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PharmGenEd™: Bridging the Gap Between Science & Practice

Train-the-Trainer Session
for Asthma

Tuesday, November 2nd, 2010

UNIVERSITY of CALIFORNIA, SAN DIEGO
SKAGGS SCHOOL of PHARMACY
and PHARMACEUTICAL SCIENCES

Disclaimer

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The content is not intended to be a substitute for professional medical advice, diagnosis, or treatment. Patients should seek the advice of their physicians, pharmacists, or other qualified health providers with any questions they may have regarding a medical condition or a medication.

Train-the-Trainer Agenda

1. Introduction
   - Objective of PharmGenEd™ program
   - Shared curriculum and format
   - Introduction of author
2. Review of educational content for selected therapeutic area
3. Future webinar dates
   - Program implementation
   - Other therapeutic areas
4. Contact information
5. Survey instruments
   - Post training survey for trainers
6. Question & Answer (Q & A) session

Overall Objective of PharmGenEd™ Program

- The "Pharmacogenomics Education Program: Bridging the Gap between Science and Practice" (PharmGenEd™) is an evidence-based pharmacogenomics education program designed for pharmacists and physicians, pharmacy and medical students, and other healthcare professionals.
- The overall objective of the PharmGenEd™ program is to increase awareness about current knowledge of the validity and utility of pharmacogenomic tests and the potential implications of benefits and harms from use of the tests.

 5

Shared Curriculum

- Educational Materials (each 1 hour)
  - Asthma
  - Cardiology I (warfarin & statins)
  - Cardiology II (clopidogrel & beta blockers)
  - Concepts and clinical applications
  - Economic issues
  - Oncology I (solid tumors)
  - Oncology II (hematologic malignancies)
  - Psychiatry I (depression)
  - Psychiatry II (antipsychotics)
- Future webinar dates for these sessions will be provided later

 6

Therapeutic Area Discussion

- Format
  - Patient case
  - Gene/Allele of interest
  - Functional effect
  - Population prevalence
  - Clinical relevance (dosing/selection, efficacy, and toxicity)
  - Genomic test and testing recommendation
  - Patient case summary

 7

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 8

Learning Objectives

- Upon completion of this program, participants will be able to:
  - Identify specific drug therapies used in asthma in which pharmacogenomic testing can be applied in the clinical setting
  - Summarize evidence-based recommendations for pharmacogenomic testing
  - Using patient case scenarios, formulate a plan for pharmacogenomics testing based upon available scientific evidence

 9

Presentation Outline

- Select pharmacogenomic effects in patients with asthma
  - β2-agonists
    - Adrenergic beta-2-receptor, surface (ADRB2)
  - Glucocorticoids (GCs)
    - Corticotropin-releasing hormone receptor (CRHR1)
    - Fc fragment of immunoglobulin E, low affinity II (FCER2)
  - Leukotriene modifiers
    - Arachidonate 5-lipoxygenase (ALOX5)

 10

Therapeutic Area Discussion

- Format
  - Patient case
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  - Functional effect
  - Population prevalence
  - Clinical relevance (dosing/selection, efficacy, and toxicity)
  - Genomic test and testing recommendation
  - Patient case summary

 11

Case Presentation

A 49-year-old African-American female presents to the ER with acute shortness of breath. Patient history reveals she had multiple hospitalizations for asthma. She denies non-adherence to her asthma medications. She reports very frequent use of her short-acting β_2-agonist (SABA) (Metzger et al 2008)

Physical examination: BP133/92 mm Hg, HR 137, respiratory rate 24 breaths/min, 81% O2 Sat

Past medical history: asthma, hypertension, community-acquired pneumonia, obstructive sleep apnea, bilateral pulmonary emboli, deep vein thrombosis

Labs: blood glucose 234 mg/dL, calcium 8.2 mg/dL, phosphate 2.2 mg/dL

(Metzger et al 2008)

 12

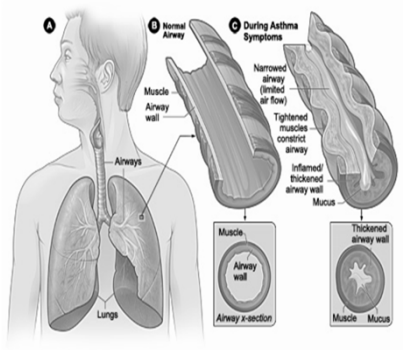
Case Presentation – cont'd

- **Asthma Meds:** albuterol, fluticasone/salmeterol, montelukast, levalbuterol, and ipratropium (doses unknown)
- **Allergies:** NKDA
- **Questions to consider:**
  - Why is the patient not responding to beta agonists?
  - What polymorphisms may impact use of beta agonists?
  - Recommendations for therapy?

