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Respiratory changes during defecation in patients with chronic respiratory failure

M. Delmastro, C. Santoro, S. Nava

Respiratory changes during defecation in patients with chronic respiratory failure. M. Delmastro, C. Santoro, S. Nava. ©ERS Journals Ltd 2004.
ABSTRACT: Oxygen (O_2) desaturation may occur in patients affected by respiratory diseases during daily activities, although most of these activities, *e.g.* walking, washing and cooking, can be avoided or eventually performed with an external aid.

In this prospective study, the respiratory changes induced by the mandatory effort of defecation were assessed in patients with chronic respiratory insufficiency. Twenty-four consecutive patients with chronic respiratory failure due to obstructive or restrictive pulmonary disorders, showing a marked O_2 desaturation during the 6-min walk test, were enrolled. Thirteen of them were already established on long-term O_2 therapy (LTOT), while 11 were not. O_2 saturation (S_{a,O_2}), respiratory rate (RR), cardiac frequency (*f*C) and dyspnoea were measured at rest, and during and after defecation.

S_{a,O_2} decreased significantly during defecation, while RR, *f*C and dyspnoea increased, both in the subgroup of patients without significant resting hypoxaemia and in the subgroup of patients receiving their usual resting flow of LTOT, as compared to resting values.

In conclusion, the respiratory system of patients with chronic respiratory failure may be significantly strained by defecation.
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Respiratory Unit, Fondazione S. Maugeri, Istituto Scientifico di Pavia, IRCSS, Pavia, Italy.

Correspondence: S. Nava
Respiratory Unit
Fondazione S. Maugeri
Via Ferrata 8
27100 Pavia
Italia
Fax: 39 382592075
E-mail: snava@fsm.it

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Oxygen (O_2) desaturation may occur in patients affected by respiratory diseases during daily activities such as walking, eating, washing and napping, and, therefore, these patients may also be prone to cardiac complications [1].

Defecation is a natural and compulsory effort that is the result of a complex coordination of muscle activities leading to an abrupt rise in intra-abdominal pressure. Strong expulsive isometric efforts in other conditions causing raised intra-abdominal pressure, such as labour and delivery, produce electrical diaphragmatic fatigue [2] that may become of clinical importance in patients with respiratory muscle weakness or impairment. Syncope and death have previously been described during defecation [3].

Methods

A study was performed on patients affected by chronic respiratory failure in order to assess the physiological changes induced by defecation on some basic cardio-respiratory variables.

A total of 24 patients affected by obstructive or restrictive pulmonary disorders were studied. Thirteen were already established on long-term O_2 therapy (LTOT) (group A), while 11 were not (group B). All the patients showed a significant drop (>5% from baseline) in arterial O_2 saturation (S_{a,O_2}) during the 6-min walk test (6MWT), which was repeated three times [4]. Table 1 shows the clinical characteristics of the patients included in the study.

All patients were instructed to call a nurse when they needed to defecate and were studied on two consecutive occasions. Group A received O_2 supplementation at the same flow rate that they would usually have at rest, while group B received no O_2 supplementation. Continuous recordings of arterial S_{a,O_2} and cardiac frequency (*f*C) were made, and a nurse monitored arterial blood pressure, respiratory rate (RR) and dyspnoea score using Borg's scale on the following occasions: sitting on the bed before going to the lavatory; sitting on the lavatory before defecation; and when S_{a,O_2} had eventually returned to resting values about 3 min after defecation. The patient was left alone during the act of defecation but was asked to press a marker on the pulse

Table 1. – Patients' characteristics

	Group A	Group B
Patients n	13	11
P_{a,O_2} mmHg	70±10	63±8
O_2 flow L·min^{-1}	1.7	
P_{a,CO_2} mmHg	48±10	41±4
pH	7.41±0.026	7.40±0.043
FEV_1 pred %	28±7	52±14
VC pred %	66±18	80±22
FEV_1/FVC	31±8	53±16
Nadir S_{a,O_2} % during 6MWT	87.5±3.5	87.5±4

Data are presented as mean±SD. group A: patients already established on long-term oxygen therapy (LTOT); group B: patients not on LTOT; P_{a,O_2}: arterial oxygen tension; O_2: oxygen; P_{a,CO_2}: arterial carbon dioxide tension; FEV_1: forced expiratory volume in one second; VC: vital capacity; FVC: forced vital capacity; S_{a,O_2}: arterial oxygen saturation: 6MWT: 6-min walk test.

