RESEARCH ARTICLE / ARAŞTIRMA

DOI: 10.4274/mjima.galenos.2021.2021.45
Mediterr J Infect Microb Antimicrob 2021;10:45
Erişim: http://dx.doi.org/10.4274/mjima.galenos.2021.2021.45

Can the Problem of Uncontrolled and Unnecessary Tetanus Vaccination of Workers Working in Industrial Workplaces Be Solved?

Sanayi İşyerlerinde Çalışan İşçilerin Kontrolsüz ve Gereksiz Tetanos Aşılanma Sorunu Çözülebilir mi?

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Abstract

Introduction: Since antibodies against tetanus decrease over time and disappear completely, especially in older ages, it is recommended to give tetanus booster every 10 years for adults. However, in some risky occupational groups, tetanus vaccination can be performed more than recommended. In our study, it was aimed to investigate tetanus antitoxin levels, to determine current vaccination histories and tetanus antibody levels by taking blood from workers working in industrial branches.

Materials and Methods: After a face-to-face questionnaire was applied to the volunteers, 6 ml of blood was taken and tetanus antitoxin levels were measured with the micro EIA method (Novum Diagnostica-Germany). The results were classified as <0.01 IU/ml negative, 0.11-0.50 IU/ml very low positive, 0.51-0.99 IU/ml low positive, and >1 IU/ml high positive.

Results: A total of 189 workers, seven of whom were women, between the ages of 24-65 (43.46 standard deviation±8.0) and working in the industry sector, participated in the study. Tetanus antitoxin levels were found to be high positive (>1 IU/ml) in 180 workers (95.2%), low positive in seven workers, very low positive in two workers, and no negative value was found in any of the workers.

Of the workers 118 (61%) had worked in similar jobs before and made two or more workplace changes; 70 workers continued to work in their first workplaces. While 30 workers did not remember tetanus vaccination in the last 10 years, 42 workers stated that they were vaccinated in the last one year, 102 workers in the last 2-5 years, and 15 workers in the last 6-10 years. When the number of tetanus vaccines performed so far were asked, one worker stated that they were vaccinated one time, 25 twice, 31 three times, 12 four times, 13 five times, and 24 six or more times. Seventy seven workers stated that the number of tetanus vaccines they received was too high that they could not remember. Tetanus vaccine of 143 workers (75.7%) was performed in the workplace.

Conclusion: In this study, it was determined that the tetanus vaccine was administered to industrial workers in a much higher number than recommended. It was thought that the reasons for this situation may be the insufficient vaccination records of the workers and the lack of knowledge of the occupational health physicians about the tetanus vaccine. It is seen that the tetanus vaccine practices of workers in the industrial sector should be integrated into the primary health care system, which has an electronic Vaccine Tracking System. Measurement of tetanus antibodies in workers whose vaccination schedule cannot be determined may also be a method that can be used when necessary for preventing unnecessary vaccinations.

Keywords: Tetanus, vaccination, antitoxin level, industry workers

Öz

Giriş: Tetanosa karşı oluşan antikorlar zamanla azalıp kaybolabildiğinden 10 yılda bir tetanos rapeli yapılması önerilmektedir. Ancak bazı meslek gruplarında tetanos aşılaması önerilenden fazla sayıda yapılabilmektedir. Çalışmamızda sanayi iş kollarında çalışan işçilerden kan alınarak tetanos antitoksin düzeylerinin araştırılması, mevcut aşılanma öykülerinin ve tetanos antikor düzeylerinin belirlenmesi amaçlanmıştır.

Cite this article as: Tosun S, Erkan H, Özkan Özdemir H, Arı A, Apak M. Can the Problem of Uncontrolled and Unnecessary Tetanus Vaccination of Workers Working in Industrial Workplaces Be Solved? Mediterr J Infect Microb Antimicrob. 2021;10:45.

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Received/Geliş Tarihi: 16.05.2021 **Accepted/Kabul Tarihi:** 10.08.2021

Presented in: This study was presented as an oral presentation at the 7th Turkey EKMUD International Congress held in Antalya between 8-13 May 2018. Page: 124, oral presentation: SS-186.

