ORIGINAL ARTICLE

Indirect Laryngoscopy With Rigid 70-Degree Laryngoscope as a Predictor of Difficult Direct Laryngoscopy☆

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KEYWORDS
Predictors; Indirect laryngoscopy; Rigid laryngoscope; Direct laryngoscopy; Difficult airway

Abstract
Introduction and objectives: The commonly used predictors for difficult airway management are not very accurate. We investigate the power of indirect laryngoscopy (IL) with the rigid 70-degree laryngoscope as a predictor of difficult visualisation of the larynx (DVL) with direct laryngoscopy (DL).

Methods: We performed preoperative indirect laryngoscopy with the rigid laryngoscope on 300 patients. The vision obtained was classified into four grades: 1 (vocal cords visible), 2 (posterior commissure visible), 3 (epiglottis visible) and 4 (no glottic structure visible). Grades 3 and 4 were considered predictors of difficult larynx visualisation. Next, direct laryngoscopy with the Macintosh laryngoscope was carried out on the patients under general anaesthesia (GA). Positive value was defined as a Cormack and Lehane III and IV. Other common clinical predictors were also analysed. A logistic regression model using the relevant variables was elaborated. We also investigated predictors of difficult visualisation of the larynx with indirect laryngoscopy.

Results: The found model and the coefficients for preparing it were: f(x) = -10.097 + 5.145 indirect laryngoscopy (3-4) + 3.489 retrognathia + 2.548 mouth opening < 3.5 cm + 1.911 thyromental distance (TMD) < 6.5 cm + 1.352 snorer + (0.151 cm neck thickness). This model provided a correct result in 94.3% of cases. In the case of indirect laryngoscopy, the model found was: f(x) = -2.641 + 0.920 snorer + 0.875 cervical mobility.

Conclusions: Indirect laryngoscopy was the independent variable with the greatest predictive power. Snoring is a common predictor in both laryngoscopy models.

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La laringoscopia indirecta mediante endoscopio rígido de 70° como valor predictivo de la dificultad de visión de la laringe

Resumen
Introducción y objetivos: Los predictores comúnmente utilizados para prever la vía aérea difícil poseen poca capacidad para pronosticarla. Nuestro objetivo es investigar la potencia de la laringoscopia indirecta con el laringoscopio rígido de 70° como predictor de dificultad de visión de la laringe con la laringoscopia directa. Métodos: Se efectuó una laringoscopia indirecta con el laringoscopio rígido en el preoperatorio a 300 pacientes. Según la visión obtenida fueron clasificados en 4 grados: 1 (cuerdas vocales visibles), 2 (comisura posterior visible), 3 (visión solo de epiglotis) y 4 (ninguna estructura glótica visible). El 3 y el 4 eran considerados predictores de dificultad de visión de la laringe. Después, bajo anestesia general, practicamos a los pacientes la laringoscopia directa con el laringoscopio de Macintosh. Valoramos como positivo el encontrar un Cormack–Lehane III–IV. Se registraron otros predictores clínicos comunes. Se elaboró un modelo de regresión logística con fines predictivos utilizando las variables relevantes. Investigamos también los predictores de la dificultad de visión de la laringe con la laringoscopia indirecta. Resultados: El modelo encontrado y sus coeficientes para confeccionarlo fueron: 

\[
f(x) = -10.097 + 5.145 \times \text{laringoscopia indirecta } (3-4) + 3.489 \times \text{retrognatia} + 2.548 \times \text{apertura boca} + 3.5 \times \text{1,911 distancia tiromentoniana} + 6.5 \times \text{1,352 roncopatía} + (0.151 \times \text{cm grosor cuello}).
\]

Proporciona un resultado correcto en el 94.3% de los casos. En el caso de la laringoscopia indirecta el modelo hallado era: 

\[
f(x) = -2.641 + 0.920 \times \text{roncopatía} + 0.875 \times \text{movilidad cervical}.
\]

Conclusiones: La laringoscopia indirecta fue la variable independiente con más poder predictivo (mayor coeficiente). La roncopatía es un predictor común entre los modelos de ambas laringoscopias.

