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Using Mobile-Based Technology to Screen for Atrial Fibrillation in India

Apurv Soni
University of Massachusetts Medical School

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Using Mobile-Based Technology to Screen for Atrial Fibrillation in India

Apyur Soni
MD-PhD Candidate
Clinical and Population Health Research
University of Massachusetts Medical School
Disclosure

I have no actual or potential conflict of interest in relation to this presentation
Pathophysiology of Atrial Fibrillation

1) The sinus node, the heart's natural pacemaker, triggers every heart beat by sending an electrical signal...

2) ...to both atria (top chambers of the heart). The Atria contract and pump blood into the ventricles (bottom chambers of the heart).

3) The atrioventricular node is the "gateway" between the atria and ventricles. It controls the flow of electrical signals to the ventricles and can slow down these electrical signals if necessary.

4) The two branches of the bundle of His (special heart muscle cells) help to conduct the electrical signals to the walls of the ventricles.

5) Ventricles contract.

When the heart beats in a normal rhythm (known as 'sinus rhythm'), blood flows freely through its chambers.
Pathophysiology of Atrial Fibrillation

Risk Factors:
- Increasing age
- Hypertension
- Diabetes
- Valvular disease
- Previous MI
- Heart surgery
- Thyroid problems
- Sleep apnea
- Alcohol use
- Genetic disposition
Pathophysiology of Atrial Fibrillation

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When the heart beats in a normal rhythm (known as 'sinus rhythm'), blood flows freely through its chambers.

All the complexes are roughly the same distance apart.

Irregular distances between complexes
No obvious P-waves seen

Atrial Fibrillation

1) The sinus node, the heart's natural pacemaker, triggers every heart beat by sending an electrical signal...
2) ...to both atria (top chambers of the heart). The Atria contract and pump blood into the ventricles (bottom chambers of the heart).
3) The atrioventricular node is the “gateway” between the atria and ventricles. It controls the flow of electrical signals to the ventricles and can slow down these electrical signals if necessary.
4) The two branches of the bundle of His (special heart muscle cells) help to conduct the electrical signals to the walls of the ventricles.
5) Ventricles contract.

When the heart beats in atrial fibrillation (AF), the atria quiver instead of contracting properly. This can cause blood to pool and form a clot.

1) Several electrical signals cross the atria at the same time.
2) Atria (top chambers of the heart) quiver instead of contracting properly.
3) Some electrical signals reach the ventricles through the atrioventricular node.
4) Ventricles contract in an irregular and uncoordinated way.
Progression of Atrial Fibrillation

“Lone” AF

Development of AF risk factors

SR

paroxysmal

persistent

ECV

ECV

AF

remodeling

Progression of AF risk factors

Clinical detection level of AF risk factors

Years

+5

+10

+15

+20

Wyse, 2014, JACC

May 20, 2016  Atrial Fibrillation in Rural India
Atrial Fibrillation: Why do we care?

In the US, the prevalence is projected to be more than doubled by 2050.

Today 5.1m

2050 12.1m

One in four adults aged over 40 develops AF in their lifetime.

Atrial fibrillation and the risk of stroke.

NORMAL HEART

ATRIAL FIBRILLATION

X5 Stroke
Atrial Fibrillation: Why do we care?

- Accounts for one-third of all strokes
- Stroke is often the first “symptom”
- Stroke caused by atrial fibrillation is more debilitating and lethal
Atrial Fibrillation: Why do we care?

- Accounts for one-third of all strokes
- Stroke is often the first “symptom”
- Stroke caused by atrial fibrillation is more debilitating and lethal

Anticoagulation treatment among people with atrial fibrillation can reduce stroke risk by 2/3 and mortality risk by 1/3
Conventional Wisdom about Global Epidemiology of Atrial Fibrillation

Results from “The Lancet Global Burden of Disease Study 2010” – A Systematic Review

Percent deaths attributable to atrial fibrillation and flutter by region, 2010

Chugh, 2014, Circulation
Conventional Wisdom about Global Epidemiology of Atrial Fibrillation

Results from “The Lancet Global Burden of Disease study 2010” – A Systematic Review

Percent deaths attributable to atrial fibrillation and flutter by region, 2010

Requires EKG

- Lack of resources
- Lack of routine EKG testing
- Out of pocket healthcare costs

Chugh, 2014, Circulation
### India: A Perfect Storm for Atrial Fibrillation

**Risk Factors:**
- Increasing Age
- Hypertension
- Diabetes
- Valvular Disease
- Previous MI
- Heart surgery
- Thyroid problems
- Sleep Apnea
- Alcohol
- Genetic disposition

#### Leading causes of death in India and the number of lives lost

<table>
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<th>RANKING</th>
<th>1990</th>
<th>2013</th>
<th>Death (in lakh)</th>
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<td>1</td>
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<tr>
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<td>10</td>
<td>2.38</td>
</tr>
</tbody>
</table>

*Source: Global Burden of Disease Study 2013*
India: A Perfect Storm for Atrial Fibrillation

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- Sleep Apnea

Disability Adjusted Life Years for Rheumatic Heart Disease (WHO 2004)
Burden of Stroke in India

3 Indians suffer a stroke every minute, don’t know it

Size of each country is proportional to number of deaths due to stroke
The paucity of data was particularly striking for India: only one relatively small-scale study qualified for inclusion in this review.”
"The paucity of data was particularly striking for India: only one relatively small-scale study qualified for inclusion in this review."