(Metzger et al 2008)

 13

Asthma



National Heart, Lung, and Blood Institute, National Institutes of Health, U.S. Department of health and Human Services. Accessed on: October 12, 2010. Available at: http://www.nhlbi.nih.gov/health/dci/Diseases/Asthma/Asthma_WhatIs.html

1) What is Asthma?
- **An inflammatory disease of the airways**

2) Pathophysiology
- **Inflammation**
- **Reversible bronchospasms**
- **Bronchial hyperresponsiveness**
- **Airway remodeling**

3) Signs and symptoms
- **Wheezing, coughing**
- **Bronchoconstriction**
- **Mucus hypersecretion**
- **SOB**
- **Intercostal retractions**

4) Treatment of Asthma?
- **Bronchodilators**
- **Anti-inflammatory**
- **Antibodies**

 14

β2-agonists and *ADRB2*

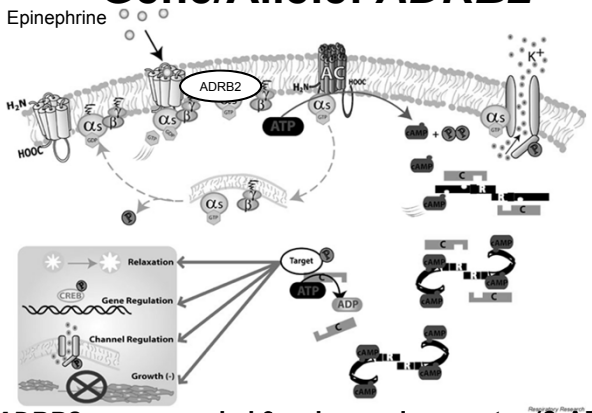
 15

Gene/Allele: *ADRB2*

- **Gene/Allele:** *ADRB2*
- *ADRB2* gene found on chromosome 5q31-33 and encodes β_2-adrenergic receptor (β_2AR) (Caron et al 1988)
  - Region has linkage to asthma and related phenotypes (Postma et al 1995)
- β_2AR is a G-protein coupled receptor (GPCR) (Johnson et al 1998)
  - Gs activation coupled to increased cAMP and bronchodilation
  - Stimulation of β_2AR results in rapid and potent relaxation of airway smooth muscle
- Short- and long-acting β_2-adrenergic agonists target the G-protein coupled β_2AR

 16

Gene/Allele: *ADRB2*



***ADRB2* gene encoded β_2-adrenergic receptor (β_2AR) and its related signaling pathways**

Billington et al 2003 available at: http://respiratory-research.com/content/4/1/2

Gene/Allele: *ADRB2*

- The β2-adrenergic receptor encoded by the *ADRB2* gene is **HIGHLY** polymorphic (Hall 2006)
- Single nucleotide polymorphisms (SNP's) of *ADRB2* most studied *in vitro* or *in vivo* include (Hall 2006):
  - *Arg/Arg*16, *Gln/Gln*27, *Thr/Thr164* are wild type alleles
  - *Arg/Gly*16, *Gln/Glu*27, *Thr/Ile*164 are heterozygote alleles
  - *Gly/Gly*16, *Glu/Glu*27, *Ile/Ile164* are homozygote variant alleles

Functional Effect: *ADRB2*

***ADRB2* alleles**	**Polymorphism allele frequency**	**In vitro effects**	**Functional effects**
*Arg/Arg*16 (wild type)	N/A	~78% reduction in receptor expression with agonist stimulation	Decreased β_2AR agonist-induced down regulation/desensitization
*Gly/Gly*16 (variant)	0.61	~96% reduction in receptor expression with agonist stimulation	Enhanced β_2AR agonist-induced down regulation/desensitization