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Introduction

It is known that problems in airway management can lead to brain damage and death among patients undergoing GA and requiring endotracheal intubation, so it is vitally important to identify these patients. However, in patients who have not previously undergone interventions under GA, the clinical factors commonly used to predict difficult airways (whose definition includes difficulty for larynx visualisation, difficulty for intubation and difficulty for correct ventilation using a face mask) have great interobserver variability and are not very accurate in preventing DVL.

It would be ideal to have a view of the upper airway before conducting GA with endotracheal intubation. There have been previous studies of IL with a laryngeal mirror or a laryngeal illuminator (a variant of the laryngeal mirror) which investigated whether it was possible to identify those patients in whom intubation was difficult due to problems in airway visualisation with mixed results. The disadvantages of these instruments include: poor view because of their small size, difficulty in learning their use and the need to support the mirror on the palate, which is a highly reflexogenic area.

We believe that a 70° rigid laryngoscope is a more appropriate instrument for this purpose, as it provides a better view of the upper airway, causes less discomfort for patients and is easier to practice with and learn. Furthermore, it is equipped with a recording system that allows us to save images and study them at a later moment.

Classical clinical predictors of DVL, such as the Mallampati test, TMD, mouth opening, cervical mobility, neck thickness and others, are usually obtained preoperatively, before intervention under GA with endotracheal intubation. Some of them have been used to predict difficult visualisation of the upper airway when performing suspended laryngoscopy. The main objective of this study was to investigate the power of IL with a 70° rigid laryngoscope as a predictor of DVL, when performing DL with a Macintosh laryngoscope under GA in relation to other clinical predictors. To do this, we elaborated a logistic regression model with relevant variables from all the predictors. The secondary objective was to identify, through another logistic regression analysis, which are the relevant variables to predict DVL if the same previous clinical predictors are used when conducting IL with a 70° laryngoscope, and thus observe the differences and similarities between both analyses.

Methods

After obtaining approval from the Ethics Committee of our hospital and informed consent in writing from subjects, we conducted a prospective, observational study of 300 consecutive patients between September 2009 and November 2010. All were scheduled to undergo elective surgery under GA with endotracheal intubation. Exclusion criteria included: age under 18 years, inability to sit, carriers of a nasogastric tube, heart disease, ankylosing spondylitis or infections such as hepatitis, HIV or tuberculosis, recent neck surgery and emergency or obstetric surgery.
The study protocol was as follows: on the day scheduled for intervention, the anaesthesiologist filled a protocol sheet in the presence of the patient which included data from the pre-anaesthesia consultation such as: age, gender, weight, height, body mass index, physical condition according to the indications of the American Society of Anaesthesiologists, type of intervention (demographic predictors) and airway evaluation. This evaluation consisted in analysing the following predictors: (a) the modified Mallampati scale,\textsuperscript{3} classes 3 (visibility only of the soft palate and uvula base) and 4 (visibility only of the hard palate) are considered predictors of DVL, (b) TMD (normal>6.5 cm), (c) mouth opening (normal>3.5 cm), lower figures in both measurements are considered as predictive of DVL, (d) neck circumference (>43 cm indicates DVL) and (e) cervical mobility test (good cervical mobility: 1, decreased cervical mobility: 2).

We also noted in the protocol sheet whether the patient suffered from snoring, obstructive sleep apnoea syndrome, and sleep abnormalities such as retrognathia, lack of teeth or others.

Subsequently, patients were taken to a room adjoining the operating room where they would undergo surgery. This room contained a tower on which the 8.5 mm 70° rigid laryngoscope was mounted (Sopro-Comeg Germany\textsuperscript{4}; reference number 162 081 685). Once the device was prepared, patients sat on a chair with their back to the monitor screen and head in extension and the IL was performed.\textsuperscript{7}

After the IL, the characteristics of the exploration were recorded in a protocol sheet, classified into 4 grades\textsuperscript{5}: (1) visible vocal cords; (2) visible posterior commissure and epiglottis; (3) only epiglottis visible; and (4) no visible glottic structures. We also noted the time required for each test, the need to repeat it and whether topical anaesthesia was used. Grades 3 and 4 were considered as positive tests (predictors of DVL). In addition, we also recorded the discovery of anomalies such as: curled, loose or hypertrophied epiglottis, the existence of lingual tonsils, growths in the upper airway or any others which were only visible by IL. However, if the abnormalities contraindicated intubation with IL, we recommended fibreoptic intubation and these patients were excluded from the study.