- 1995 study in a tribal Himalayan village
- Found 0.1% prevalence
  - Single-point screening
  - 94% of participants < 65 years old
The Known Unknown: Atrial Fibrillation Epidemiology in India

“The paucity of data was particularly striking for India: only one relatively small-scale study qualified for inclusion in this review.”

• 1995 study in a tribal Himalayan village
• Found 0.1% prevalence
  • Single-point screening
  • 94% of participants < 65 years old

Barriers:
• Out of pocket healthcare costs
• Lack of routine EKG tests
Overcoming Barriers with Mobile Technology

Letters to the Editor

iPhone ECG application for community screening to detect silent atrial fibrillation: A novel technology to prevent stroke


Original Article

PULSE-SMART: Pulse-Based Arrhythmia Discrimination Using a Novel Smartphone Application

DAVID D. McMANUS M.D., B.O.M., F.H.R.S. 1,2,3,*, JO WOON CHONG PH.D. 2, APURVA SONI B.S. 2, JANE S. SACZYNSKI Ph.D. 1,2,*, NADA ESA M.D. 1, CRAIG NAPOLITANO M.D. 1, CHAD E. DARLING M.D., S.C.M. 4, EDWARD BOYER M.D., Ph.D. 5, ROCHELLE K. ROSEN Ph.D. 5, KEVIN C. FLOYD M.D., M.S., F.H.R.S. 1 and KI H. CHON Ph.D. 5

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Device N Sensitivity Specificity

PULSE-SMART 104 .97 .94
ALIVECOR 204 .98 .97

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Peace of mind in your pocket

FDA-Cleared
Kardia is the most clinically-validated mobile EKG available.

EKG in 30-Seconds
Smaller than a credit card, Kardia allows you to capture a medical-grade EKG in just 30-seconds from anywhere, anytime.

Track and Share
Kardia’s app-based service enables you to proactively care for the health of your heart. Now you can capture reliable heart activity data and relay it to your doctor to inform your diagnosis and treatment plan.
SMART-India Feasibility Study
Smartphone Monitoring for Atrial fibrillation in Real-Time - India

RAHI (pathfinder) - SATHI (partnership): UMMS-CAM collaboration

Randomly recruited 353 participants for the screening study
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Screened participants for five consecutive days using Alivecor and PULSESsmart
• 118 participants did not receive Alivecor screening (device malfunction)

Of the 235 remaining participants
• 85% completed four or more screenings
Randomly recruited 353 participants for the screening study

Screened participants for five consecutive days using Alivecor and PULSESMA RT
• 118 participants did not receive Alivecor screening (device malfunction)

Of the 235 remaining participants
• 85% completed four or more screenings

12 participants screened positive for atrial fibrillation (based on gold-standard of 1-lead EKG reading by a Cardiologist)
• Prevalence: 5.1% (2.7 – 8.7%)

PULSESMA RT app was less accurate in this setting in comparison to our US clinical study (AUC = 0.67 vs 0.90)
SMART-India: Ongoing Activities

Smartphone Monitoring for Atrial fibrillation in Real-Time - India

Recipient of 2016 Office of Global Health Pilot Project Grant

AIM 1: Evaluate the epidemiology of atrial fibrillation in Gujarat, India

- Screen 2,000 people from rural and urban regions three times in 1 week
- Obtain age and sex-stratified population level estimates of disease prevalence
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• Follow-up of all participants who screen positive and 20% random sample of those who screen negative
• Echocardiogram and clinical biomarker evaluation
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**AIM 3: Determine the performance of two mobile technologies for community-based atrial fibrillation screening**
- Leverage existing workforce of community health workers
- Modify PULSE-SMART to develop Automated Novel AF Non-invasive Detection (ANAND) App for community-based screening in India*
- Compare performance with gold-standard 12-lead EKG tests

* NIH-R03 and Indian Dept. of Biotechnology Grant in Review
Challenges conventional wisdom that atrial fibrillation is a condition disproportionately affecting individuals in North America, Europe, and other high-income countries
SMART-India: Implications

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Highlights the need for improved surveillance in low and middle-income countries.
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Highlights the need for improved surveillance in low and middle-income countries.
SMART-India: Future Steps

• Implementation of community-based atrial fibrillation screening program using mobile technology
SMART-India: Future Steps

- Implementation of community-based atrial fibrillation screening program using mobile technology
- Guidelines for initiation and monitoring of anticoagulation treatment

India Overview

- Total Population: 1,255,777,000
  - Urban: 31%
  - Rural: 69%

- Active Mobile Subscriptions: 886,300,000
  - Mobile Subscription Penetration: 70%

Mohfw.in | Photocredit: Alan Herzog | DSIM.IN | IMAI, 2014
Parting Thought

“What efforts can we take to ensure that some of these very interesting and practical solutions that we make do not remain inaccessible to the people who need it the most...

Because nothing can be more shameful than to have a solution available in 2016, but only accessible to the people who need it in 2076.”

“What efforts can we take to ensure that some of these very interesting and practical solutions that we make do not remain inaccessible to the people who need it the most...

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