(Kelly 2005, Liggett 2000, Green et al 1994, Green et al 1995, Green et al 2001, Green et al 1993)

Functional Effect: *ADRB2*

***ADRB2* alleles**	**Polymorphism allele Frequency**	**In vitro effects**	**Functional effects**
*Gln/Gln*27 (wild type)	N/A	~78% reduction in receptor expression with agonist stimulation	Decreased β_2AR agonist-induced down regulation/desensitization
*Glu/Glu*27 (variant)	0.43	~29% reduction in receptor expression with agonist stimulation	Minimal β_2AR agonist-induced down regulation/desensitization
*Thr/Thr*164 (wild type)	N/A	•Enhanced binding affinity of β_2AR agonist •Enhanced Gs-coupling and adenylate cyclase activation	Enhanced β_2AR agonist binding
*Thr/Ille*164 (variant)	0.05	•Decreased binding affinity of β_2AR agonist •Reduced Gs-coupling and adenylate cyclase activation	Decreased β_2AR agonist binding; decreased duration of action of salmeterol

(Kelly 2005, Liggett 2000, Green et al 1994, Green et al 1995, Green et al 2001, Green et al 1993)

Population Prevalence: *ADRB2*

***ADRB2* alleles**	**Caucasian (C)**	**African-American (A-A)**	**Asian (A)**	**Hispanic (H)**
*Arg/Arg*16 (wild type)	11-20%	24-31%	28-35%	18%
*Gly/Gly*16 (variant)	30-53%	22-31%	18-21%	30%
*Gln/Gln*27 (wild type)	24-53%	59-69%	80-90%	64-80%
*Glu/Glu*27 (variant)	12-32%	3-13%	0-0.7%	3%
*Thr/Thr*164 (wild type)	95%	96%	99%	97%
*Thr/Ille*164 (heterozygote variant)	4%	2-4%	0–1%	3%

(Kelly 2005, Hawkins et al 2006, Leineweber et al 2009)

Population Prevalence: *ADRB2*

- Differences exist in allelic frequencies among ethnic groups
- Allelic frequencies for *Arg*16*Gly* and *Gln*27*Glu* are significantly different among groups
- *Arg/Arg*16 polymorphism has an increased occurrence in African-Americans and Asian populations (Taylor 2007)
  - In vivo and clinical studies have focused on this polymorphism
- *Thr/Ille*164 polymorphism has a low frequency among ethnic groups, and the Ile/Ile164 has not been found in an individual to date
  - Polymorphism under evaluation with unknown clinical significance

Taylor 2007; Xie et al 1999

Clinical Relevance: *ADRB2*

- Dosing/selection: No literature, to date, to suggest changes in dosing or selection of beta-2 agonists
- Toxicity: No literature related to *ADRB2* polymorphism and beta-2 agonist side effects

Clinical Relevance: Efficacy/response

Gene/ Allele	**Study Design**	**Conclusions**
Arg/Arg16 *Arg/Gly16* *Gly/Gly16*	Randomized, double blind, placebo controlled, 3-way crossover study of 157 adult patients with mild to moderate asthma. Primary endpoint: Asthma exacerbations, $PEFR_{AM}$	*Arg/Arg16* patients observed increased frequently of major and total asthma exacerbations with albuterol vs placebo (p=0.005). No significant difference in $PEFR_{AM}$ with *Arg/Gly16* and *Gly/Gly16* patients vs. placebo No significant increase in asthma exacerbations with long-acting beta agonist salmeterol