In patients who suffered nausea impeding visualisation of the upper airway, we attempted IL a second time. If it still could not be performed we proceeded to administer 2 lidocaine sprays, waited 5 min and tried again. This operation was repeated up to 3 times, but if the patient continued to suffer nausea or cough which prevented the test from being performed, the procedure was abandoned and recorded as a failure.

We should note that IL was not performed in the pre-anaesthesia consultation because patients took months to be operated and the date of the intervention was unknown. This was incompatible with the development of the study, since it included 5 anaesthesiologists who had to be coordinated. In addition, an ENT specialist advised the anaesthesiologist, when necessary, on the performance of IL and the diagnosis of various abnormalities which were observed during the exploration.

Later, patients passed to surgery and were premedicated with 0.05 mg fentanyl. Before induction of anaesthesia, patients breathed 100% O\textsubscript{2} for 3 min through a face mask. Subsequently, we administered propofol at 2 mg/kg and succinylcholine at 1 mg/kg. Next, the anaesthesiologist (who had over 5 years experience and was different from the one who performed the IL and thus unaware of its result, although he did know all the other results from DVL prediction tests) proceeded to evaluate DL using a Macintosh laryngoscope of suitable size, without performing the cricothyroid pressure manoeuvre, and finally performed the intubation manoeuvre.

The view obtained by DL was classified according to the Cormack–Lehane\textsuperscript{6,11} scale: grade I: completely exposed and open larynx; grade II: visible posterior portion of the larynx; grade III: only the epiglottis is visible; grade IV: no visible glottic structures, only the soft palate is visible. Grades I and II were considered as easy visualisation of the larynx and grades III and IV as DVL. This classification was considered as the gold standard and gave us a certain diagnosis. When we failed to observe the opening of the glottis (Cormack–Lehane: III–IV) we proceeded to perform cricothyroid pressure (this manoeuvre was recorded) and if a good view could not be obtained we used the appropriate instruments for intubation (Eschmann guide, GlideScope or Airtraq, etc.).

We performed logistic regression analysis in order to assess the power of IL as a predictor of DVL and also to investigate which explanatory or independent variables (clinical, demographic and IL predictors) were related to the variable or dependent response DVL with IL (Cormack–Lehane grades III–IV). We conducted a second logistic regression analysis using DVL with IL as a response variable (view 3–4) and including the clinical and demographic predictors as explanatory variables.

However, before performing a logistic regression analysis, it was useful to explore the association and to estimate the statistical significance existing between the clinical, demographic and IL predictors, with DVL observed by IL, as well as between these same clinical and demographic predictors with DVL observed by IL. To do this, we conducted 2 bivariate descriptive analyses and observed which variables changed or were similar in both analyses.

Once we conducted the logistic regression analyses with the coefficients found, we prepared an f(x) model in each case, in order to determine the theoretical probability (y) of finding DVL associated to a patient:

\[ y = \frac{e^{{f(x)}}}{1+e^{{f(x)}}} \]

Using the theoretical or predicted probability of finding DVL in each patient we could elaborate the ROC curve (receiver operating characteristic), which provided us with the overall measure of the power of the equation by assessing the area under the curve obtained, representing the sensitivity and specificity of the model.

IL was correlated with DL using the Pearson correlation coefficient (r) if the distribution was normal or using the Spearman Rho when the assumptions of normality were not fulfilled.

We consulted 4 reference studies of DVL diagnosis included in the literature to calculate the sample size.\textsuperscript{1,2,4,6}

Data were analysed using the software package SPSS 15\textsuperscript{8} for Microsoft Windows\textsuperscript{9}. The results were expressed as mean, median (range) and frequency. We used the Student
Indirect Laryngoscopy as a Predictor of Difficult Direct Laryngoscopy

Figure 1 Distribution of the 300 patients included in this study according to the type of surgery.

