Research News

Creation of the Argentina-Alzheimer's Disease Neuroimaging Initiative

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Abstract

The Alzheimer's Disease Neuroimaging Initiative (ADNI) is a multisite, longitudinal study that assesses clinical, imaging, genetic, and biospecimen biomarkers through the process of normal aging to mild cognitive impairment and dementia. We present the creation of the Argentina-ADNI—the first South American ADNI—and its effort to acquire data comparable with those gathered in other worldwide ADNI centers.
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1. Introduction

In late 2011, the Argentina-Alzheimer's Disease Neuroimaging Initiative (ADNI) was established. The Argentina-ADNI is the first worldwide ADNI center in Latin America [1]. The Institute for Neurological Research, "Fundación para la Lucha contra las Enfermedades Neurológicas de la Infancia (FLENI; [Foundation for the Fight against Neurological Diseases in Childhood], http://www.fleni.org.ar/), in Buenos Aires, is home for the Argentina-ADNI. The ADNI protocol received institutional review board approval at FLENI on February 10, 2011. The Argentina-ADNI became official on October 25, 2011.

2. Structure and design of the study

The methodological organization of the Argentina-ADNI is comparable with other worldwide ADNI programs [2]. The Argentina-ADNI team has been enrolling volunteers, age 55–90 years, for this study since January 2012. Argentina-ADNI participants are monitored for 36 months using the ADNI 2 protocol [3]. Recently (June 2013), we finish recruiting 60 Argentine participants as part of pilot phase, 15 of whom have a current diagnosis of mild Alzheimer's disease (AD) dementia, 30 of whom have mild cognitive impairment (MCI), and 15 control subjects.

All participants are evaluated in a uniform manner at entry and longitudinally thereafter with instruments that include a clinical and neuropsychological test battery, biological fluids collection, and structural, functional, and amyloid neuroimaging.

However, distinct differences to the ADNI are that the neuropsychological test battery includes validated indicators and scales of cognitive reserve for MCI participants; tensor diffusion images and cortical evoked potentials, which are acquired every 12 months; and a determination of the presence of neuroinflammation as a substantial contributor to AD and the role of neurodegeneration (measured by cerebrospinal fluid [CSF] tau) as a cause or consequence of typical amyloid cascade.

All participants have clinical/cognitive assessments and undergo 3.0-T structural magnetic resonance imaging (MRI) and positron emission tomography (PET) at specified intervals. Participants are assessed at 0, 6, 12, and 24 months for 2 years. CSF collection occurs at 0 and 12 months [3,4].

3. Principal investigators team

The Argentina-ADNI is overseen by a management committee. The structural organization of the Argentina-ADNI is comprised of four streams of research (Fig. 1), each of which are directed by a stream leadership group.

4. The Argentina-ADNI clinical stream

The clinical stream is the most important in the flow diagram (Fig. 1). Patients present with self- and/or caregiver-reported memory/behavioral problems, some of whom have mild AD.

To increase recruitment, several activities were carried out to foster awareness of prodromal AD, such as talks in scientific forums, consulting for memory concerns, videotaped interviews, and the use of press ads. Although these activities do not make explicit reference to the study, they have been useful in bringing potential patients to the sites.
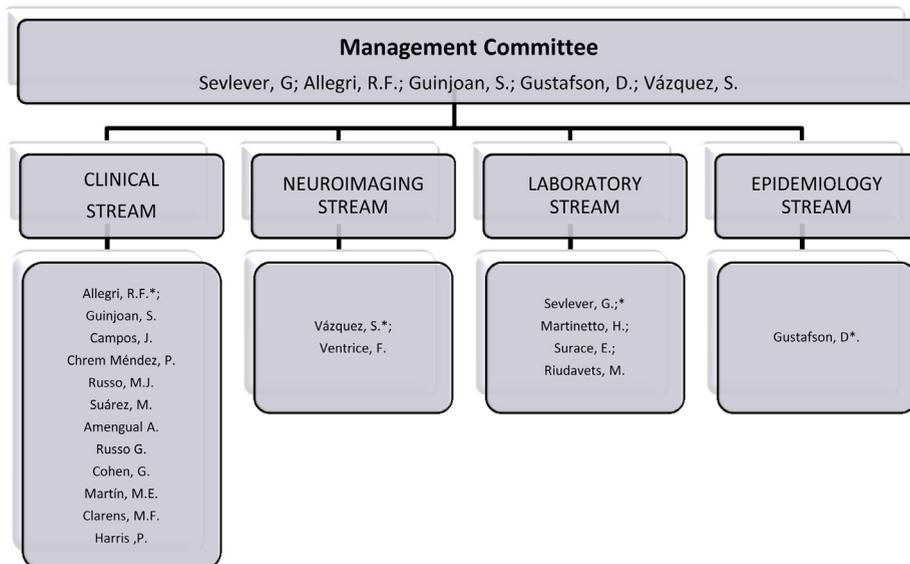
In August 2011, we administered a simplified international survey (adapted from the original) to evaluate the perception and the level of public knowledge of AD, and to ascertain their point of view regarding the value of making an early diagnosis of the disease [5,6]. Results from the survey show that AD was the third biggest health fear after cancer and stroke. More than 90% of the people wanted to know the true diagnosis if they have the disease, and 80% of the people agreed to undergo an ancillary study to confirm the diagnosis. This is a big change in the attitude of Latin American people. This survey was very important in the ethical context linked to the advent of new biomarkers and the possibility of an early diagnosis. We need to consider the proactive opinion of patients in relation to the clinical use of these biomarkers.