Published: 13 August 2021

Gereç ve Yöntem: Yüzyüze anket uygulandıktan sonra gönüllülerden 6 ml kan alınarak mikro EIA yöntemiyle (Novum Diagnostica-Almanya) tetanos antitoksin düzeyleri ölçülmüştür. Sonuçlar; <0,01 IU/ml negatif, 0,11-0,50 IU/ml çok düşük pozitif, 0,51-0,99 IU/ml düşük pozitif, >1 IU/ml yüksek pozitif olarak sınıflandırılmıştır.
Bulgular: Yaşları 24-65 arasında (43,46 standart deviasyon±8,0) ve yedisi kadın olan 189 sanayi işçisi katılmıştır. Tetanos antitoksin düzeyleri, 180 kişide (%95,2) yüksek pozitif (>1 IU/ml), yedi işçide düşük pozitif, iki işçide çok düşük pozitif olarak belirlenmiş, hiçbirinde negatif değer saptanmamıştır. İşçilerin 118'i (%61) daha önce de benzer işlerde çalışmışlar, iki ve daha fazla sayıda iş yeri değişikliği yapmışlardır; 70 işçi ilk işyerlerinde çalışmaya devam etmektedirler. Otuz işçi son 10 yıl içindeki tetanos aşılanma durumlarını hatırlamazken, 42 işçi son bir yıl içinde, 102 işçi son 2-5 yıl içinde, 15 işçi de son 6-10 yıl içinde aşılandığını belirtmiştir. Şimdiye kadar yapılan tetanos aşı sayısı olarak, bir işçi bir kez, 25 işçi iki kez, 31 işçi üç kez, 12 işçi dört kez, 13 işçi beş kez, 24 işçi altı veya daha fazla kez aşılandığını belirtmiştir; 77 işçi ise yapılan tetanos aşı sayılarının hatırlayamadıkları kadar çok olduğunu belirtmiştir. Toplam 143 işçinin (%75,7) tetanos aşısı iş yerinde yapılmıştır.
Sonuç: Sanayi işçilerine tetanos aşısının önerilenden çok fazla sayıda yapıldığı belirlenmiştir. Bunun en önemli nedeni işçilerin aşı kayıtlarının yetersiz/belgesiz olması, bu nedenle iş sağlığı hekimlerinin tekrarlayan aşılamalar yaptırmasıdır. Çözüm için aşı uygulamalarının, elektronik aşı takip sisteminin olduğu birinci basamak sağlık sistemine entegre edilmesi gereklidir. Geçiş döneminde aşı takvimi belirlenemeyen işçilerin tetanos antikorlarının ölçümü de gereksiz aşılamaları önlemek açısından kullanılabilecek bir yöntem olabilir.
Anahtar Kelimeler: Tetanos, aşılama, antitoksin düzeyi, sanayi çalışanları

Introduction

Tetanus is a disease defined in the 5th century BC, and *C. tetani* was isolated in humans for the first time in 1891. In our country, tetanus toxoid was developed in 1927, and tetanus vaccine began to be produced in 1931. The use of diphtheria-pertussis-tetanus triple mixed vaccine was started in 1968 and it became significantly widespread with other national programs carried out following the "Turkey National Vaccination Days" vaccination program started in 1985. Since the risk of tetanus infection is present in birth, expectant mothers are vaccinated during pregnancy and babies are tried to be protected from this infection by including them into the routine vaccination program beginning from the 2nd month following birth. In our country, two more doses of booster are administered in childhood following the combined vaccination (diphtheria-acellular pertussis-tetanus-inactivated polio and *Haemophilus influenzae* type B: DaBT-IPA-Hib) administered to infants at 2, 4, 6 and 18 months within the scope of the national vaccination program. These booster doses were administered as DaBT-IPA in primary school 1st grade and adult type diphtheria-tetanus (Td) vaccination in 8th grade within the scope of school vaccinations until July 1, 2020, now DaBT-IPA is administered at 48th month and Td is administered at age of 13 years by family physicians. Although it has decreased worldwide in recent years thanks to widespread vaccination programs, tetanus which is an infectious disease with a very high mortality rate and continues to be a problem in terms of public health, is almost always seen in unvaccinated or inadequately vaccinated people. Since the antibodies formed with the tetanus vaccine decrease over the years and sometimes disappear completely in advanced ages, it is recommended that adults be given a booster every 10 years. Nowadays, it is preferred that one of the boosters be in the form of adult type diphtheria-tetanus and acellular pertussis vaccine. Adult patients with tetanus are mostly encountered in developed countries today due to decreasing tetanus protection with age[1-8].

