Prevalence of infection in prisoners recently vaccinated with a single dose of adenovirus vector ChAdOx1 and in non-vaccinated prisoners during a COVID-19 outbreak

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Summary

Introduction: To determine the prevalence of infection in prisoners recently administered a single dose of Adenovirus vector ChAdOx1 (AVChOx1) and in non-vaccinated prisoners during an outbreak of SARS-CoV-2.
Methods: Observational study carried out at Brians-1 Prison, Barcelona. After detecting a case of infection, rt-PCR was administered to all prisoners (some of whom had been vaccinated 21-23 days previously with a dose of AVChOx1) and to staff. The infection rate in the partially vaccinated and unvaccinated populations was calculated. The number of cases that could have been prevented if all inmates had been partially vaccinated was also estimated.
Results: One hundred and eighty-four asymptomatic prisoners (50.3% partially vaccinated) and 33 staff were screened. Forty-eight (25.9%) infections by the SCV-B.1.17 variant were recorded in prisoners and none in staff. Infection rates were higher in younger prisoners, immigrants, and those admitted ≥7 days previously. In all, 22.6% of vaccinated subjects were infected vs. 29.3% of unvaccinated (p = 0.15). Vaccine effectiveness was 23%. Only 6.2 cases would have been prevented by vaccinating the unvaccinated individuals. At seven days, the rt-PCR was negative in 66.6% of vaccinated subjects vs. 25% of unvaccinated (p = 0.02).
Discussion: In a prison outbreak, a dose of AVChAdOx1 administered 21-23 days earlier did not significantly prevent the occurrence of infections, but did reduce the duration of rt-PCR positivity. Maintaining post-vaccination preventive measures is essential.

Key words:
COVID-19. Infectious disease. Outbreak. Vaccination. Prisons. Public health.

Prevalencia de infección en presos vacunados recientemente con una sola dosis de "adenovirus vector ChAdOx1" y en no vacunados en un brote de COVID-19 en una prisión

Resumen

Introducción: Determinar la prevalencia de infección en presos recientemente vacunados con una sola dosis de "Adenovirus vector ChAdOx1" (AVChOx1) y en no vacunados en un brote de SARS-CoV-2 detectado en una prisión.
Métodos: Estudio observacional realizado en la Prisión de Brians-1, Barcelona. Tras detectar un caso de infección, se estudió mediante rt-PCR a todos los presos (algunos vacunados 21-23 días antes con una dosis de AVChOx1). Se calculó la tasa de infección en la población parcialmente vacunada y en la no vacunada y se estimó el número de casos que hubieran podido evitarse si todos hubieran estado parcialmente vacunados.
Resultados: Se examinaron ciento ochenta y cuatro presos asintomáticos (50,3% parcialmente vacunados). Hubo 48 (25,9%) infecciones por la variante SCV-B.1.17. Las tasas de infección fueron más altas en los más jóvenes, en los inmigrantes y en los ingresados hacía ≥7 días. El 22,6% de los vacunados con 1 dosis se infectaron frente al 29,3% de no vacunados (p = 0.15). Sólo 6, casos en no vacunados se hubieran prevenido con una dosis de vacuna administrada 21-23 días antes. A los siete días, la rt-PCR fue negativa en el 66,6% de los parcialmente vacunados frente al 25% de los no vacunados (p = 0,02).
Discusión: En un brote en prisión, una dosis de AVChAdOx1 administrada 21-23 días antes no previno significativamente la aparición de infecciones, pero redujo la duración de la positividad de rt-PCR. Mantener las medidas de prevención posvacunación es fundamental.

Palabras clave:
COVID-19. Infección. Brote. Vacunación. Prisiones. Salud pública.

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Introduction

In prisons, interpersonal contact and the high density of occupation have favored the transmission of SARS-CoV-2. In fact, only 27 days after the first case detected in a Catalan prison, the first outbreak occurred, affecting 40 inmates, two health workers, and four prison guards[1].

Many guides have been published by national and international agencies regarding the management and control of SARS-CoV-2 infection in prisons. In general, they coincide in terms of the measures and procedures to be used. However, control will only be fully effective when there is high vaccination coverage (this is the case outside prison as well).

The Vaccination Strategy against Covid-19 in Spain[2] made the following recommendations: a) to group and simplify vaccination activities in the prison population; b) to start vaccination as soon as possible, coinciding at least with prioritization group 8 determined by the Expert Committee; and c) to use the vaccine that was best suited to the characteristics of the population of each center[2]. In Catalonia, the vaccination of prison inmates began in February 2021, starting with the most vulnerable groups, who were administered the Pfizer BioNTech vaccine. Subsequently, the recommendations of the COVID-19 Vaccination Technical Working Group were followed. By May 2021, 72.6% of the prison population had received at least one dose of an anti-COVID-19[3] vaccine[3].

