UNIVERSITI SAINS MALAYSIA
GERAN PENYELIDIKAN UNIVERSITI
PENYELIDIKAN
LAPORAN AKHIR

A RANDOMIZED CONTROLLED TRIAL ON THE USE OF BUDESONIDE/FORMOTEROL (SYMBICORT) AS AN ALTERNATIVE RELIEVER MEDICATION FOR MILD TO MODERATE ASTHMATIC ATTACK IN ADULT PATIENTS IN EMERGENCY DEPARTMENT, HUSM

PENYELIDIK

DR. CHEW KENG SHENG

PENYELIDIK BERSAMA

DR. HAMIDAH KAMARUDIN
DR. CHE' WAN AMINUDDIN HASHIM

2012

UNIVERSITI SAINS MALAYSIA

LAPORAN AKHIR PROJEK PENYELIDIKAN JANGKA *PENDEK*

FINAL REPORT OF SHORT TERM RESEARCH PROJECT

Sila kemukakan laporan akhir ini melalui Jawatankuasa Penyelidikan di Pusat Pengajian dan Dekan/Pengarah/Ketua Jabatan kepada Pejabat Pelantar Penyelidikan

1. Nama Ketua Penyelidik: DR. CHEW KENG SHENG
Name of Research Leader

☐ Profesor Madya/ *Assoc. Prof.* ☑ Dr./ *Dr.* ☐ Encik/Puan/Cik *Mr/Mrs/Ms*

2. Pusat Tanggungjawab (PTJ):
School/Department PUSAT PENGAJIAN SAINS PERUBATAN

3. Nama Penyelidik Bersama: Dr. Hamizah Kamarudin
Name of Co-Researcher Dr. Che' Wan Aminuddin Bin Hashim

4. Tajuk Projek:
Title of Project

A RANDOMIZED CONTROLLED TRIAL ON THE USE OF BUDESONIDE/FORMOTEROL (SYMBICORT®) AS AN ALTERNATIVE RELIEVER MEDICATION FOR MILD TO MODERATE ASTHMATIC ATTACK IN ADULT PATIENTS IN EMERGENCY DEPARTMENT, HOSPITAL UNIVERSITI SAINS MALAYSIA

5. Ringkasan Penilaian/*Summary of Assessment*:	Tidak Mencukupi *Inadequate*		Boleh Diterima *Acceptable*	Sangat Baik *Very Good*	
	1	2	3	4	5
i) Pencapaian objektif projek: *Achievement of project objectives*	☐	☐	☐	✓	☐
ii) Kualiti output: *Quality of outputs*	☐	☐	✓	☐	☐
iii) Kualiti impak: *Quality of impacts*	☐	☐	☐	✓	☐
iv) Pemindahan teknologi/potensi pengkomersialan: *Technology transfer/commercialization potential*	☐	✓	☐	☐	☐
v) Kualiti dan usahasama : *Quality and intensity of collaboration*	☐	☐	✓	☐	☐
vi) Penilaian kepentingan secara keseluruhan: *Overall assessment of benefits*	☐	☐	☐	✓	☐

6. Abstrak Penyelidikan
(Perlu disediakan di antara 100 - 200 perkataan di dalam **Bahasa Malaysia dan juga Bahasa Inggeris**. Abstrak ini akan dimuatkan dalam Laporan Tahunan Bahagian Penyelidikan & Inovasi sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti & masyarakat luar).

Abstract of Research
(An abstract of between 100 and 200 words must be prepared in Bahasa Malaysia and in English). This abstract will be included in the Annual Report of the Research and Innovation Section at a later date as a means of presenting the project findings of the researcher/s to the University and the community at large)

ABSTRAK

PENGENALAN

Kajian ini dijalankan untuk melihat keberkesanan symbicort turbuhaler (merupakan gabungan formoterol dan budesonide) sebagai rawatan alternatif untuk serangan akut asma yang ringan dan sederhana.

METODOLOGI

Pesakit yang memenuhi kriteria serangan ringan atau sederhana dan bersetuju menyertai kajian ini dipilih secara rawak untuk menerima rawatan nebulized salbutamol atau symbicort turbuhaler. Bacaaan parameter objektif seperti kadar pernafasan, nilai oksigen dalam darah (SPO2), kadar hembusan nafas tertinggi (PEFR) termasuk ukuran hembusan nitrik oksida (FENO) serta parameter subjektif berdasarkan Skala Visual Analog (VAS) dan Skala 5-point Likert untuk tahap kesukaran bernafas sebelum dan selepas penggunaan ubat masing-masing. Pesakit dinilai semula selepas 15 minit pertama untuk mengenalpasti keperluan rawatan susulan.