The screening visit is the first step in the clinical protocol. Screening consists of explaining the study, acquiring informed consent and demographic information, determining inclusion/exclusion, acquiring a medical history, conducting a physical examination and a neurological examination, administering screening neurocognitive tests, acquiring vital signs, conducting blood sampling for screening laboratory results and apolipoprotein E genotyping, determining current medications and any adverse events, and acquiring a magnetic resonance image. If patients are eligible based on these assessments, they are is asked to participate in a baseline interview, which includes more extensive neurocognitive assessments. All are available in Spanish and are used at FLENI (Table 1 [7–21]). Participants complete the baseline visit by undergoing a lumbar puncture and PET.

5. The Argentina-ADNI neuroimaging stream

The MRI protocol is as described in the *ADNI 3T MRI Technical Procedures Manual* [22]. The FLENI machine is a 3.0-T MRI machine with an eight-channel head coil, and it is located on the FLENI Belgrano campus. A magnetization-prepared 180 degrees radio-frequency pulses and rapid gradient-echo (MP RAGE) and inversion prepared spoiled gradient-recalled-echo (IRSPGR) images is used to measure rate of change and predict future change in MCI and in control subjects. All scans are uploaded to the Laboratory of

Management Committee
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| CLINICAL STREAM | NEUROIMAGING STREAM | LABORATORY STREAM | EPIDEMIOLOGY STREAM |

Allegri, R.F.*;
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* Stream Chair.

Argentina-ADNI, Argentina- Alzheimer's Disease Neuroimaging Initiative.

Fig. 1. Structural organization of Argentina-Alzheimer's Disease Neuroimaging Initiative ADNI. *Stream Chair.

Table 1
Neurocognitive assessments for the Argentina-Alzheimer's Disease
Neuroimaging Initiative

Screening visit
Modified Hachinski Score [7]
Mini-Mental State Examination Test [8]
Logical Memory I and II (Delayed Paragraph Recall) [9]
Spanish Geriatric Depression Scale [10]
Clinical Dementia Rating [11]
Baseline visit
Alzheimer's Disease Assessment Scale Cognitive Subscale [12]
Boston Naming Test [13]
Categorical and Phonological Fluency Test [14]
Clock Drawing Test [16]
Digit Span Test [16]
Rey Auditory Verbal Learning Test [17]
Trail Making Test, parts A and B [18]
Digit Symbol Substitution Test [16]
Functional Activities Questionnaire [19]
Neuropsychiatric Inventory Q [20]
Scale of Cognitive Reserve [21]

Neuro Imaging. In preparation for the ADNI, FLENI completed ADNI Grant Application (ADNI GO) 3-T site qualification and registration with the Laboratory of Neuro Imaging (http://www.loni.ucla.edu/). Site qualification included two different examinations. The first examination was a scan on the specially designed ADNI phantom, with the ADNI GO phantom quality control (QC) sequences loaded at FLENI. This phantom was on order by FLENI through a grant from the U.S. Alzheimer's Association. Second, a human volunteer was scanned with the approved ADNI GO human sequences. Mayo QC reviewed the phantom and human scans for protocol compliance and image quality.

The Pittsburgh compound B PET acquisition protocol is used to evaluate amyloid deposits in the brain. FLENI has a PET-CT 690 from GE, with a Lutetium-based scintillator and 64-slice computed tomography. The cyclotron is the GE PET-trace 6 and the cell is Comecer. The synthesis module is from GE. The PET-CT 690 is located on the FLENI Escobar campus.

Magnetic resonance images and positron emission tomographic scans are also interpreted locally by Dr. Vázquez and a FLENI neuroradiologist team.

6. The Argentina-ADNI laboratory stream

In line with other ADNI studies, Argentina-ADNI collects 12-hour fasting blood samples from all volunteers. The samples are drawn, and whole blood, plasma, and serum are processed and used for immediate routine clinical chemistry analyses or they are stored. Aliquots of blood components are stored in 1.0-mL polypropylene cryovials at $-80°C$. DNA is extracted using the Wizard Genomic DNA Purification kit from Promega. Apolipoprotein E genotyping follows the protocol of Hixson and Vernier [23].