Thanks to the Maternal Neonatal Tetanus Elimination Program, which was successfully implemented in our country, a neonatal tetanus elimination certificate was given by World Health Organization in 2009. However, adult patients with tetanus are still encountered in small numbers. When the patients with tetanus reported to the Ministry of Health are examined, the total number of patients encountered between 1980-1984 was 389, 1407 between 1985-1999, 366 between 2000-2009, it decreased to 96 between 2010-2015. There were 16 adult patients with tetanus in 2016, 25 in 2017, 0 in 2018, and 18 in 2019[9]. Therefore, it is necessary to give importance to adult vaccination and it is important to meticulously question and learn the previous vaccination history, as well as age, while planning adult vaccination. However, it is frequently observed that tetanus vaccinations of workers working in industrial sectors in our country are generally performed outside the standard vaccine recommendations and without being bound by any protocol. The aim of this study is to investigate the levels of tetanus antitoxin by collecting blood from volunteers of different age groups working in industrial sectors, to determine whether they need vaccination or how many doses of vaccine they will need, to prevent unnecessary vaccinations, and to ensure that people are followed with vaccination cards and proper records.

Materials and Methods

Patient Selection and Methodology

Following the approval of the Ethics Committee (University of Health Sciences Turkey, İzmir Bozyaka Training and Research Hospital, Clinical Research Ethics Committee, date: 11.10.2017 decision no: 9) a face-to-face questionnaire was applied to the volunteers participating in the study on the working day, their sociodemographic data and previous vaccination status were recorded. Tetanus antitoxin levels were measured using the Novum Diagnostica-Germany method. Tetanus antitoxin

levels and their meanings: Absolute negative result; <0.01 IU/ml (those who need to be vaccinated three doses), low positive result; between 0.11-0.50 IU/ml (requires booster dose and subsequent control), between 0.51-0.99 IU/ml; those who have protection but need a booster within two years, between 1-4.99 IU/ml; those who do not need a vaccine for at least five years, and ≥5 IU/ml; those who do not need a vaccine for at least 10 years.

Statistical Analysis

Statistical analysis was made using IBM Statistical Package for the Social Sciences, version 22.0 package program. Descriptive analysis; mean and standard deviation (SD) were used for continuous variables in descriptive analysis, Pearson chi-square test was used for categorical variables, and statistical significance level was accepted as $p<0.05$.

Results

A total of 189 workers, seven of whom were women, between the ages of 24-65 (43.46 SD±8.0) and working in the industry, participated in the study. In terms of educational status, one of the participants was illiterate, two of them were literate (1.6%); 66 (34.9%) were primary school graduates, 39 (20.6%) were secondary school graduates, 63 (33.4%) were high school graduates, and 18 (9.5%) were university graduates. According to the risk of occupational groups in terms of injury; 90 (48%) of the employees were working in high-risk jobs, 80 (42%) medium- and low-risk jobs, and 19 (10%) were office workers.

When the tetanus antitoxin levels were examined, absolute negativity was not detected in any of the workers, and it was found that 180 participants (95.2%) had very high titers of antitoxin levels (Table 1). Apart from this, very low titer of protection (0.11-0.50 IU/ml) was detected in two workers, and antitoxin levels were found to be protective at low titer (0.51-0.99 IU/ml) in seven workers. Very low positivity was observed in two male participants, aged 50 and 58, and it was learned that these participants had worked in the same workplace for more than 20 years and had their last tetanus vaccination more than five years ago. When these individuals were given a single dose of booster and called for control one month later, the antibody titers in both of them increased ≥1 IU/ml. Antibody levels were found to be low in a total of seven participants, one of whom was female, aged between 38-58 years, and they were recommended to have a booster within two years. The 38-year-old woman in this group never got pregnant and was vaccinated against tetanus only after she started working at the workplace. It was learned that two of the other workers were primary school graduates, two of them had been working in the same workplace for less than one year, two of them for the last five years, and two of them for more than 20 years. Three of seven participants could not remember their last tetanus vaccination date, while the others stated that they were vaccinated more than five years ago. These participants were also offered booster within two years.

