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Effectiveness of controlled breathing techniques on anxiety and depression in hospitalized COPD: a randomized clinical trial

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Abstract

BACKGROUND: Anxiety and depression are highly prevalent comorbid complications in COPD. Breathing techniques can improve anxiety and depression in subjects hospitalized due to COPD exacerbation. We conducted a randomized clinical study using two groups.

The sample comprised 46 male patients aged 67-86 years hospitalized with acute COPD exacerbation. Patients were randomly and equally divided into the control and controlled breathing intervention groups.

METHODS: Baseline and post-intervention recordings of Dyspnea, Anxiety and depression, Quality of life (SGRQ and EURQoL), Respiratory pressures (PImax-PEmax), Hand-grip test and Sleep quality were taken in all subjects. Subjects hospitalized due to acute COPD exacerbation showed high levels of dyspnea and low values in overall quality of life as measured with the St. George's Respiratory Questionnaire (SGRQ). **RESULTS:** Controlled breathing techniques had a significant effect on dyspnea, anxiety and mobility ($p<0.05$). All the measured areas were improved in the intervention group. The control group had poorer values in all the areas after the hospitalization period. **CONCLUSIONS:** Controlled breathing exercises benefit patients hospitalized due to COPD exacerbation in anxiety and depression values.

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Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of disability and death worldwide[1] with rising trends.[2] COPD is associated with intermittent hospitalizations due to exacerbations characterized by acute deterioration in the symptoms of chronic dyspnea, cough and sputum production. Hospitalizations due to acute exacerbations are common (up to 60%)[3] and an important part of the care of patients with COPD.

Anxiety and depression are the most prevalent psychological consequences in COPD patients and have a negative impact on their quality of life. They are associated with greater disability[4] and impaired functional status[5] in the areas of general health, physical roles, emotional roles, social functioning, bodily pain, mental health function and vitality.[6] Even after statistically controlling for the effects of overall health status, including additional medical diseases, COPD severity and dyspnea, anxiety and depression remain significantly associated with decreased functional status.[5,7] Anxiety has also been found to be related to the disease characteristics of COPD, including forced vital capacity,[7] chest symptoms[8] and dyspnea.[9]

Numerous studies have proven that the human respiratory rate is increased by physiological arousal. In COPD patients, the hyperventilation that results from anxiety markedly worsens shortness of breath by causing bronchoconstriction and lung hyperinflation.[10-12] Hyperinflation increases the work and effort of breathing and reduces inspiratory reserve capacity.[12,13]

Finally, anxiety is a significant predictor of the frequency of hospital admission for acute exacerbations of COPD,[13] risk of mortality,[14,15]increased risk of relapse[16] and hospital readmission.[17] Few studies have assessed the effect of a therapeutic program on anxiety in patients with acute COPD exacerbations.

Numerous studies have explored the anxiety that develops in the hospitalization process.[14,17] To our knowledge, however, few studies[18] have explored the effects of a breathing program on anxiety.

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Previous studies have found controlled breathing to be an effective treatment for different pulmonary symptoms.[19] We hypothesized that controlled deep breathing would reduce negative affect levels, as it has been found to do with smoking withdrawal.

Controlled breathing is an all-embracing term for a range of exercises such as active expiration, slow and deep breathing, pursed lips breathing (PLB), relaxation therapy, specific body positions, inspiratory muscle training and diaphragmatic breathing.[20] In COPD patients, controlled breathing is used to relieve dyspnea by (1) reducing dynamic hyperinflation of the rib cage and improving gas exchange, (2) increasing strength and endurance of the respiratory muscles, and (3) optimizing the pattern of thoracoabdominal motion.[21] In addition, psychological effects such as controlling respiration may also contribute to the effectiveness of controlled breathing. However, these effects are not discussed in this study.

This study aimed to assess the feasibility of implementing controlled breathing techniques among patients hospitalized for a COPD exacerbation process and to test the efficacy of these techniques in alleviating common symptoms associated with hospitalization (i.e., dyspnea, sleep disturbance, anxiety and depression) and improving quality of life.

Methods

Study design

This randomized pilot study compared the effects of a ten days controlled breathing program with a standard care control intervention (SC) in patients hospitalized with acute COPD exacerbation at San Cecilio University Hospital in Granada, Spain. Patients in the SC group received the standard medical treatment. Primary and secondary outcomes were measured at hospital admission and discharge.