Results

Descriptive Analysis

A total of 324 patients were included in the study. Of these, 23 were excluded because it was not possible to perform IL due to nausea or cough (7%) and 1 because he presented an epiglottic tumour, so orotracheal intubation with a nasal fibroscope while wakeful was indicated instead.

The classification of patients by surgical specialty can be seen in Fig. 1.

We found DVL in 45 patients (15%) when we conducted DL. It was necessary to employ cricothyroid pressure in 57 patients (19%) in order to perform tracheal intubation, and in 14 patients (4.7%) we performed at least 3 tracheal intubation attempts. We found DVL in 39 patients when we conducted IL.

We recorded 46 anomalies during the exploration of the upper airway by IL with a rigid laryngoscope: 6 findings of lingual tonsils, 31 alterations of the epiglottis (22 curled epiglottis, 9 flaccid or hypertrophied epiglottis), 3 cases of upper airway tumours, 6 patients with tongue alterations (4 hypertrophies, 1 hemiglossectomy, 1 tongue base cyst). In addition, 138 patients were snorers (46.2%), of whom 18 suffered obstructive sleep apnoea syndrome, 10 suffered retrognathia and 18 lacked some teeth.

The intubation plan was modified in 3 patients who were scheduled for intubation with a nasal fibroscope while wakeful. In these cases, after performing IL and exploring other predictors, it was considered more convenient to perform orotracheal intubation under GA. In all 3 cases we observed Cormack–Lehane grade I or II. In the first case, the theoretical probability (y) of presenting DVL was 0.10301, in the second it was 0.00882 and in the third it was 0.03842.

At the time of conducting IL we found nausea in 119 patients (39.7%). The manoeuvre had to be repeated up to 3 times in 89 patients (29.6%) and it was necessary to use topical anaesthesia to perform the test in 34 patients. The mean performance time of the test was 12.46 s (1.815) with a range of 9–20 s.

We found no patients with Cormack–Lehane grade 4 with IL or with DL.

No patients experienced wounds or bruises in the pharynx during the performance of IL.

Predictive Analysis of Difficult Visualisation of the Larynx

Table 1 shows the bivariate analysis of DVL predictor and demographic variables with DL.

Table 2 shows the independent clinical predictors of DVL with DL found after performing logistic regression analysis. With the coefficients obtained we elaborated the following model:

\[ f(x) = -10.907 + 5.145 \text{IL} (3-4) + 3.489 \text{retrognathia} \\
+ 2.548 \text{mouth opening} < 3.5 \text{cm} + 1.911 \text{TMD} < 6.5 \text{cm} \\
+ 1.352 \text{snoring} (0.151 \times \text{neck width in cm}) \]

This model provided a correct result in 94.3% of cases. The predicted probability (y) presented a maximum value of 0.99911 and a minimum value of 0.00169. The mean value was 0.1473245.

Table 3 shows the different pairs (sensitivity, 1 – specificity) obtained when considering the possible cut-off values of the test, with the predicted probability values.

Fig. 2 shows the ROC curve which was constructed based on the values in Table 3.

Table 4 shows the bivariate analysis of the same predictive factors from Table 1 (with the exception of IL) for difficult visualisation through IL.

Table 5 shows the independent clinical predictors of difficult visualisation with IL. We used the coefficients obtained to elaborate the following model:

\[ f(x) = -2.641 + 0.920 \text{snorer} + 0.879 \text{cervical mobility} \]
This model provided a correct result in 87.2% of cases. Fig. 2 shows the ROC curve obtained with the predicted probability values when performing regression analysis of DVL with IL.

The correlation between IL and DL was 0.698; $P<.01$.