Of the employees 118 (61%) had worked in similar jobs before and 14 employees had been doing similar jobs for less than one year, 25 for 1-3 years, 19 for 4-5 years, 17 for 6-10 years, 72 for 11-20 years, and 42 stated that they had been working in the same workplace for 21 years or more. Of the workers 70 (37%) stated that they were still working in their first workplace, 55 (29%) stated that they made two changes, 38 (20%) three changes, 13 (7%) four changes, and 13 (7%) five or more workplace changes. The relationship between working time at the workplace and tetanus antitoxin levels is shown in Table 2. When the participants were asked about their tetanus vaccination status in the last 10 years, 30 stated that they did not remember, 42 stated that they were vaccinated in the last one year, 102 in the last 2-5 years, and 15 in the last 6-10 years.

When asked about the reasons for tetanus vaccination; while 10 participants did not remember, four stated that they were vaccinated as a result of injury in a work accident, 15 due to a sharp object injury caused by a non-occupational accident, and 145 (76.7%) stated that they were vaccinated as a precautionary measure to avoid tetanus in the workplace.

When asked how many doses of tetanus vaccine they received so far, it was learned that most workers were vaccinated both in the last one year, in the last 2-5 years, in the last 6-10 years, and in the previous dates (Table 3). In terms of the number of vaccinations, one participant stated that he was vaccinated once, 25 twice, 31 three times, 12 four times, 13 five times,

Table 1. Distribution of tetanus protection levels of workers in the industrial sector by age groups

Antibody response	Comments and suggestions	25-35 years	36-45 years	46-54 years	>55 years	Total
0.11-0.50 IU/ml	Booster vaccination and control after one month is required	-	-	1	1	2 (1%)
0.51-0.99 IU/ml	Low positive (boost in two years)	-	3	3	1	7 (3.7%)
1-4.99 IU/ml	Strong positive (no booster required for at least five years)	25	73	44	13	155 (82%)
>5 IU/ml	Strong positive	7	12	5	1	25 (13.3%)
Total		32 (17%)	88 (46.5%)	53 (28%)	16 (8.5%)	189

24 six or more times, while 6 stated that they recently got vaccinated in another workplace, but they were vaccinated again when they started working, 77 stated that the number of tetanus vaccinations they received was so high that they could not remember (Table 4).

Ten participants (5.2%) could not remember in where they were vaccinated, one (0.5%) stated that he was vaccinated at the pharmacy, three (1.6%) at the Family Health Center (FHC), 32 (17%) at the hospital, and 143 (75.7%) stated that they were vaccinated at the workplace.

When asked whether they had a vaccination card regarding the tetanus vaccination, only five (3%) stated that they had a vaccination card, 23 stated that they had vaccination cards at any time but lost them, while the others stated that they were not given any vaccination cards.

When the military service status of male participants was questioned, it was learned that six participants did not perform their military service yet, five performed their military service in the last 10 years, and 171 performed their military service 11 years or longer before. Responding to the question "Was tetanus vaccine administered in the military service", 54 of the 174 participants answered "yes", 27 "no", 28 "I was vaccinated but I didn't know what vaccine it was"; 65 stated that they did not remember this information. When the participants were asked whether they had hobbies such as gardening that involved contact with the soil outside of their work, 97 answered "no", 41 "yes", and 51 "sometimes".

Discussion

In various studies conducted in many countries of the world and in our country, it has been reported that the level of tetanus antitoxin decreases with age, especially in people over 50-60 years of age, and sometimes becomes completely negative[10-14]. In a study conducted in six countries in Europe in 2015, it was determined that approximately 25% of individuals over the age of 65 had antibody titers below the protective level[15].

As of 2017, 82 patients with tetanus, 46 of whom were confirmed, were reported in European Union countries, it was determined that the most affected age group was over the age of 65, that women were more affected, and that 54% of the patients originated from Italy and Poland. Therefore, publications on tetanus in the European region are mostly made from these two countries[16].

