7%	16.2	9.1-28.8	<0.0001
Sum score = 5 points	0.94	0.49	1.8	0.429	2.0%	14.9	9.6-23.2	<0.0001
Sum score = 6 points	0.85	0.61	2.2	0.461 [§]	2.4%	8.9	6.6-12.0	<0.0001
Sum score = 7 points	0.72	0.75	2.8	0.461 [§]	3.0%	7.4	5.8-9.3	<0.0001
Sum score = 8 points	0.56	0.86	3.9	0.420	4.2%	7.8	6.3-9.6	<0.0001
Sum score = 9 points	0.44	0.93	5.8	0.361	6.1%	9.6	7.7-11.9	<0.0001
Sum score = 10 points	0.29	0.97	8.2	0.250	8.4%	11.1	8.7-14.1	<0.0001

[§] The optimal cut-off value according to the Youden index = sensitivity+ specificity-1.
CI: confidence interval; DMV: difficult mask ventilation; Prev: prevalence; Pos LR: Positive likelihood ratio; Sens: Sensitivity; Spec: Specificity.

References

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