### Discussion

Firstly, the results section shows that although cricothyroid pressure was applied only in patients with DVL, it was used in 57 cases and yet DVL was only diagnosed in 45 cases. This indicates that at least 12 patients belonging to the non-DVL group (Cormack–Lehane grade 1–2) required more than one intubation manoeuvre. This discrepancy is explained by the fact that difficulty to visualise the glottis and difficulty to intubate are two different concepts. Intubation may be difficult even if the airway is easy to visualise, since there are extrinsic factors apart from the view of the glottis (individual ability, poor laryngeal muscle relaxation and lack of teeth among others) which may make cases with easy laryngoscopies difficult to intubate.12 The cricothyroid pressure manoeuvre centres the glottis, makes it descend and also fixes it, thus facilitating orotracheal intubation.

The authors of a recent study13 recommended that the pre-anaesthetic evaluation of ENT patients with upper airway pathologies who were to undergo surgery should include examination by nasal fibroscoopy prior to the intervention, in order to facilitate the choice of the anaesthetic technique, as well as the choice between intubation in wakeful patient or intubation under GA with direct laryngoscopy. However, when this technique was performed the nostrils of patients were previously sprayed with oxymetazoline and, subsequently, a plug containing 5% lidocaine ointment was
Table 3  Sensitivity and Specificity of the Various Cut-off Points of DVL With DL.

<table>
<thead>
<tr>
<th>Predicted Probability</th>
<th>Sensitivity</th>
<th>1 - Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0000000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>0.0033447</td>
<td>0.118</td>
<td>0.000</td>
</tr>
<tr>
<td>0.0060796</td>
<td>0.314</td>
<td>0.023</td>
</tr>
<tr>
<td>0.0091571</td>
<td>0.427</td>
<td>0.023</td>
</tr>
<tr>
<td>0.01137493</td>
<td>0.494</td>
<td>0.023</td>
</tr>
<tr>
<td>0.0262129</td>
<td>0.620</td>
<td>0.023</td>
</tr>
<tr>
<td>0.0330577</td>
<td>0.690</td>
<td>0.045</td>
</tr>
<tr>
<td>0.0432697</td>
<td>0.765</td>
<td>0.068</td>
</tr>
<tr>
<td>0.0502032</td>
<td>0.800</td>
<td>0.091</td>
</tr>
<tr>
<td>0.0731756</td>
<td>0.871</td>
<td>0.114</td>
</tr>
<tr>
<td>0.0892339</td>
<td>0.878</td>
<td>0.136</td>
</tr>
<tr>
<td>0.1117494</td>
<td>0.894</td>
<td>0.159</td>
</tr>
<tr>
<td>0.2899699</td>
<td>0.941</td>
<td>0.182</td>
</tr>
<tr>
<td>0.3842783</td>
<td>0.957</td>
<td>0.182</td>
</tr>
<tr>
<td>0.4862700</td>
<td>0.973</td>
<td>0.250</td>
</tr>
<tr>
<td>0.5484591</td>
<td>0.976</td>
<td>0.273</td>
</tr>
<tr>
<td>0.6636515</td>
<td>0.984</td>
<td>0.318</td>
</tr>
<tr>
<td>0.7496826</td>
<td>0.988</td>
<td>0.432</td>
</tr>
<tr>
<td>0.8243199</td>
<td>1.000</td>
<td>0.523</td>
</tr>
<tr>
<td>0.9044212</td>
<td>1.000</td>
<td>0.682</td>
</tr>
<tr>
<td>0.9479796</td>
<td>1.000</td>
<td>0.841</td>
</tr>
<tr>
<td>1.0000000</td>
<td>1.000</td>
<td>1.000</td>
</tr>
</tbody>
</table>

DL, direct laryngoscopy; DVL, difficult visualisation of the larynx.

introduced into each. In our study, there was only a need to administer lidocaine spray in 11.3% of patients.

When we examine Table 3 we can see that, according to the cut-off values shown therein, the first patient in our study in whom the intubation plan was modified presented a predicted probability closely associated to the cut-off value 0.1117494. This corresponds to a sensitivity of 89% (possibility of DVL) and a specificity of 84.1% (possibility of not presenting DVL). The second patient was near the cut-off value 0.0091571, with a sensitivity of 42% and a specificity of 97.7%, while the closest cut-off value for the third patient was 0.03842, with a sensitivity of 69% and a specificity of 95.5%. Thus, in the last 2 patients, the decision to perform DL under GA offered less doubts than in the first.