Sample size calculation

Sample size calculation was based on the primary outcomes: anxiety and Depression symptoms level. An increase in anxiety and depression symptoms level (2±3.3 points in HAD questionnaire) was expected in the control group, as previously reported in different studies,[22] and a small positive effect (-5 points in HAD questionnaire) was anticipated in the treatment group.

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Hence, in order to have 80% power using a two-sided α=0.05, and a hypothetical dropout rate of 20%, 23 patients in each group would be needed to show statistically significant differences in anxiety and depression between the two groups.

Randomization procedure:

An independent nurse assigned participants to the treatment or control groups according to a computer-generated randomization list. The nurse informed the physiotherapist after participants had given their approval and been included in the study.

Patients

Forty six patients were recruited during a 6-month period from those admitted to the hospital's Pulmonary Care Unit diagnosed from a non-infectious exacerbation of COPD. The diagnosis of COPD was made according to the criteria of the American Thoracic Society (ATS).[23] All patients had been free from their exacerbation for at least 10 days (range 10-12 days). Patients with other organ failure, cancer or inability to co-operate were excluded from the study. The project was approved by the university and hospital ethics committees, and all participants gave written consent.

During their exacerbation, all patients had been treated with standard medical therapy including systemic steroids (76%), inhaled bronchodilators (100%) and oxygen.[24]

The flow diagram with the groups distribution of participants is shown in Figure 1.

Please insert Figure 1

Controlled breathing program

The controlled breathing program was delivered by a trained physiotherapist twice a day during all the hospitalization period. The Physiotherapy session's duration was 30 minutes and the participants were instructed to take a break of 3 minutes when necessary.

The controlled breathing program included relaxation exercises, pursed lips breathing and active expiration as follows:

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Relaxation exercises:

Studies on relaxation exercises are based on the observation that hyperinflation is a partially reversible airway obstruction that is at least partly caused by an increased activity of inspiratory muscles during expiration.[25] This increased activity may continue even after recovery from an acute episode of airway obstruction and hence contributes to dynamic hyperinflation. Relaxation is also meant to reduce the respiratory rate and increase tidal volume, thus improving breathing efficiency.[26]

Pursed lips breathing (PLB)

PLB works to improve expiration both by requiring active and prolonged expiration and by preventing airway collapse. The subject performs a moderately active expiration through half-open lips, inducing expiratory mouth pressures of about 5 cm H2O.[27] Compared to spontaneous breathing, PLB reduces respiratory rate, dyspnea and arterial partial pressure of carbon dioxide (PCO2) and improves tidal volume and oxygen saturation in resting conditions.[28] 'Symptom benefit patients' have been found to have a more marked increase of tidal volume and decrease of breathing frequency.[29]

Active expiration

Contraction of abdominal muscles results in increased abdominal pressure during active expiration. This lengthens the diaphragm and contributes to operating the diaphragm close to its optimal length. Indeed, diaphragm displacement and its contribution to tidal volume during resting breathing has not been found to be different between COPD patients and healthy participants.[30,31] In addition, active expiration increases elastic recoil pressure of the diaphragm and the rib cage. The release of this pressure after relaxation of the expiratory muscles assists the next inspiration.

In summary, active expiration is a normal response to increased ventilatory requirements. In COPD patients, depending on the severity of airway obstruction, spontaneous activity of abdominal muscles is often already present at rest. Although active expiration improves diaphragm function,[32] its effect on dyspnea remains unclear.

Outcome measures

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Hospital Anxiety and Depression (HAD) scale

The HAD scale is a 14-items self-report questionnaire designed to detect psychological morbidity in medically ill patients.[33] It contains depression and anxiety subscales, each with scores ranging from 0 to 21. A score above 8 on either subscale can be used to screen for possible depression and anxiety and a score above 11 indicates probable disorder.[34] A score of less than 8 on the depression scale is considered normal, 8–10 indicates mild depression, 11–14 indicates moderate depression and 15 or above represents severe depression.[34] The HAD scale is a valid measure of depression and anxiety with Cronbach's alpha values of 0.83 for anxiety and 0.82 for depression.[34]

St. George's Respiratory Questionnaire (SGRQ)

The SGRQ is a standardized, self-administered questionnaire for measuring impaired health and perceived health-related quality of life (HRQoL) in airway disease.[35] It includes 50 items, divided into three domains: Symptoms, Activity and Impacts. A score is calculated for each domain and a total score including all items is also obtained. Low scores indicate better HRQoL.

mMRC dyspnea scale

Dyspnea was assessed with the modified Medical Research Council (mMRC) chronic dyspnea self-administered questionnaire that consists of six questions about perceived breathlessness:[36] category 0, no dyspnea; category 1, slight degree of dyspnea (troubled by shortness of breath when hurrying on the level or walking up a slight hill); category 2, moderate degree of dyspnea (walks slower than people of the same age on the level because of breathlessness); category 3, moderately severe degree of dyspnea (has to stop because of breathlessness when walking at own pace on the level); category 4, severe degree of dyspnea (stops for breath after walking about 100 yards or after a few minutes on the level); and category 5, very severe degree of dyspnea (too breathless to leave the house or breathless when dressing or undressing).