KEPUTUSAN

Setelah dipilih secara rawak, 17 daripada 32 pesakit dipilih untuk menerima rawatan nebulizer salbutamol dan selebihnya menerima rawatan symbicort. Hasil kajian mendapati kesan perubahan yang diperolehi oleh pesakit yang menerima rawatan symbicort dari segi kadar pernafasan (RR), nilai oksigen dalam darah (SPO2) dan kadar hembusan nafas tertinggi (PEFR) adalah signifikan (p=0.001 untuk RR, p=0.027 untuk SPO2 dan $p<0.001$ untuk PEFR) sebagaimana juga rawatan konvensional nebulizer salbutamol. Apabila dibandingkan purata perbezaan kesan perubahan-perubahan ini diantara kedua-dua kumpulan didapati ia adalah tidak signifikan.

Dari segi parameter subjektif berdasarkan 'Visual Analog Scale' dan 5-point Likert scale' untuk tahap kesukaran bernafas, juga didapati tiada perubahan signifikan antara kedua-dua kumpulan rawatan ini.

KESIMPULAN

Symbicort turbuhaler berpotensi sebagai rawatan alternatif bagi serangan akut ringan dan sederhana teruk pesakit asma kerana terbukti tiada perbezaan yang signifikan bagi kesan perubahan dari segi parameter objektif dan parameter subjektif dengan rawatan nebulised salbutamol untuk 15 minit yang pertama.

ABSTRACT

INTRODUCTION

This study is done to evaluate the effectiveness of symbicort (a combination of formoterol and budesonide) as an alternative reliever in mild to moderate acute axacerbation of bronchial asthma.

METHODOLOGY

Patients who fulfilled the criteria of mild or moderate asthmatic attack and agreed to participate in this study were randomly assigned to either nebulized salbutamol or symbicort turbuhaler as the treatment. Objective and clinical parameters such as respiratory rate (RR), oxygen saturation (SPO2), peak expiratory flow rate (PEFR) and fraction of exhale nitric oxide (FENO) were recorded before and after treatment. Subjective assessment using visual analog score and 5-point Likert scale were also taken. The patients were reassessed 15 minutes later for need of further treatment.

RESULTS

After randomization, 17 out of 32 patients were chosen to receive nebulized salbutamol and another 15 patients to receive symbicort. There were significant improvements in respiratory rate (RR), oxygen saturation (SPO2) and PEFR in patients received symbicort turbuhler (p=0.001, p=0.027 and p=*<0.001* respectively). This result is significant in patients receiving nebulized salbutamol as well. When compared between these two groups, no significant difference was demonstrated.

In terms of subjective parameters using 'Visual Analog Score' and '5-point Likert Scale' of breathlessness, it also showed that there were no significant difference in patients who received symbicort turbuhaler or nebulized salbutamol.

CONCLUSION

Symbicort has the potential to be used as an alternative treatment for patients with mild to moderate exacerbation of asthma as there were no significant difference in terms of objective and subjective improvements at least for the first 15 minutes.

7. Sila sediakan laporan teknikal lengkap yang menerangkan keseluruhan projek ini.
[Sila gunakan kertas berasingan]
Applicant are required to prepare a Comprehensive Technical Report explaning the project. (This report must be appended separately)

TECHNICAL REPORT

This study was completed well ahead of the stipulated time (of March 2013). Generally we were able achieve all objectives set out at the beginning of the study. However, the number of subjects we were able to recruit was far fewer than expected from sample size calculation. We expected about 60 to 70 patients but only able to recruit 32 patients due to the stringent inclusion criteria whereby patients who had not been started on symbicort could be recruited into the study.

Furthermore, the performance of nitrix oxide test kits (NIOX MINO) which is the most expensive component in our budget did not turn to be as we expected. NIOX MINO is much more difficult to use and non-user friendly, requiring a lot of coordinated effort. The results were not that reliable and promising as well.

Other than that, the study went on well. WE managed to publish one paper (in Int J of Emerg Med, as attached) and another paper has been submitted and is under review at the moment. We have presented three free papers presentation in the Singapore Society of Emergency Medicine Annual Scientific Conference 2012 (attached).