In a study conducted in Italy between 2011 and 2013, 5,275 construction workers were included and tetanus antibody levels were measured with the EIA. All of the participants were

Table 2. The relationship between the tetanus antibody levels of the workers and the working time at the workplace

Antibody response	0-11 months (n=14)	1-3 years (n=25)	4-5 years (n=19)	6-10 years (n=17)	11-20 years (n=72)	>21 years (n=42)	Total
0.11-0.50 IU/ml	0	0	0	1	0	1	2
0.51-0.99 IU/ml	0	2	1	0	2	2	7
1-4.99 IU/ml	9	20	15	12	62	37	155
>5 IU/ml	5	3	3	5	8	1	25
Total	14	25	19	18	72	41	189

Table 3. Number of tetanus vaccinations administered to workers (n=189)

One vaccine	Two vaccines	Three vaccines	Four vaccines	Five vaccines	Six or more vaccines	Uncountable number of vaccines	Total
7 (3.7%)	24 (12.7%)	34 (18%)	12 (6.3%)	11 (5.8%)	24 (12.7%)	77 (40.7%)	189

Table 4. The relationship between the vaccination numbers of the workers and the antibody titers

Antibody response	One vaccine	Two vaccines	Three vaccines	Four vaccines	Five vaccines	Six or more vaccines	Uncountable number of vaccines	Total
0.11-0.50 IU/ml (booster vaccine and one month later control)	1					1		2
0.51-0.99 IU/ml (low positive-booster recommended within two years)	1	1	1			1	3	7
1-4.99 IU/ml (strong positive-five years no booster required)	5	21	29	8	9	18	65	155
>5 IU/ml (strong positive - no booster for 10 years)		2	4	4	2	4	9	25
Total	7 (3.7%)	24 (12.7%)	34 (18%)	12 (6.3%)	11 (5.8%)	24 (12.7%)	77 (40.7%)	189

male, with an average age of 43, and 11% stated that they had never been vaccinated against tetanus. In the tests performed, the presence of protective antibodies was found in 78% of the participants. It was found that low antibody levels were associated with advanced age, low education level, inability to comply with business rules, and coming from some regions (Egypt, Morocco)[17].

In another study conducted in Northern Italy, a questionnaire was applied to 554 construction workers and their vaccination histories and vaccination certificates were examined, and it was determined that 240 workers (43.3%) did not have any or had very insufficient documents. The mean age of the participants in the study group was 38, the last tetanus vaccination date was before more than 10 years in 184 workers (33.2%), and it was determined that 20 workers did not have primary tetanus vaccination. In the antibody titer evaluation, adequate antibody was detected in 314 workers (41.4%), while antibody levels in 240 workers (31.7%) were below the protective level[18].

In another study conducted in Italy, tetanus vaccination data of 205 construction workers with an average age of 40 were evaluated. It was determined that 90% of the participants had vaccination data, 106 (51.7%) had at least one tetanus vaccine in the last 10 years, and 59 (38.5%) had their last tetanus vaccine more than 10 years ago. As a result, it was emphasized that the tetanus vaccination rates of workers in this sector were insufficient in Italy, since construction workers were required to be vaccinated for tetanus by law since 1963[19].

In our country, some studies were conducted on people at increased risk for tetanus. In a recent study conducted on patients with diabetic foot infection, 91 patients with a mean age of 62 were included and as a result of serological examinations, it was determined that 65 patients (71.4%) did not have protective antibody titers[20].

In a study conducted in Afyonkarahisar in 2002 and investigating tetanus antibodies in marble workers, 76 workers aged between 22-48, 74 of whom were male, were included. Antibodies of blood donors were evaluated as control group. Protective antibody levels were found to be 23.7% in marble workers and 32.3% in the control group. When the relationship between the antibody levels of the participants and the last vaccination date was investigated, the presence of protective antibodies was found in 68.4% of those vaccinated in the last five years, 19.3% of those vaccinated within 6-10 years, and 9.7% of those vaccinated more than 10 years ago[21]. Again, in a study conducted in our country in 2010, the presence of tetanus protective antibodies was detected in 99 (33.9%) of 293 farmers, 55% of whom were female, by EIA method, and it was determined that the two most important factors affecting the antibody response were age and gender[22].