EUroQol 5D

The generic European Quality of Life Questionnaire, also known as the EUroQol (EQ-5D),[37,38] consists of the EQ-5D Visual Analogue Scale (VAS) and the EQ-5D index. The VAS has a rating scale of 0 to 10 points, taken as 0-100% (0%, death/worst possible health; 100%, best possible health). The EQ-5D index

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is a 5-item questionnaire (mobility, self-care, usual activity, pain/discomfort and anxiety/depression). For each item, the patient selects one of three descriptive health states (from good to poor) and the number/percentage of patients selecting each state is recorded.

Handgrip strength

Measurements were made with a handgrip dynamometer (TEC-60; Productos Técnicos, EE.UU.) individually adjusted for the size of the subject's handgrip. Three measurements were made on each hand, the peak force was recorded in each case.[39] This test has been used for measuring muscle strength in people with COPD.[40]

Respiratory muscle strength

Maximal inspiratory (PImax) and expiratory (PEmax) pressures were measured (Micro-MPM; Sensor-MEDICS, Yorba Linda, CA, USA) in each patient four times at 2-minute intervals with maximal readings retained and normalized to predicted values.[41] All respiratory tests were performed by cardiopulmonary physiotherapists with patients in sitting position.

Statistical analyses

Baseline characteristics were compared using Mann-Whitney U test for continuous variables and Chi-quare test for categorical variables. Results are shown as absolute number (percentage) or mean (standard deviation). The difference for each variable was compared using a two-way repeated measures analysis of variance between both groups and within each group. Paired sample Student T test were used for comparisons within each group. An intention-to-treat analysis was carried out assuming that patients who can not continue the program had the same change as the average improvement in the intervention group. A two-tailed P-value less than 0.05 was considered significant. All statistical analyses were performed using the SPSS 20.0 software package (SPSS Inc., Chicago, IL, USA).

Results

The baseline characteristics of the final sample according to the intervention group are shown in Table 1.

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All participants included in the study were males with a mean age of 76±5.5 in the intervention group and 74.43±6.7 in the control group. Percentages of alcohol and tobacco use did not show differences between groups ($p>0.05$). Both the intervention and control groups reported two hospitalizations per year. St. George's Respiratory Questionnaire subscales showed significant differences between groups in the activity subscales and the total score, with higher scores in the control group, meaning a worse QoL.

Main variables values at baseline between groups are presented in table 2

Please insert table 2

No differences were found in any of the baseline values.

Results of the intervention during the hospitalization process are shown in Table 3.

Please insert table 3

Dyspnea scores were found to significantly improve in the intervention group ($p=0.004$) whereas the control group's perception of dyspnea increased between baseline and discharge.

The anxiety and depression subscores of the HAD scale showed better results after the controlled breathing intervention.

Higher mean change values were found in depression scores (10.56 ±0.465).

All the EUroQol-5D subscales showed better values at discharge in the intervention group, with a higher improvements in the mobility score and the anxiety/depression score.

Discussion

The objective of this study was to assess the effects of a controlled breathing program on anxiety and depression in subjects hospitalized due to an acute exacerbation of COPD.

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Although numerous studies have recognized the physical and psychological effect of a hospitalization process,[42,43] no studies have explored these effects in acute COPD.

Previous studies had shown a poor physiological status, a moderately impaired quality of life and higher levels of anxiety and depression than other pathologies in COPD.[44,45] Adittionally, Individuals with COPD referred that episodes of heightened and intractable dyspnea as being inextricably associated with anxious feelings.[46]

The presence of anxiety and/or depression remains an important risk factor for re-hospitalisation within a 12-month period in COPD patients with poor health-related quality of life.

Various studies have evaluated the effects of different therapeutic interventions on subjects hospitalized due to COPD exacerbations. Results of these studies on quality of life or function are contradictory.