To minimize biases and conflict of interest, although symbicort is a proprietary drug of AstraZeneca (Malaysia), we did not receive any support from AstraZeneca (Malaysia) except for the dummy turbuhalers which are needed in order for us to teach the patients.

Overall, the study went well and we were happy to be able to finish the study off well ahead of time, sufficient time, not only for one of our co-investigators (Dr. Hamizah's) dissertation submission on this topic, but managed to, just in time, publish a paper before her final examination.

We thank Universiti Sains Malaysia for this grant support for the project.

Prepared by:
Dr. Chew Keng Sheng

On behalf of:
Dr. Hamizah Kamarudin
Dr. Che' Wan Aminuddin Bin Hashim

Senaraikan kata kunci yang mencerminkan penyelidikan anda:
List the key words that reflects your research:

Keywords (English):
Asthma
budesonide
formoterol
salbutamol
nitrix oxide

Keywords (Bahasa Malaysia):
Asma
budesonide
formoterol
salbutamol
nitrik oxida

8. Output dan Faedah Projek
Output and Benefits of Project

(a) * Penerbitan Jurnal
Publication of Journals

As mentioned, one manuscript has been published and another is under review in Medical Journal of Malaysia.

Citation of published article:
Chew, K. S., Kamarudin, H. & Hashim, C. W. A Randomized Open-Label Trial On The Use Of Budesonide/Formoterol (Symbicort(R)) As An Alternative Reliever Medication For Mild To Moderate Asthmatic Attacks. Int J Emerg Med, 5(1), 16.

(b) Faedah-faedah lain seperti perkembangan produk, pengkomersialan produk/pendaftaran paten atau impak kepada dasar dan masyarakat.
State other benefits such as product development, product commercialisation/patent registration or impact on source and society.

Impact to society:
This study has shown that symbicort has the potential to be used as an alternative reliever for mild to moderate asthmatic attacks and thereby avoiding or minimizing the need to use nebulized salbutamol which is a risk to spread air-borne respiratory infections via the exhaled droplets. This risk, which is inherent to the aerosolization mechanism of nebulization, can be substantial in epidermics and pandemics situations such as the recent H1N1 infections.

Latihan Sumber Manusia

Training in Human Resources

i) Pelajar Sarjana:
Graduates Students
(Perincikan nama, ijazah dan status)
(Provide names, degrees and status)

This study has provided the opportunity for Dr. Hamizah Kamarudin to complete her dissertation which is a parital fulfillment of her Master of Medicine (Emergency Medicine) degree.

ii) Lain-lain:
Others

None

Peralatan yang Telah Dibeli:
Equipment that has been purchased

None

Komen Jawatankuasa Penyelidikan Pusat Pengajian/Pusat
Comments by the Research Committees of Schools/Centres

This project was been completed successfully and all objectives achieved.
The output include one publication in International J. of Emergency Medicine 2012.
This report was been assessed by an independent assessor and approved by PTJ PPD committee.

oral presentation abstracts

OP 01

A Randomized Open-Label Trial on the Use of Budesonide/Formoterol (Symbicort®) as an Alternative Reliever Medication for Mild to Moderate Asthmatic Attacks

Dr Chew Keng Sheng

Objectives

Conventionally, a nebulized short acting β2 agonist like salbutamol is used as the reliever in acute exacerbations of asthma. Recent worldwide respiratory outbreaks discourage routine use of nebulization. Previous studies show that combined budesonide/formoterol (Symbicort®, AstraZeneca) is effective as both a maintenance and reliever anti-asthmatic medication.

Methods

We performed a randomized, open label study from March until August 2011 to compare the bronchodilatory effects of Symbicort® (160/4.5 mcg per dose) vs. nebulized salbutamol in acute exacerbation of mild to moderate asthmatic attack in an emergency department. Initial objective parameters include the oxygen saturation (SaO2), peak expiratory flow rate (PEFR) and respiratory rate. During clinical reassessment, subjective parameters (Visual Analog Scale (VAS) and 5-point Likert Scale of breathlessness) as well as the second reading of the objective parameters were measured. For the 5-point Likert scale, the patients were asked to describe their symptom relief from "1 – much worse", "2 – a little worse", "3 – no change", "4 – a little better" and "5 – much better".