The aims of the present study are to describe an outbreak of SARS-CoV-2 detected in a prison, to assess the infection rate observed in partially vaccinated and unvaccinated prisoners, and to estimate the number of cases that could have been avoided if all individuals had received a dose of the adenovirus vector ChAdOx1 (AVChAdOx1) vaccine administered 21-23 days previously.

Material and methods

Observational study of inmates in module 2 (M2) of Brians-1 Prison, Barcelona. Can Brians-1 is a mixed prison, housing both prisoners in custody awaiting trial and convicted inmates, in separate areas. The prison, which has a modular design, has a built area of 61,562 sq.m., with 652 double-occupancy cells and 172 single cells, as well as training rooms, libraries, an assembly hall, occupational workshops, a sports center, recreation areas, a shop and a nursing unit. The distribution allows inmates to pursue cultural, educational, work or sports activities in specifically defined areas[4]. Inmates live in cells for one or two people. Contact with inmates from other modules is possible, but unlikely and very limited in time. The prison population is slightly below 1,000.

On March 16, 2021, a real-time reverse transcription polymerase chain reaction test (rt-PCR) with a sample of nasopharyngeal/oropharyngeal exudate was performed in an asymptomatic M2 inmate. Twenty-one days earlier, along with other inmates, this prisoner had received the first dose of AVChAdOx1 vaccine. The rt-PCR result was positive. The module housing 185 inmates was isolated and all were screened with rt-PCR, as well as staff members who had worked in the prison during the previous seven days, although the interaction of staff with inmates was limited and masks were worn at all times. All the samples were analysed and sequenced using the same method in the laboratory at Bellvitge University Hospital.

The M2 was sequentially disinfected and divided into three independent zones: a) zone "A" for cases with a positive rt-PCR result; b) zone "B" for cases with a negative rt-PCR result but who previously lived with an inmate with a positive result (close contacts); and c) zone "C" for cases with a negative rt-PCR result who had not lived with infected persons. Only essential health workers and security workers were allowed to enter the M2.

Cases with negative rt-PCR were screened at seven days and again in all cases after 14 days of isolation. In the cases with a positive result, the isolation was maintained and weekly rt-PCR was scheduled, adding cycle threshold values in SARS-CoV-2 to rule out cases with residual rt-PCR.

Infection rates in partially vaccinated and non-vaccinated patients, attributable risk (AR) and vaccine effectiveness of a recently administered single dose were calculated, estimating how many unvaccinated individuals would have avoided infection had they been vaccinated.

To calculate the attributable risk (AR), the formula pc–pc/RR was used, in which "pc" is the proportion of patients at a particular level of exposure and "RR" is the relative risk at this level of exposure.