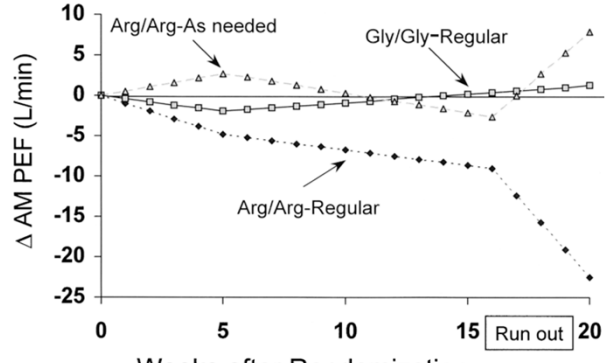
Metzger et al 2008; Taylor et al 2000

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
Arg/Arg16 *Arg/Gly16* *Gly/Gly16* (Israel et al 2000, Drazen et al 1996)	Retrospective study that included 190 adult patients with mild asthma (defined as $FEV_1 \geq$ 70% predicted) who were in a previous randomized, double blind, multicenter study. Primary endpoint: $PEFR_{AM}$	*Arg/Arg16* patients with regular albuterol use had a greater decline in $PEFR_{AM}$ (p=0.012)
Arg/Arg16 *Gly/Gly16* (Israel et al 2004)	BARGE trial was a randomized, placebo controlled, cross over study in 78 adults with mild asthma. Primary endpoint: $PEFR_{AM}$	*Arg/Arg16* patients had decreased $PEFR_{AM}$ (p=0.0209) *Arg/Arg16* negatively affects albuterol use *Gly/Gly16* patients had increased $PEFR_{AM}$ (p=0.0175)

 25

Clinical Relevance*:* Efficacy/response



Regular treatment with albuterol in *Arg/Arg16* patients negatively alters $PEFR_{AM}$

 26

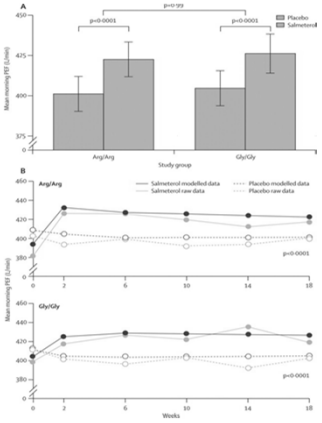
Clinical Relevance: Efficacy/Toxicity

Gene/ Allele	Study Design	Conclusions
Arg/Arg Gly/Gly (Wechsler et al 2009)	Randomized, double-blind, placebo controlled study that included 173 adult patients with moderate asthma (defined as $FEV_1 \geq$ 40% predicted; or ≥ 50% if using regular ICS) to determine whether the response to LABA's plus ICS therapy is genotype specific. Primary endpoint: PEF_{AM}	*Arg/Arg16* and *Gly/Gly16* patients with combination treatment of LABA + ICS improved PEF_{AM} compared to ICS alone. Increased PEF_{AM} was not significant between genotypes (p=0.99) Ethnicity specific difference observed in PEF_{AM} in African-American: *Gly/Gly16* patients showed benefit with treatment (p=0.013) but not *Arg/Arg16 patients* (p=0.57)

Wechsler et al 2009

 27

Clinical Relevance: Efficacy/response



Reprinted from The Lancet, 349, Wechsler ME, et al. Effect of β_2-adrenergic receptor polymorphism on response to longacting β_2 agonist in asthma (LARGE trial): a genotype-stratified, randomised, placebo-controlled, crossover trial, 1754-64, 2010, with permission from Elsevier.

Improvement in lung function with addition of LABA to ICS therapy is independent of genotype Wechsler et al 2009

 28

Clinical Relevance: Toxicity

- Regular use of SABA's have demonstrated adverse treatment effects in Arg/Arg 16 homozygotes
- LARGE trial indicated that lung function is not significantly different between *Arg/Arg16* or *Gly/Gly16* homozygotes when LABA's are added to ICS therapy
  - African-Americans may not benefit from addition of LABA's to ICS therapy

Pharmacogenomic Test and Testing Recommendations

- Genomic Testing
  - β_2AR genotyping: *Arg/Arg*16 confers risk for asthma exacerbations (Kelly 2005)
  - Currently no FDA approved test
- Testing recommendations
  - No recommendation in asthma guidelines for routine use (National Asthma Education and Prevention Program Expert Panel Report 2 2007)
- A pharmacogenetic predictive test is currently under development (Wu et al 2010)

Case Presentation Summary

- Due to patient's asthma history, self-reported adherence, and ethnicity, she was tested for the β_2-adrenoreceptor genotype
  - Genotype indicated she was *Arg/Arg16*
  - Application of the Naranjo probability scale revealed probable causality between uncontrolled asthma in patient and SABA use
- Recommendations for Therapy
  - β_2-Agonists were discontinued
  - Tiotropium for maintenance therapy and ipratropium as primary rescue therapy were initiated
- Patient Outcome:
  - Patient followed in outpatient pulmonary clinic
  - To date, not been admitted to hospital for asthma-related events