Results

Out of the 32 patients enrolled, 17 (53%) were randomized to receive nebulized salbutamol and 15 (47%) for Symbicort®. For both arms, by using paired T-test and Wilcoxon Signed Rank tests, it was shown that there were statistically significant improvements in SaO2, PEFR and respiratory rate within the individual treatment groups (pre- vs post treatment) (Table 1). Comparing the effects of Symbicort® vs. nebulized salbutamol, the average improvement of SaO2 was 1% in both treatment arms (p= 0.464); PEFR 78.67 l/min vs. 89.41 l/min respectively (p=0.507) and respiratory rate 2/min vs. 2/min (p=0.890). For subjective evaluation, all patients reported improvement in VAS (average 2.45 cm vs. 2.20 cm) respectively (p=0.765). All patients in both treatment arms reported either "a little better" or "much better" on the 5-point Likert scale, with none reported "no change" or getting worse.

Conclusion

This study suggests that Symbicort® is as effective as nebulized salbutamol as a reliever in emergency department and can be used as an alternative reliever.

Disclosure of Interest

K. S. Chew Grant / Research Support from: The authors received dummy turbuhalers from AstraZeneca (Malaysia) solely for the purpose of patient education. No other financial gain was received from AstraZeneca (Malaysia) in this study. This study is funded by a short term grant from Universiti Sains Malaysia. , H. Kamarudin: None Declared

Keywords

Nebulization, asthma, budesonide, formoterol, salbutamol

OP 02

Bladder Care Protocol Initiated at the Emergency Department for Elderly Patients Presenting with Hip Fractures Reduced Urinary Retention and Urinary Tract Infection

Dr Madeline Phuah

Introduction

This project has indeed been a paradigm shift for the Emergency Department (ED). At present 25% of attendees to the ED are comprised of elders and this trend has been steadily rising over the last ten years. It was timely to think out-of-the-box with regards to conventional ED services and to embark on elder-friendly initiatives to

improve patient outcomes. This fundamental objective enabled us to develop a first-of-its-kind protocol at the ED in collaboration with Geriatric Medicine, Orthopaedic Surgery, Urology and Nursing.

Objective
To evaluate the effectiveness of Bladder care protocol at the ED in elderly presenting with hip fractures in the reduction of pre-operative rates of acute retention of urine (ARU) and urinary tract infection (UTI).

Methods
Inclusion criteria:
1) Age 65 years and above
2) X-ray diagnosis confirmed isolated neck of femur or inter-trochanteric fracture

Exclusion criteria:
1) Existing indwelling urinary catheter
2) Haemodynamic instability
3) Refusal by patient / next-of-kin
This protocol involved skills training of ED nurses in bladder ultrasound techniques. Recruited patients were managed by an emergency physician and an accredited nurse; with regular administration of analgesia and potting of patients performed in accordance to protocol.

Results
There were 169 patients in the historical control group from 1 August to 31 December 2010, and 267 patients in the intervention group from 1 January to 5 June 2011. There was a 20% reduction in the pre-operative rates of ARU. Similarly there was a reduction in UTI rates from 10% in the control versus 3.3% following intervention.

Conclusion
This study demonstrated good outcomes with the reduction in pre-operative rates of acute retention of urine and urinary tract infection in the elderly hip fracture patients. A first-of-its-kind skills training of ED nurses in bladder ultrasound for elderly patients has resulted in improved quality of patient care at the ED and impacted patient care downstream. This model of care can be effectively implemented for other conditions in at risk elderly such as back pain, immobility and stroke.

Keywords
Elderly hip fracture, retention of urine

OP 03
The Feasibility of Initiating "SMART" Therapy for Mild to Moderate Asthma in Emergency Department. Moderate Asthmatic Attacks
Dr Chew Keng Sheng

Objectives
Combined budesonide/formoterol (Symbicort®) has recently been used as a novel approach called Symbicort® as Maintenance and Reliever Therapy (SMART) approach. We attempted to evaluate the use of Symbicort® as an alternative reliever medication for mild to moderate acute exacerbation of asthma attack among adult patients that is admitted in to our Emergency Department (ED), and the subsequent feasibility of initiating SMART approach in ED for patients fit for discharge.

Methods
We performed a randomized, open label study (March until August 2011) comparing the bronchodilatory effects of Symbicort® (160/4.5 mcg per inhalation) vs that of nebulized salbutamol as the initial reliever in acute exacerbation of mild to moderate bronchial asthma. Patients in the Symbicort® arm fit for discharge were initiated on SMART approach with the instruction to take 2 inhalations b.d. regularly with additional inhalations as needed. If a patient takes more than 8 inhalations, he is required to call up the investigator. Otherwise, follow-up dates were given 4 weeks later. During the follow-up, the patients were asked 7 questions to assess their acceptance on the SMART regime: 1) "SMART is easy to understand and use" 2) "SMART simplifies my life as an asthmatic" 3) "My asthma generally better controlled" 4) "More convenience to use: just one inhaler" 5) "I get quick relieve from attacks" 6) "The device is easy to use" 7) "I need fewer times of rescue medication now" on a four-point Likert scale of "highly agree", "agree", "disagree", "highly disagree."