Moreover, we believe that exploration with both a nasal fibroscope and with a rigid laryngoscope may be useful in patients with ENT pathologies in whom the indices with best predictive performance, such as the Arné index, decrease in sensitivity and specificity. The reason for this belief is that exploring the upper airways serves to diagnose anomalies in this area (more common in this specialty) which will hinder visualisation. This information, coupled with the possibility of employing the above statistical parameters, should improve predictive power.

In our study, when comparing the 2 bivariate analyses performed on both types of laryngoscopies (Tables 1 and 4), we found that predictors such as snoring and TMD in cm displayed an association with DVL \( P<.05 \) in both analyses. However, neck width in inches, TMD<6.5 cm, mouth opening in cm and mouth opening>3.5 cm, Mallampati classification grades 3–4 and retrognathia only showed an association with DVL in the case of DL, and conversely, cervical mobility and age in years only showed a significant association with DVL when IL was performed.

In our opinion, the explanation for the differences observed between both types of laryngoscopy is based on the different characteristics of the instruments employed, since the structure of the rigid laryngoscope and the placement of the lens at the tip with the 70º angle enables a total or partial visualisation of the glottis in most patients with retrognathia and decreased mouth opening (the 2 strongest predictors after IL in the visualisation difficulty with DL model), while

Table 4  Bivariate Analysis of the Demographic Variables and the Variables Affecting DVL With IL.

<table>
<thead>
<tr>
<th></th>
<th>IL 3–4 No. = 39</th>
<th>IL 1–2 No. = 261</th>
<th>Value of ( P. \chi^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender M/F</td>
<td>21/18</td>
<td>114/147</td>
<td>NS</td>
</tr>
<tr>
<td>Age, years</td>
<td>62.97 (15.12)</td>
<td>55.38 (18.18)</td>
<td>.014*</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>28.66 (4.10)</td>
<td>27.99 (5.49)</td>
<td>NS</td>
</tr>
<tr>
<td>BMI&gt;30 kg/m²/BMI&lt;30 kg/m²</td>
<td>13/26</td>
<td>112/149</td>
<td>NS</td>
</tr>
<tr>
<td>Neck width, cm</td>
<td>40.01 (4.13)</td>
<td>38.83 (4.25)</td>
<td>NS</td>
</tr>
<tr>
<td>Neck width&gt;43/neck width&lt;43</td>
<td>8/31</td>
<td>38/223</td>
<td>NS</td>
</tr>
<tr>
<td>TMD, cm</td>
<td>7.11 (0.89)</td>
<td>7.63 (1.21)</td>
<td>.011*</td>
</tr>
<tr>
<td>TMD&lt;6.5 cm/TMD&gt;6.5 cm</td>
<td>8/31</td>
<td>28/233</td>
<td>.079 NS</td>
</tr>
<tr>
<td>Mouth opening, cm</td>
<td>4.051 (0.53)</td>
<td>4.26 (0.63)</td>
<td>NS</td>
</tr>
<tr>
<td>Mouth opening&lt;3.5 cm/mouth opening&gt;3.5 cm</td>
<td>2/37</td>
<td>14/247</td>
<td>NS</td>
</tr>
<tr>
<td>Mallampati predicted difficulty</td>
<td>6–15/14–4</td>
<td>89–93/57–22</td>
<td>.079 NS</td>
</tr>
<tr>
<td>1–2/no Mallampati predicted difficulty 3–4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cervical mobility normal/reduced</td>
<td>26/13</td>
<td>229/39</td>
<td>.005*</td>
</tr>
<tr>
<td>Snoring yes/no</td>
<td>26/12</td>
<td>112/149</td>
<td>.003*</td>
</tr>
<tr>
<td>Retrognathia yes/no</td>
<td>1/38</td>
<td>9/252</td>
<td>NS</td>
</tr>
</tbody>
</table>