(Metzger et al 2008, Small et al 2003; Hall, 2007; Martinez,1997; Israel, 2000)

Inhaled corticosteroids (ICS) and *CRHR1*

Inhaled corticosteroids (ICS)

- ICS are a mainstay of asthma therapy
  - Mechanism of action is via binding to the glucocorticoid (GC) receptor
  - GC-GC dimer functions as transcription factors via activating or repressing gene transcription
    - GCs can inhibit pro-inflammatory gene expression
    - GCs can stimulate anti-inflammatory gene expression
- In asthma ICS pharmacotherapy decreases airway inflammation and airway hyperresponsiveness (AHR)
- ICS resistance has been demonstrated in asthmatics treated with ICSs

(Weiss et al 2006)

Gene/Allele: *CRHR1*

- **Gene/Allele:** Corticotropin-releasing hormone receptor (*CRHR1*)
- *CRHR1* gene found on chromosome 17q21-22 and encodes CRHR (Polymeropoulos et al 1995, Tantisira et al 2004)
- CRHR is a G-protein coupled receptor (GPCR) (Eckart et al 2002, Kageyama et al 2009)
  - Gs activation coupled to adenylate cyclase activation and increased cyclic AMP (cAMP)
  - Endogenous ligand is corticotropin-releasing factor (CRF)
  - CRF stimulates adrenocorticotropic hormone (ACTH) production via CRHR Gs-coupled signaling pathway in HPA-axis
  - ACTH stimulates GC synthesis
- CRHR1 has been shown to be a major regulator of GC synthesis (Weiss et al 2006)

CRHR1

- **Functional Effect**
  - Heterogeneity exists in the response to ICS among asthmatics (Tantisira et al 2004)
  - Identified SNPs associated with *CRHR1* gene in three clinical trial populations
  - Specific *CRHR1* genotypes and haplotypes have been studied:
    - Example 1: rs242941
      - *CRHR1 G/G* (wild type genotype), *CRHR1 G/T* (heterozygous), *CRHR1 T/*T (homozygous variant)
    - Example 2: rs1876828
      - *CRHR1 G/G* (wild type genotype), *CRHR1 A/G* (heterozygous), *CRHR1 A/A* (homozygous variant)

Clinical Relevance: *CRHR1*

- Dosing/selection: No literature related to *CRHR1* polymorphism impacting ICS dosing or selection
- Efficacy/response:
  - Specific variants in the *CRHR1* gene demonstrate enhanced lung function to short-term ICS treatment (Tantisira et al 2004)
  - Decreased lung function associated with *CRHR1* polymorphism during long-term ICS treatment (Rogers et al 2009)
- Toxicity: No literature related to *CRHR1* polymorphism and ICS side effects

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
CRHR1	Evaluated 3 independent studies of mild-moderate asthmatic populations who were on various ICS. Primary endpoint: change in FEV_1 from baseline	Specific genetic variants in the *CRHR1* gene demonstrate enhanced lung function (FEV_1) to **short-term** ICS treatment in childhood and adult asthma (P-values ranged from 0.006 to 0.0.025) Individuals with these variants were more likely to positively respond to ICS therapy

Tantisira et al 2004

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
CRHR1	Evaluated mild to moderate asthmatics in CAMP study for long-term effects of ICS Primary endpoint: change in FEV_1 from baseline; number of asthma exacerbations	*CRHR1* allele variant confers increased risk of poor lung response (FEV_1) during **long-term** ICS treatment (P = 0.05) Patients with these variants had lower bronchodilator response to albuterol during ICS therapy Poor long-term responses to ICS are genetically and phenotypically distinct when outcomes are defined

Rogers et al 2009; Tantisira et al 2004

Pharmacogenomic Test and Testing Recommendations for *CRHR1*

- Genomic Testing
  - Currently no FDA approved test
- Testing recommendations
  - No recommendation in asthma guidelines for routine use (National Asthma Education and Prevention Program Expert Panel Report 2 2007)