Results
Only 14 out of 32 patients enrolled (43.8%) came back for follow up. Out of these 14, 8 belong to the Symbicort®

arm. When asked regarding their acceptance on the SMART approach, all patients answered either "highly agree" or "agree" for all 7 questions except for question 6 ("the device is easy to use") where 1 patient (12.5%) answered "disagree", 2 (25%) answered "agree" and 5 (62.5%) answered "highly agree".

Conclusion
This study suggests that initiating SMART approach in ED is feasible except that some patients may find technical difficulties with the turbuhaler®.

Disclosure of Interest
K. S. Chew Grant / Research Support from: Short term grant from Universiti Sains Malaysia, H. Kamarudin: None Declared

Keywords
Asthma discharge pharmacotherapy, asthma, emergency visits, budesonide, formoterol.

OP 04
Comparison of Bio-Nanocellulose and Conventional Wound Dressing on Acute Superficial Wound at Sonklanagarind Hospital
Dr Karn Tipsri

Introduction
Abrasion wound is common and associate with trauma. The hospital has a trend to higher rate of wound care. The authors propose that the Bio-nanocellulose is decrease the days to complete healing, infection, pain and cost in an abrasion wound care.

Objective:
This study aims to identify rate of healing, infection, pain and cost of the Bio-nanocellulose wound dressing and compare with the conventional technique in an abrasion wound.

Methods
A prospective study conducted at trauma ward in Songklanagarind hospital enrolled 35 adult patients age over 15 years old who had an abrasion wound and arrived emergency room within 6 hours of injury. And the wound had no sign of infection or dressing wound before arrived at emergency room. The evaluation of rates of healing, infection, pain and cost of the Bio-nanocellulose wound dressing and compare with the conventional technique in an abrasion wound since April 1, 2011 to December 15, 2011.

Results
Of the 35 patients and 120 wounds had conducted in this study, mean age 42 + 16 years old, male 30 patients and female 5 patients. The most common of mechanism of injury is motor vehicle crash 31 patients . The Median of the healing rate in the conventional technique and the Bio-nanocellulose was date of 6th and 5th respectively. The Median of pain score between the conventional technique and the Bio-nanocellulose in date of 3rd was 5 and 2 scores respecteively, and date of 5th was 2 and 0 score respectively.

Conclusion
Bio-nanocellulose technique decreased the day to complete healing, degree of pain, cost and safe to use in abrasion wound care.

Keyword
Abrasion wound, Bio-nanocellulose technique, Conventional technique.

OP 05
Improving the Quality of Cardiopulmonary Resuscitation by Training Dedicated Cardiac Arrest Teams in the Usage of a Mechanical Load-Distributing Device at the Emergency Department.
A/Prof Marcus Ong

Objective
To determine if implementing cardiac arrest teams trained with a sequence protocol in using a load distributing band mechanical CPR device (AutoPulseTM ZOLL), improves the quality of CPR, as determined by the No-Flow Ratio [NFR] in the first 10 minutes of resuscitation. The NFR is a function of compressions to pauses during the CPR cycle.

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K. S. Chew Grant / Research Support from: Short term grant from Universiti Sains Malaysia, H. Kamarudin: None Declared

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A/Prof Marcus Ong

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UNIVERSITI SAINS MALAYSIA

Pusat Pengajian Sains Perubatan
School of Medical Sciences

Pusat Pengajian Sains Perubatan

Kampus Kesihatan
Universiti Sains Malaysia,
16150 Kubang Kerian
Kelantan, Malaysia.
Tel: 609 767 3000
Fax: 609 765 3370
www.medic.usm.my

Tarikh: 5 Jun 2012

Kepada:

Cik Noor Adnie Bajuri
Penolong Pegawai Tadbir
Pejabat Pengurusan dan Kreativiti Penyelidikan (RCMO)
Aras 6, Bangunan Canselori
Universiti Sains Malaysia
11800 Pulau Pinang.