In one trial, incentive spirometry resulted in a significant improvement on the St. George's Respiratory Questionnaire compared with standard care,[47] while another trial found a mean increase in the Barthel score favoring the use of a gutter frame over a rollator.[48] No significant improvements were found in daily weight, eating, sleeping and exercise scores when the incentive spirometry group was compared with standard care.[49] To our knowledge, no previous studies have assessed the effectiveness of a therapeutic program in subjects with COPD exacerbation considering the variables included in the present study.

Several studies have shown that acute exacerbations (AEs) have a negative impact on health- related quality of life,[50] pulmonary function[51] and survival[52] of COPD patients.

The present study showed a significant improvement of functional and psychological variables in the intervention group and significant deterioration values in the control group due to the hospitalization effect. This suggests that the marked inactivity observed by different researchers[53] during the hospitalization period should be included as one of the factors linked to functional and psychological impairment during acute COPD exacerbation.

Pulmonary rehabilitation programs have shown in COPD patients a reduction of anxiety.[54,55] Emery *et al.* [56]demonstrated that a exercise training program combined with education that included stress management techniques, yielded significant reductions in symptoms of anxiety. Curiously, stress

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management sessions without exercise training did not improve anxiety. This is in line with our results, suggesting that an additional value of exercise in its different modalities (breathing or global training) can improve the psychological status in COPD.

There are several limitations to this study. First, the sample size was small. Second, it would be important to obtain follow-up data after discharge.

Our study addresses an important rehabilitation option in COPD patients and is novel as few studies have investigated the effect of breathing techniques during the early post-exacerbation period.[43]

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RESPIRATORY CARE Paper in Press. Published on July 23, 2013 as DOI: 10.4187/respcare.02565

Table 1

	Intervention group N=23	Control group N=23	
Age (years)	76 ± 5.5	74.43 ± 6.7	
Smoker (%)	25	21	
Daily alcohol user (%)	12	15	
Hospitalizations/year (n)	2.75 ±1	2.54 ± 1.06	
Handgrip strength (kgf)	20.929 ± 8.3	19.71 ± 6.9	
Maximal respiratory pressures **PImax(cm H2O)** **PEmax(cm H2O)**	 34.29 ± 19 66.57 ± 42.7	 20.4 ± 13 49.4 ± 35.3	
SGRQ scores: **TOTAL** **Symptoms** **Activity** **Impact**	 74.88 ±8.9 88.76 ± 12.6 90 ± 11.8 65.73 ± 8.4	 79.3 ± 5.6 85.41 ± 18.5 93.7 ± 4.8 69.5 ± 4	

Table 1: Values (mean ± SD) were collected before the intervention. SGRQ= St. George's Respiratory Questionnaire, PImax=Maximal inspiratory pressures, PEmax=Maximal expiratory pressures. Controlled breathing intervention group: Intervention group; Standard care group: Control group

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Table 2

	Intervention group N=23	**Control group N=23**
Dyspnea	2.75 ± 1.2	2.71 ± 0.4
HAD scale		
Anxiety	13.75 ± 4	14 ± 4.9
Depression	9.62 ± 2.1	8.85 ± 4
EUroQol score		
Mobility	2.14±0.9	2 ± 0.63
Self-care	1.91±0.95	2.17±0.75
Activity	2.31±0.81	2.50±0.54
Pain	1.97±0.53	2.10±0.89
Anxiety/depression	2.38±0.74	2.51±0.75

Table 2: Values (mean ± SD) were collected before the intervention (Controlled breathing intervention group: Intervention group; Standard care group: Control group

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Health outcome	Mean (SD) change from baseline Intervention group N=23	 Control group N=23	Mean (SD) difference in change from baseline as observed	Between -group difference [95% CI]	p-Value
Dyspnea	3.56 (5.66)	0.643 (0.911)	2.917 (3.21)	[-1.228 , 0.280]	p<0.001
HAD scale					
Anxiety	6.10 (8.27)	-0.214 (6.79)	6.314 (0.712)	[-18.36 , 2.014]	p<0.001
Depression	3.56 (5.66)	-7.00 (3.12)	10.56 (0.465)	[-9.79 , 1.05]	p<0.001
EUroQol score					
Mobility	0.714 (0.651)	-0.167 (0.917)	0.881 (0.789)	[-0.738 , 0.168]	p<0.001
Self-care	0.286 (0.460)	-0.167 (0.917)	0.453 (0.654)	[-0.905 , 0.209]	p<0.001
Activity	0.143 (0.651)	0.167 (0.702)	0.024 (0.689)	[-0.476 , 0.161]	0.005
Pain	0.429 (0.742)	0.00 (0.590)	0.429 (0.651)	[-0.857 , 0.260]	p<0.001
Anxiety/depression	1.25 (1.414)	-1.00 (0.770)	2.25 (0.945)	[-1.58 , 0.196]	p<0.001

Table 3: Change values (mean ± SD) were presented comparing the pre-intervention and at discharge values.