Inhaled corticosteroids (ICS) and *FCER2*

FCER2

- Gene/Allele: Fc fragment of immunoglobulin E, low affinity II (*FCER2*)
- Functional Effect and Population Prevalence:
  - *FCER2* encodes for the low affinity IgE receptor
  - Presence of variant confers higher levels of IgE and differential expression of *FCER2* (Tantisira et al 2007)
    - *FCER2 2206TT* (wild type genotype)
    - *FCER2 2206CT* (heterozygous genotype)
    - *FCER2 2206CC* (homozygous genotype)
      - 26% in Caucasians, 44% in African-Americans

Clinical Relevance: *FCER2*

- Dosing/selection: No literature related to *FCER2* polymorphism impacting ICS dosing or selection
- Efficacy/response: Presence of a *FCER2* polymorphism confers an increased risk for severe asthma exacerbations and poor lung function while being treated with ICS (Tantisira, 2007;Rogers, 2009)
- Toxicity: No literature related to *FCER2* polymorphism impacting ICS side effects

Clinical Relevance: Efficacy/response

Alleles	Study Design	Conclusions
FCER2 2206T and 2206C	Randomized, double blind, longitudinal, placebo controlled study in children (5-12 years of age) with mild-moderate asthma. Primary endpoint: Severe asthma exacerbations (ER or hospitalization over 4 years); poor lung function (decline in FEV_1) Secondary endpoint: IgE levels	Patients who are homozygous for the *2206C* variant allele had a significantly greater risk for severe asthma exacerbations while on ICS *2206C* variant allele contributed to both recurrent exacerbations and poor lung function (p=0.046) Presence of the *2206C* variant allele confers higher levels of IgE and differential expression of *FCER2*

Tantisira et al 2007; Rogers et al 2009

Pharmacogenomic Test and Testing Recommendations for *FCER2*

- Genomic Testing
  - Currently no FDA approved test
- Testing recommendations
  - No recommendation in asthma guidelines for routine use (National Asthma Education and Prevention Program Expert Panel Report 2 2007)

Leukotriene modifiers & arachidonate 5-lipoxygenase (ALOX5)

 45

Leukotriene Pathway

- Multiple genes are involved in the leukotriene signaling pathway
- Patients receiving leukotriene modifiers for asthma have a variable response to therapy (Malmstrom et al, 1999)
- Multiple polymorphisms related to the leukotriene pathway genes have been identified
  - *ALOX5, LTA4H, LTC4S, MRP1, CYSLTR2* and *CYSLTR1* (Drazen et al 1999; Lima et al, 2006; Wechsler et al 2002; Telleria et al 2008)
  - Heterogeneity in response to treatment with leukotriene modifiers may be result of genetic variations (Langmack et al 2010)

 46

ALOX5

- Gene/allele: *ALOX5*
- Functional Effect:
  - *ALOX5* encodes for 5-lipoxygenase (5-LO), which is involved in leukotriene synthesis (Hall 2006)
  - Presence of variant confers variability in FEV_1 response when treated with leukotriene modifiers (Currie et al 2003, Drazen et al 1999)
  - Transcription factor binding motif in promoter region of *ALOX5* was analyzed for tandem repeats of the Sp1-binding motif (GGGCGG) (Drazen et al 1999)
  - *ALOX5* SNP's have been analyzed for response to leukotriene modifiers (Fowler 2002; Lima 2006)

 47

ALOX5

- Population Prevalence: (Drazen et al 1999)
  - Transcription factor binding motif in promoter region of *ALOX5* was analyzed for tandem repeats of the binding motif (Sp1 repeats)
  - 5 Sp1 repeats (wild-type allele, 60.2%)
  - 3, 4, or 6 Sp1 repeats (heterozygote allele, 33.8%)
  - Absence of Sp-1 repeats (variant allele, 6%)

 48

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
ALOX5	Randomized, double blind, placebo controlled study in adults with mild-moderate asthma treated with 5-LO inhibitor Additionally, independent studies on *ALOX5* polymorphisms were studied in moderate persistent asthmatics treated with LT-receptor antagonist Primary endpoint: change in FEV_1 from baseline; asthma exacerbations	*ALOX5* variant demonstrated decreased response ($p < 0.05$) Patients with 1 or 2 *ALOX5* wild-type alleles on a LT-receptor antagonist had improved FEV_1 and fewer asthma exacerbations compared to *ALOX5* variant genotype (P=0.0006 and 0.001, respectively) Polymorphisms in *ALOX5* are associated with changes in FEV_1 and asthma exacerbations