All participants donate a sample of CSF via a lumbar puncture. FLENI runs CSF markers using Innogenetics enzyme-linked immunosorbent assay kits and participates in the ADNI QC program. CSF markers include amyloid-β 1–42, total tau protein, and tau phosphorylated at position threonine 181. The QC program is run by the Clinical Neurochemistry Laboratory at the University of Gothenburg in Sweden in conjunction with the Alzheimer's Association. FLENI is registered as a participant in the QC program, and details are located at: http://www.neurophys.gu.se/sektioner/psykiatri_och_neurokemi/neurokem/TheAlzAssQCProgram/.

FLENI houses the only brain bank in South America (www.fleni.org.ar/contenido1/242/Biobancos). Argentina-

Table 2
Demographic, neuropsychological, and CSF characteristics at baseline

Characteristic	Control, mean ± SD	EMCI, mean ± SD	LMCI, mean ± SD	AD dementia, mean ± SD	ANOVA	*P* value
Age, y	62.38 ± 4.1	67.09 ± 6.1	73.13 ± 7.2	77.00 ± 4.7	8.275	.000
Female, %	60	40	58.3	50		
MMSE score, pt	29.90 ± 0.316	28.87 ± 1.9	27.64 ± 1.7	21.75 ± 2.9	21.576	.000
GDS	1.70 ± 1.7	2.07 ± 1.9	1.73 ± 1.8	1.20 ± 1.0	0.309	.819
WMS III-Delay	8.00 ± 1.9	6.0 ± 1.9	2.09 ± 2.5	0.00 ± 0.00	12.145	.000
Boston Test	28.11 ± 3.3	26.29 ± 2.9	23.40 ± 3.6	22.17 ± 4.8	2.311	.093
Categorical VFT	22.50 ± 3.3	18.85 ± 2.9	17.30 ± 3.6	11.83 ± 4.8	11.615	.000
Letter VFT	18.80 ± 3.8	15.75 ± 6.6	15.40 ± 5.0	13.40 ± 5.4	1.309	.288
RAVLT-Delay	8.60 ± 2.5	4.62 ± 2.9	2.56 ± 2.0	1.00 ± 2.4	14.078	.000
RAVLT-Recog	7.70 ± 6.6	7.62 ± 5.0	4.67 ± 4.7	5.50 ± 4.9	0.746	.532
CSF biomarkers, n	4	8	4	2		
Aβ1–42	758.9 ± 210	943.7 ± 375.2	457.3 ± 48.8	678.9 ± 482.3	2.232	.130
p-Tau	40.3 ± 7.9	45.3 ± 15.1	95 ± 17.5	26.6 ± 2.3	16.420	.000
Tau	213.2 ± 44	205.1 ± 116.9	597.9 ± 67.7	137 ± 52.3	20.036	.000
AD CSF profile	1.5 ± 0.5	2.09 ± 1.09	0.48 ± 0.08	1.7 ± 1.4	3.242	.054

Abbreviations: CSF, cerebrospinal fluid; SD, standard deviation; EMCI, early mild cognitive impairment; LMCI, late mild cognitive impairment; AD, Alzheimer's disease; ANOVA, analysis of variance; MMSE, Mini-Mental State Examination [9]; GDS, Geriatric Depression Scale [11]; WMS III-Delay, Wechsler Memory Scale III delayed [10]; VFT, Verbal Fluency Test [15]; RAVLT-Delay, Rey Auditory Verbal Learning Test delay recall trial; RAVLT-Recog, RAVLT recognition trial (trial VIII) [18]; Aβ, amyloid-β; p-Tau, phosphorylated tau.

ADNI participants are asked to consent to brain donation at the time of death.

7. The Argentina-ADNI epidemiology stream

Data management and dissemination are one of the core areas addressed by the Argentina-ADNI. The epidemiology stream is involved in the planning, implementation, and maintenance of data policies and procedures. Data are not combined with U.S. ADNI, but rather are entered in addition to it, for comparative purposes (documentation available on request). All participants are identified using a unique study identifier. No personal identification information is included. Survey variables are coded responses.

8. Preliminary results

We have 60 participants, of 108 who were screened, who meet ADNI inclusion criteria. We are seeking to recruit and characterize another 100 individuals as part of this cohort, at least 25 of whom have a current diagnosis of mild dementia of the Alzheimer's type, at least 25 healthy control subjects, and at least 50 of whom have MCI and are willing to participate in the 2-year study (Table 2).

9. Conclusions

The Argentina-ADNI is the first worldwide ADNI center in Latin America and the first Hispanic community-dwelling subjects worldwide. The Argentina-ADNI is a growing sample with ongoing recruitment of patients with MCI and mild dementia of the Alzheimer's type, and control subjects. Since its creation, the Argentina-ADNI has established communications among the sites and the various components of the worldwide ADNI to improve the plan for recruitment and retention of subjects; to collect and harmonize clinical, neuropsychological, and biomarker data management; to generate novel hypotheses; and to be part of a naturalistic, multisite, longitudinal worldwide study.

Follow-up of this important sample, particularly related to CSF and brain biomarkers, will allow better characterization of AD in Argentina, and perhaps point to unique environmental factors influencing brain health in South America.

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