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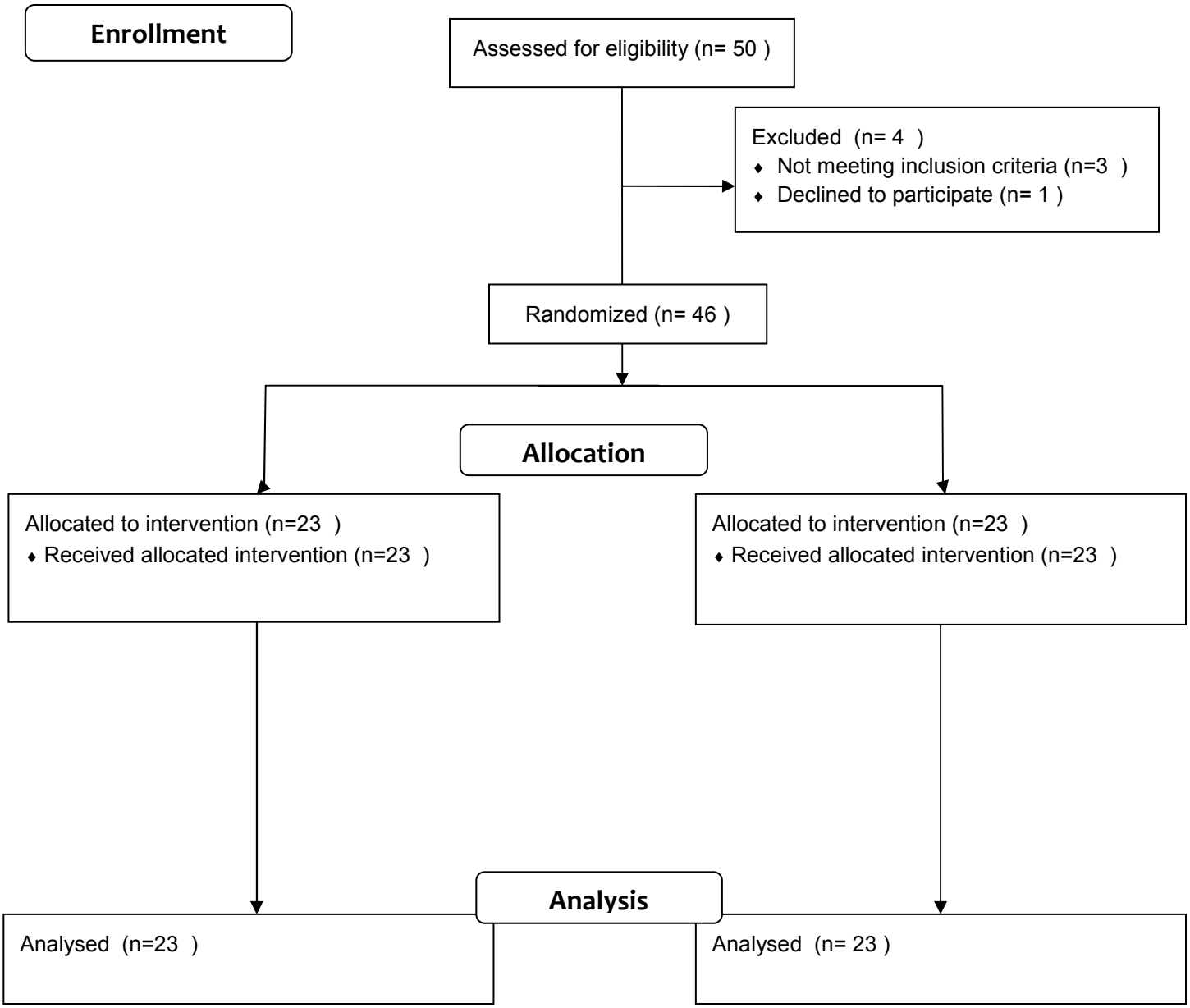

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