Drazen et al 1999; Telleria et al, 2008

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
ALOX5 *MRP1*	Study of poorly controlled mild-to-moderate adult asthmatics treated with LT-receptor antagonist plus theophylline Primary endpoint: change in FEV_1 from baseline; asthma exacerbations	*ALOX5* heterozygous variant carriers had a 73%; reduced risk for asthma exacerbations versus the wild type who had a higher risk ($p<0.045$) *MRP1* heterozygous variant carriers had a 76% reduced risk for asthma exacerbations ($p=0.023$) compared to variants

Drazen et al 1999; Lima et al, 2006; Telleria et al 2008

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
ALOX5 *CYSLTR2*	Data from adolescents and adults with a history of persistent asthma treated with LT-receptor antagonist Primary endpoint: change in FEV_1 from baseline; PEF_{AM}	Changes in FEV_1 and PEF_{AM} associated *ALOX5* ($p=0.01$ and $p=0.01$, respectively) and *CYSLTR2* ($p=0.02$ and $p=0.02$) polymorphisms *ALOX5* and *CYSLTR2* variant alleles had a higher PEF_{AM} response A small subset of the population with *ALOX5* and *CYSLTR2* polymorphisms confers a distinct phenotype whereby they respond positively to leukotriene modifiers

Klotsman et al, 2007

Clinical Relevance: Efficacy/response

Gene/ Allele	Study Design	Conclusions
ALOX5	Study in children with mild or moderate-severe asthma Primary outcome: LTC_4 secretion Secondary outcome: severity of asthma	*ALOX5* variant genotype more likely to have moderate to severe asthma ($p=0.008$) The *ALOX5* genotype predicts asthma severity

Kalayci et al 2006; Lima et al 2006

Clinical Relevance Summary: *ALOX5*

- Heterogeneity in the treatment response to leukotriene modifiers exist
- The heterogeneity may be the result of the combination of polymorphisms in the key genes regulating leukotriene synthesis

Pharmacogenomic Test and Testing Recommendations for *ALOX5*

- Genomic Testing
  - Currently no FDA approved test
- Testing recommendations
  - No recommendation in asthma guidelines for routine use (National Asthma Education and Prevention Program Expert Panel Report 2 2007)

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Future Webinar Dates
(all times are PST)

- **Oncology II: Hematologic Malignancies**
  - Tuesday, Aug. 10, 2010 10am-12pm – COMPLETED
- **Concepts and Clinical Applications**
  - Wednesday, August 11, 2010 – COMPLETED
- **Psychiatry II: Antipsychotics**
  - Tuesday, Aug. 24, 2010 10am – 12pm – COMPLETED
- **Oncology I: Solid Tumors**
  - Thursday, Aug. 26, 2010 10 am – 12 pm – COMPLETED
- **Cardiology I: Warfarin and Statins**
  - Tuesday, Sept. 21, 2010 10am –12 pm – COMPLETED
- **Cardiology II: Clopidogrel and Beta Blockers**
  - Thursday, Sept. 23, 2010 10 am – 12 pm – COMPLETED
- **Economic Issues**
  - Tuesday, Oct. 5, 2010 9:30 am – 11:30 am – COMPLETED
- **Psychiatry I: Depression**
  - Thursday, Oct. 21, 2010 10am – 12pm – COMPLETED

 65

Future Webinar Dates
(all times are PST)

- **Asthma**
  - Tuesday, Nov. 2, 2010 10 am – 12 pm
- **PharmGenEd™ Program Implementation**
  - Thursday, Aug. 12, 2010: 10 am – 12 pm – COMPLETED
  - Thursday, Sept. 9, 2010: 10 am – 12 pm – COMPLETED
- Please register at www.pharmacogenomics.ucsd.edu to download materials prior to the scheduled webinar

 66

Survey Instruments: Evaluation

- Faculty trainers will complete a Post-Training Survey
  - Evaluate knowledge, attitudes, and self-efficacy
- All survey materials will be mailed after completion of all webinars in November 2010

 67

Question and Answer Session

 68