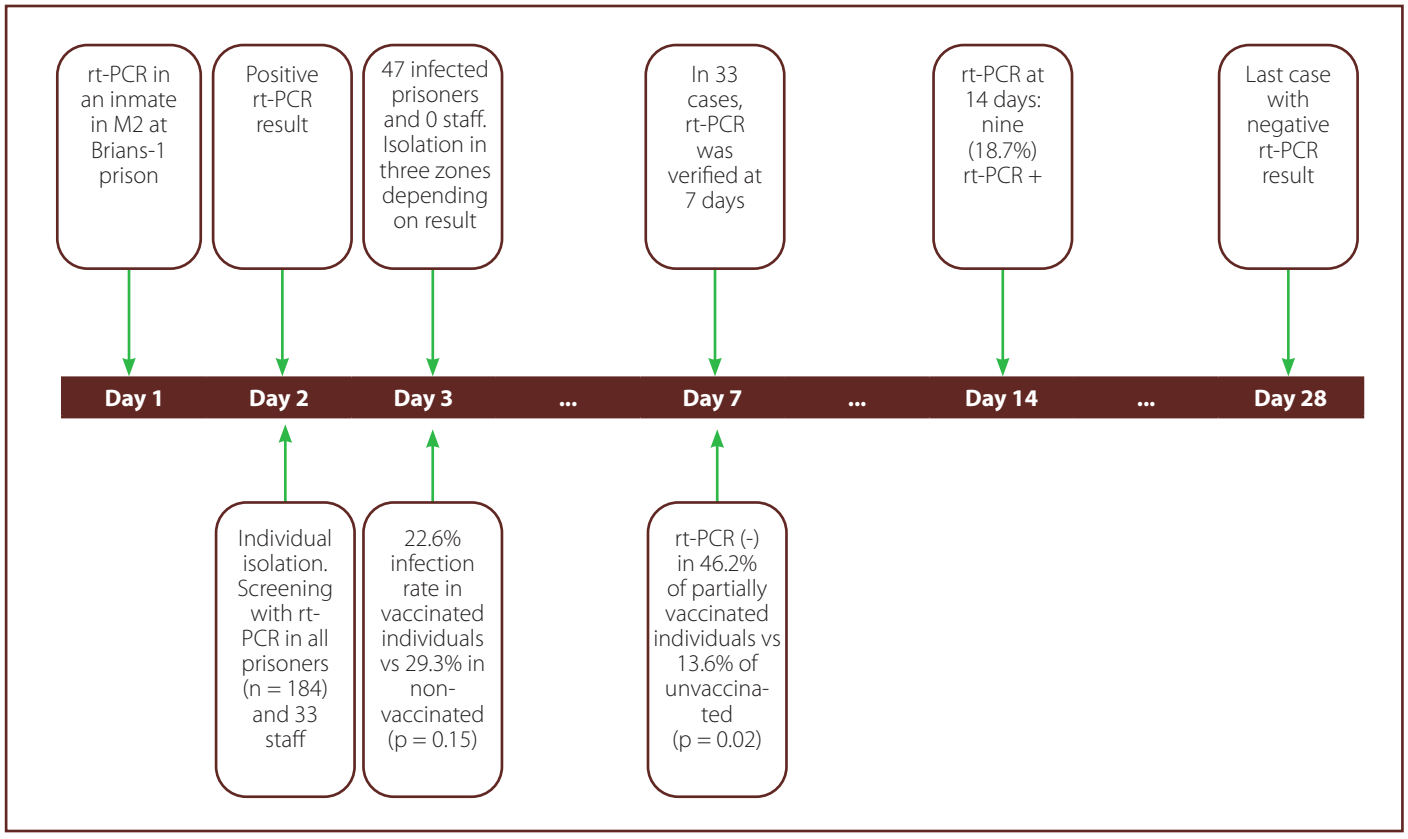
Ethical considerations

This observational study presents the results of the rt-PCR used for screening in accordance with our clinical practice. The tests were not requested for research purposes. However, the patients were informed of the purpose of data collection and their written informed consent was requested. The study was evaluated and approved by the Clinical Research Ethics Committee of the Jordi Gol Foundation (CEI: 21/169-PCV).

Results

After detection of the index case, 184 prisoners and 33 workers were screened within 24 hours (Figure 1). All inmates were male and asymptomatic. Twenty-nine (15.7%) had resided in the

Figure 1. Measures taken and results of the screenings carried out in the inmates of module 2 of Brians-1 prison in Barcelona, from the detection of the first case of infection by SARS-CoV-2 B.1.1.7 variant until the time when the last case presented a negative rt-PCR result.



rt-PCR: real-time PCR. M2: module 2

M2 for <7 days and 156 (84.3%) for ≥7 days. Mean age was 38.6 years (range: 20-62); 29.7% were Spanish and five (2.7%) were HIV-infected.

Ninety-three (50.3%) had received a dose of AVChAdOx1 vaccine 21-23 days previously. Two (1.1%) who had presented COVID-19 in the last three months were not vaccinated, 45 (24.3%) refused vaccination and another 45 (24.3%) were recent admissions who had not yet been vaccinated. Rejection of vaccination was only associated with immigrant status (10.3% non-immigrant vs. 30% immigrant; p = 0.002).

The screening detected another 47 (25.9%) inmates infected with the SCV-B.1.17 variant, but no staff members, who had received a dose of antiCOVID vaccine. Infection was associated with: a) younger age (mean age was 37.8 years in infected subjects vs 41.3 years in non-infected; p = 0.01); b) length of stay in the M2 (one case <7 days vs 47 cases ≥7 days; p = 0.001); and c) immigrant status (31.5% in immigrants *vs.* 12.7% in non-immigrants; p = 0.003).

The rt-PCR was positive in 21 (22.6%) vaccinated subjects and in 27 (29.3%) unvaccinated subjects (p = 0.15). The AR was 6.8, and vaccine effectiveness was 23% (Table 1). According to these data, if the 27 unvaccinated infected subjects had been vaccinated, 6.2 cases would have been avoided.

All patients evolved satisfactorily. The result of the rt-PCR was checked at seven days in 33 cases (Table 2), and was negative in 66.6% of vaccinated subjects vs. 25% of unvaccinated (p = 0.02). Nine patients (18.7%) still had positive rt-CRP at 14 days, and one up to 28 days later.