Table 2. – Patients' physiological changes before, during and after defecation

	Group A			Group B		
	Before defecation	During defecation	Post defecation	Before defecation	During defecation	Post defecation
S_{a,O_2} %	95±1.5$^+$	90±4	94±2	95±2.6$^+$	92±4	95±3
f_C pulses·min^{-1}	92±15*	99±13	99±18	81±12$^\#$	99±18	94±21
RR breaths·min^{-1}	20±3¶		25±7	18±1¶		22±4

Group A: patients already established on long-term oxygen therapy (LTOT); group B: patients not on LTOT; S_{a,O_2}: arterial oxygen saturation; f_C: cardiac frequency; RR: respiratory rate; 6MWT: 6-min walk test. #: $p<0.02$ difference between before, during and post (two way ANOVA test); *: $p<0.05$ difference between before, during and post (two way ANOVA test); ¶: $p<0.005$ difference between before and post (paired t-test); +: $p<0.0001$ difference between before, during and post (two-way ANOVA).

oximeter when defecation started and ended, and was also asked to quantify on a sheet the maximal dyspnoea she/he felt during the defecation. By protocol, defecation was started only when the main physiological variables had returned to baseline value (*i.e.* sitting before going to the lavatory). Pulse oximetry data were then downloaded onto a personal computer and analysed. Patients on chronic laxative therapy and with severe constipation were excluded. A group of seven normal patients were also studied as a control group (mean age 42±6.9 and male/female ratio four : three). The study was approved by the local Ethical Committee and informed consent was obtained from the patients.

Results are presented as a mean±SD for continuous variables and as median (quartiles or range) for dyspnoea values. Comparisons for S_{a,O_2} and f_C values were performed with the two-way analysis of variance (ANOVA) test, the paired t-test was used to compare RR values, while Friedman's test was used to compare repeated measures of dyspnoea. Differences between the group of patients receiving O_2 therapy and the group breathing room air were evaluated with a unpaired t-test. Comparisons of absolute delta changes from the resting condition to during defecation and to during the 6MWT were carried out with the t-test or Wilcoxon's test for dyspnoea.

Results

No major adverse effects were observed, except in two patients who complained of severe dyspnoea and had a S_{a,O_2} <80% during defecation so that O_2 flow had to be increased, therefore these data were not considered in the data analysis. Thereafter, the trial was repeated with higher O_2 without any complications. The coefficient of variations between the two separate tests performed on consecutive days was <5% for all the variables considered. Since two of the exclusion criteria were the use of laxative therapy or constipation, the stool consistency was normal in all the patients, except in one whose stools were soft on both occasions. The patients' characteristics are shown in table 1. The mean changes in the cardio-respiratory variables for groups A and B are shown in table 2. Compared to resting values, defecation induced a significant desaturation in both subgroups of patients. As shown in figure 1a for individual data, one patient from group A and six patients from group B reached a S_{a,O_2} <90%. The time elapsed from the nadir S_{a,O_2} to the return to baseline S_{a,O_2} was 146±26 s. As shown in figure 1b for individual patients, dyspnoea increased statistically during defecation. f_C and RR also increased significantly and remained high after the 3-min recovery period. No statistical differences were observed in the changes recorded in the two subgroups.

Overall, the degree of desaturation during defecation (delta changes from baseline) was lower than during the 6MWT ($p<0.05$). No correlation was found between the degree of desaturation from baseline during defecation and during 6MWT ($r=0.117$ and $p=0.6$). No significant changes were observed in all physiological variables in the control group (basal S_{a,O_2} 97.2%±0.6, during defecation 97.0%±0.8 and post-defecation 96.9%±0.7).