Puan,

LAPORAN AKHIR GERAN PENYELIDIKAN USM JANGKA PENDEK

Tajuk:
A Randomized Controlled Trial On The Use Of Budesonide/Formoterol (Symbicort®) As An Alternative Reliever Medication For Mild To Moderate Asthmatic Attack In Adult Patients In Emergency Department, Hospital Universiti Sains Malaysia

No: Akaun: 304/PPSP/61310047

Tarikh Mula: 1 November 2010
Tarikh Tamat (Berdasarkan kelulusan RCMO): 31 October 2012

Dengan segala hormatnya perkara di atas adalah dirujuk.

Untuk makluman puan, laporan akhir projek penyelidikan jangka pendek yang bertajuk seperti di atas telah dihantar kepada Bahagian Penyelidikan, Pusat Pengajian Sains Perubatan, Kampus Kesihatan USM untuk tindakan selanjutnya.

Sekian, harap maklum.

"BERKHIDMAT UNTUK NEGARA"
"Memastikan Kelestarian Hari Esok"

Chew et al. International Journal of Emergency Medicine 2012, 5:16
http://www.intjem.com/content/5/1/16

International Journal of Emergency Medicine
a SpringerOpen Journal

ORIGINAL RESEARCH Open Access

A randomized open-label trial on the use of budesonide/formoterol (Symbicort®) as an alternative reliever medication for mild to moderate asthmatic attacks

Keng Sheng Chew[1*], Hamizah Kamarudin[1] and Che Wan Hashim[2]

Abstract

Background: Conventionally, a nebulized short-acting β-2 agonist like salbutamol is often used as the reliever in acute exacerbations of asthma. However, recent worldwide respiratory outbreaks discourage routine use of nebulization. Previous studies have shown that combined budesonide/formoterol (Symbicort®, AstraZeneca) is effective as both a maintenance and reliever anti-asthmatic medication.

Methods: We performed a randomized, open-label study from March until August 2011 to compare the bronchodilatory effects of Symbicort® vs. nebulized salbutamol in acute exacerbation of mild to moderate asthmatic attack in an emergency department. Initial objective parameters measured include the oxygen saturation, peak expiratory flow rate (PEFR) and respiratory rate. During clinical reassessment, subjective parameters [i.e., Visual Analog Scale (VAS) and 5-point Likert scale of breathlessness] and the second reading of the objective parameters were measured. For the 5-point Likert scale, the patients were asked to describe their symptom relief as 1, much worse; 2, a little worse; 3, no change; 4, a little better; 5, much better.

Results: Out of the total of 32 patients enrolled, 17 patients (53%) were randomized to receive nebulized salbutamol and 15 (47%) to receive Symbicort®. For both treatment arms, by using paired t- and Wilcoxon signed rank tests, it was shown that there were statistically significant improvements in oxygen saturation, PEFR and respiratory rate within the individual treatment groups (pre- vs. post-treatment). Comparing the effects of Symbicort® vs. nebulized salbutamol, the average improvement of oxygen saturation was 1% in both treatment arms ($p = 0.464$), PEFR 78.67 l/min vs. 89.41 l/min, respectively ($p = 0.507$), and respiratory rate 2/min vs. 2/min ($p = 0.890$). For subjective evaluation, all patients reported improvement in the VAS (average 2.45 cm vs. 2.20 cm), respectively ($p = 0.765$). All patients in both treatment arms reported either "a little better" or "much better" on the 5-point Likert scale, with none reporting "no change" or getting worse.

Conclusion: This study suggests that there is no statistical difference between using Symbicort® vs. nebulized salbutamol as the reliever for the first 15 min post-intervention.

Background

Defined as a chronic inflammatory airway disorder with bronchial hyper-responsiveness to a variety of stimuli, bronchial asthma is often punctuated with recurrent episodes of exacerbations with classical manifestations such as wheezing, breathlessness, chest tightness, and nocturnal or early morning cough. These episodes are usually associated with widespread but variable airflow obstruction within the lung that is often reversible either spontaneously or with treatment [1].

Conventionally, a nebulized short-acting β_2 agonist (SABA) like salbutamol is often used as the reliever in acute exacerbations of asthma. However, the recent worldwide respiratory outbreaks, such as the H1N1

* Correspondence: dksheng74@yahoo.com
[1]Emergency Medicine Department, School of Medical Sciences, Health Campus, Universiti Sains Malaysia, 16150 Kota Bharu, Kelantan, Malaysia
Full list of author information is available at the end of the article