BMI, body mass index; DVL, difficult visualisation of the larynx; F, female; IL, indirect laryngoscopy; M, male; TMD, thyromental distance. Data are expressed as mean and standard deviation in brackets or frequency.  *\( P<.05 \).
Table 5  Independent Clinical Predictors of Viewing Difficulty With IL.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Sig.</th>
<th>Exp (B)</th>
<th>95% CI for Exp (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Superior</td>
</tr>
<tr>
<td>Snoring</td>
<td>0.920</td>
<td>0.015</td>
<td>2.510</td>
<td>1.193</td>
</tr>
<tr>
<td>Cervical mobility</td>
<td>0.875</td>
<td>0.026</td>
<td>2.400</td>
<td>1.108</td>
</tr>
<tr>
<td>Constant</td>
<td>−2.641</td>
<td>0.000</td>
<td>0.071</td>
<td></td>
</tr>
</tbody>
</table>

*B*, coefficient of the variable; CI, confidence interval; Exp (B), odds ratio; IL, indirect laryngoscopy; Sig, statistical significance.

for DL we found a greater difficulty for visualisation in these patients.

However, we observed that IL was the most powerful factor in the model obtained with the independent clinical predictors of DVL with DL. This is illustrated in Table 2, which shows that Exp (B), the odds ratio (risk of DVL in a patient with IL=3–4, compared to another with IL=1–2), was obtained by raising the number *e* to coefficient *B* (*e*<sup>−2.641</sup>=2.7172<sup>−0.14</sup>) with the result being 171.555. This corresponds to the highest value obtained in Table 2 for this parameter.

If we compare the models obtained for the prediction of DVL with both DL and IL, we can observe that the second model has less predictive capacity. Furthermore, when graphically comparing the ROC curves in Fig. 2, we can observe that the first presents an excellent discrimination power, whereas the second a very poor one, since a larger area under curve corresponds to a better overall accuracy of the test.

Examining the 2 models we may also notice that only the snoring variable is an independent predictor of DVL with both DL and IL. A study of snoring<sup>15</sup> found difficulty to visualise the vocal cords while exploring through IL with a laryngeal mirror in 77.5% of these patients. The most common type found was IIb in the Fujita classification (only the epiglottis was visible). Furthermore, snoring was mainly associated with difficulty for ventilation with facial mask<sup>16</sup>, which in turn was related to DVL.

In addition, we must also note that image acquisition and the image obtained presented differences between both types of laryngoscopy, such as: (a) IL was performed on wakeful and sitting patients, whereas DL was performed on anaesthetised patients in the supine position; (b) IL required tongue extraction whereas DL did not; (c) the image with IL was reversed with respect to that observed with DL; (d) improvement of the view of the glottis in DL was obtained through the cricothyroid pressure manoeuvre, whereas in IL this was achieved by patients pronouncing the vowel ‘i’; and (e) the view in IL was not static, it varied with swallowing or coughing, whereas in DL the view was much more static due to muscle relaxation.

The laryngoscope used to treat glottic lesions during suspended laryngoscopy is a similar device to the Macintosh laryngoscope. In the study by Hekiert et al.,<sup>11</sup> the authors correlated the degree of difficulty in obtaining binocular vision of the larynx during suspended laryngoscopy with that obtained by anaesthetists during DL. The result was: *r*=0.57; *P=*0.03. In our study, we obtained a better correlation when analysing the correlation between the 2 types of laryngoscopy, indirect and direct.

The disadvantages of using IL compared to the classical predictors of DVL evaluation are: the use of a complex instrument such as a rigid laryngoscope requires a longer learning and performance time, it is more uncomfortable for some patients (nausea and coughing) and it requires sterilisation of the laryngoscope after each test. Another inconvenience that may bias the test is the appropriateness of assessing the upper airway while the patient is unable to make swallowing or coughing movements, which is sometimes difficult to achieve.

**Conclusions**

We believe that the addition of IL with a 70° rigid laryngoscope to clinical predictors does not represent an excessive workload, improves prediction of DVL in patients who are scheduled to undergo surgery under GA and DL, and helps in the choice of the orotracheal intubation technique. By contrast, clinical predictors are not useful to predict DVL when IL is employed.

**Conflict of Interests**

The authors have no conflicts of interest to declare.

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**References**

Indirect Laryngoscopy as a Predictor of Difficult Direct Laryngoscopy