Discussion

LTOT is prescribed on the basis of the results of repeated measurements of arterial blood gases at rest after 30 min of breathing air, while walking oximetry may be used to determine exercise flow settings [5]. It has, however, been shown that the O_2 flow rate prescribed does not protect ~85%

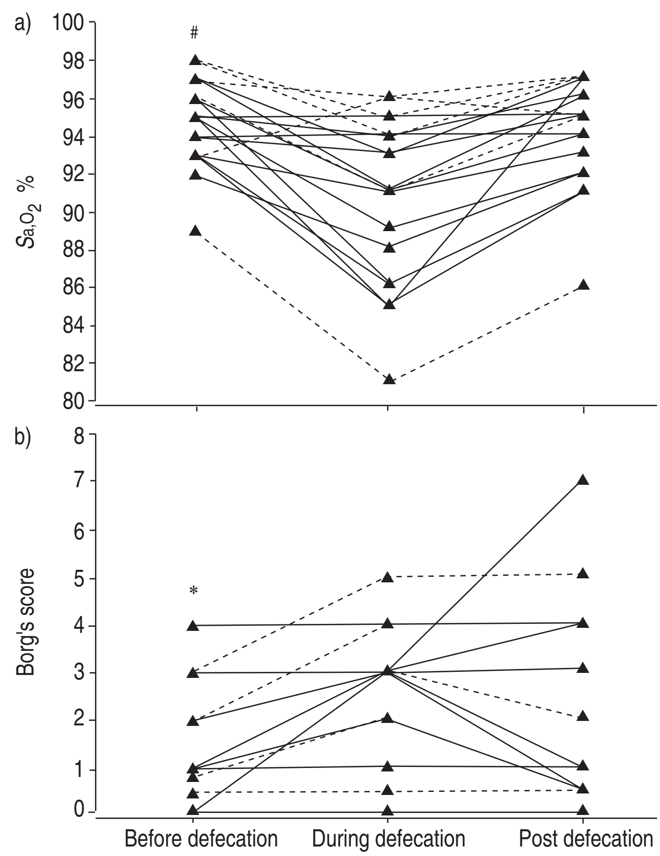

Fig. 1. – Individual data of a) dyspnoea score (Borg's score) and b) arterial oxygen saturation (S_{a,O_2}) before, during and after defecation. -----: group A patients (already established on long-term oxygen therapy (LTOT)); ——: group B patients (not on LTOT). *: $p<0.05$ difference between before, during and post defecation, statistical analysis was performed for all patients; #: $p<0.0001$ difference between before, during and post defecation, statistical analysis was performed for all patients.

of patients from drops in S_{a,O_2} during daily life and sleep. Similar transient desaturations have also been observed in patients with moderate to severe chronic pulmonary disorders [6] without significant resting hypoxaemia (*i.e.* arterial oxygen tension 55–60 mmHg). O_2 desaturation, leading to an impairment in O_2 transport and dyspnoea, is a major descriptor of exercise capacity [4], and, therefore, most patients with drops in S_{a,O_2} voluntarily restrict their daily activities such as walking, cooking and even washing to prevent the occurrence of symptoms. Defecation is a natural effort that clearly cannot be avoided. In this study, a significant reduction in S_{a,O_2} during defecation was observed both in the group of patients already established on LTOT and in those with borderline hypoxia. It would also have been interesting to study the LTOT group without O_2 supplementation, however, since the authors' institution usually prescribes O_2 therapy for these patients during every kind of effort (*i.e.* walking, dressing, cooking and washing), the authors are confident that their "real-life" situation has been replicated in this study. The degree of desaturation was similar to that reported in other studies of most common daily activities, but significantly less than that observed during the 6MWT. The 6MWT is, however, the standard for easy assessment of the impairment of functional exercise tolerance, while most daily living activities are performed at submaximal levels of exertion. Even mild hypoxaemic episodes can be associated with severe cardiac arrhythmias and, therefore, it is not surprising that events such as syncope, death or changes in the ST segment have been reported to occur during defecation [3]. In the current study, f_C and RR were still higher 3 min after defecation, suggesting that a period of rest may be recommended in particular vulnerable patients after defecation.

This study has some intrinsic limitations. It would have been interesting to compare the physiological effects of defecation in patients with constipation or, conversely, those with loose stool, to eventually detect important differences. However, the aim of the study was to assess the physiological changes, if any, during defecation without potential confounds. Further studies may be needed to further explore the potential different response in the two subsets of patients.

In addition, RR was not measured during the act of defecation, as this was not permitted by the local ethical committee. However, during defecation, the respiratory pattern is somehow difficult to interpret, due to the performance of the Valsalva manoeuvre. Nevertheless, an increased RR was observed 3 min after defecation, suggesting that the respiratory system was still strained.

This is the first report of oxygen desaturation during defecation in patients without significant resting hypoxaemia and in those already on long-term oxygen therapy receiving their usual resting flow. Further studies are now needed to assess the degree of oxygen drop in patients with far-advanced lung disease.

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