Discussion

The effectiveness of a dose of AVChAdOx1 vaccine administered 21-23 days previously for preventing new infections was 23%. In these conditions, only 6.2 cases would have been avoided if the unvaccinated subjects had been vaccinated. This low rate may be due to the fact that the vaccine is effective after 10-13 days, but does not achieve maximum protection until some weeks later[5]. In all inmates (or in the vast majority), infection probably occurred in the seven days prior to rt-PCR; that is, between 14

Table 1. Incidence of infection by the variant SARS-CoV-2 B.1.1.7 in partially vaccinated and unvaccinated individuals, attributable risk and vaccine effectiveness of a single dose of adenovirus vector ChAdOx1 vaccine, administered 21-23 days previously, in an outbreak detected in Module 2 of Brians-1 Prison, Barcelona.

Infected/Vaccinated* (Incidence/100)	Infected/Not Vaccinated (Incidence/100)	Infected/Total (Incidence/100)	AR	VE
21/93 (22.6)	27/92 (29.3)	48/185 (25.9)	6.8	23%

(*): Vaccinated with a single dose of ChAdOx1-S (recombinant) 21- 23 days previously.
AR: attributable risk
VE: vaccine effectiveness

Table 2. Results of the rt-PCR carried out in the initial screening and in the cases studied at 7 days.

	Vaccinated* n (%)	Non-vaccinated n (%)	"p" value
Initial rt-PCR	21 (22.6)	27 (29.3)	0.15
rt-PCR after 7 days[1]	6 (66.6)	6 (25.0)	0.02

rt-PCR: real-time PCR.
A single dose administered 21-23 days previously*.
rt-PCR was administered at 7 days in 33 cases: 9 vaccinated with a single dose and 24 not vaccinated[1].

and 21 days post-vaccination, before the vaccine reached maximum effectiveness. Furthermore, this effectiveness was studied in the worst possible conditions: a) in a prison outbreak, in which exposure is likely to be high; and b) with the highly transmissible SARS-CoV-2 variant B.1.1.7, which generated a high percentage of infections among vaccinated inmates. This high infection rate may well have affected the calculation of the vaccine's effectiveness.

The infection rate was 25.9%, which is not high for an outbreak of SARS-CoV-2 B.1.1.7 in prison, this variant is between 43% and 90% more transmissible than the predecessor lineage[6]. The low rate reported is probably due to the reduction of the viral load by vaccination, as observed in the present study and in studies of the AVChAdOx1 vaccine[7,8] and the BNT162b2 mRNA Covid-19 vaccines[9], and also because the rt-PCR becomes negative more quickly in vaccinated individuals. The reduction in viral load is important, since studies with the BNT162-2 mRNA[9,10] and AVChAdOx1 vaccines[7,8] have suggested that it may lead to a reduction in transmission.

Like other vaccines, the AVChAdOx1[5,7,8] vaccine has been shown to prevent symptomatic cases. This may have contributed to the fact that in this outbreak patients were asymptomatic. The absence of symptomatic cases could be due to: a) the low viral load, as suggested above; b) the early detection of infection and the minimization of viral shedding due to the rapid isolation of inmates; and c) the drastic reduction in symptomatic cases, but not asymptomatic cases, achieved by vaccination. This reduction was also found in the study by Voysey *et al*[7], in which protection with one dose in the first 90 days was 76% but protection against asymptomatic infection was only 16%. In fact, those authors doubted whether the vaccine had any impact on asymptomatic infection; they suggested that it might convert severe cases into mild cases and mild cases into asymptomatic ones, without modifying the positivity of the rt-PCR.

It is a matter of concern that 32.6% of inmates who were offered vaccination declined. Rejection was significantly higher in immigrants, especially those who were not legally registered in this country, who tend to have lower education and income levels, variables also associated with greater rejection by Lazarus *et al*[11]. Campaigns to promote vaccination are essential but may be insufficient in places such as prisons, where socio-cultural and religious ties are extremely important. In these cases, in order to increase vaccination coverage, it would be sensible to work together with ethnic, civic and religious leaders, community health agents and other respected inmates in the prison.

These results should be evaluated with care, as this is an observational study carried out at a time when the vaccine may not have reached maximum effectiveness. However, it has the advantage of feasibility, since it was carried out in the context of an outbreak in a closed institution, which made it possible to study all cases in detail.

A vaccine dose has been shown to reduce morbidity and mortality due to COVID-19[5-7,8,10], but protection from asymptomatic infection is more controversial. In our view, two aspects are particularly important: 1. The decrease in the time to positivity of the rt-PCR, which may help to avoid transmission (always an important issue, and especially in closed facilities such as prisons) and also a shorter isolation time in some cases; 2. The fact that a single dose does little to prevent the appearance of asymptomatic cases highlights the need to maintain post-vaccination protection measures, especially if vaccination is not complete.

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