Due to all these and similar studies, tetanus vaccine is administered to workers working in industry, especially in order to protect them from possible injuries, but since the records of the workers are not correct and the concept of adult vaccination card has not yet been established in the society, three doses of tetanus vaccine are administered again at the same workplace or in every job change. It is observed that the vaccine is boosted many times. In fact, since the workers working in this industry are generally in the young or middle age group, it is not necessary to vaccinate them so frequently, and a single dose booster every 10 years is sufficient for adults whose childhood vaccination has been completed. However, since these workers frequently change workplaces and the vaccination card or digital registration system for the vaccinations is not yet sufficient, the workplace managers are afraid to take risks in this regard and administer the tetanus vaccine with repeated doses to the employees. Vaccine Tracking System (VTS) has been used in our country since 2016, this system monitors the temperature and stock of vaccines. At the same time, records of vaccinated persons are also kept electronically. Although information about the past vaccination status of the patients can be obtained by examining the VTS records, it is not possible to reach the vaccination records of the previous years since this system has been in use since 2016. In addition, tetanus vaccine is still freely sold in pharmacies in our country, and it is possible to obtain it in bulk from pharmaceutical warehouses. In such cases, since the VTS registration cannot be made, the vaccination record of the people is not kept in the digital system. If the VTS system is integrated into units such as pharmacies and workplaces where vaccines are administered outside of hospitals, or if vaccination is not allowed in such places (vaccination only in places with VTS system), vaccination records of individuals will be accessible from all over our country and unnecessary vaccinations will be eliminated or will decrease. Administration of vaccines without VTS registration is not suitable as it means that the vaccine does not have a cold chain follow-up. However, in our study, it was determined that 143 (75.7%) of the participants were vaccinated against tetanus at their workplaces. It is known that the situation in the field is similar.

A very high titer of tetanus protection was found in all participants in the study. For this reason, statistical difference analyzes of antibody titers in terms of parameters such as age, education level, working time at the workplace could not be performed. However, it was observed that the antibody titers increased as the number of vaccines increased.

The limitations of our study were as follows; since our study was conducted in İzmir, a province in the western region of our country where sensitivity to vaccines was high, vaccination rates may have been found to be high. In addition, a significant part

of the workers participating in our study consisted of people who worked at the same workplace for many years. If the number of workers who changed their workplaces frequently in our study group were higher, the number of workers who had been vaccinated against tetanus could have been even higher. However, this study is the first study in this context for our country, and we anticipate that it will create a prototype and that this practice will become widespread in many workplaces.

Conclusion

Our suggestions for solving this problem we have identified are as follows:

1) The VTS system should become widespread and all vaccines should be administered through this system.

2) During the transition period, which will last until this practice is fully started, the tetanus vaccination history should be questioned in detail at the time of employment, VTS records should be checked and, if necessary, tetanus vaccination records should be requested from the previous workplace/s.

3) If these are not possible, the tetanus antibody level of the worker to be recruited should be checked and it should be decided whether the worker will be vaccinated or how many doses will be administered according to the result. The examination results of the workers should be written on a vaccination card to be issued and given to the worker by hand, and this data should be used in the workplaces where he/she will go next, by being processed in the personal file of the worker.

4) If tetanus vaccination is required in the workplaces during this transition period, the vaccine should be administered at the Community Health Centers to be determined/assigned for this purpose or at the FHCs to be defined. Thus, unnecessary vaccinations and financial losses will be prevented, and both occupational physicians, occupational safety specialists and employers will feel safer both medically and legally.

Acknowledgement

We would like to thank İzmir Katip Çelebi University Public Health Specialist Dr. Murat Aysin for his statistical analysis support.

Ethics

Ethics Committee Approval: Permission was obtained from the University of Health Sciences Turkey, İzmir Bozyaka Training and Research Hospital, Clinical Research Ethics Committee (date: 11.10.2017, decision no: 9).

Informed Consent: All participants were informed before the study and signed consent forms were obtained from all of them.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: S.T., H.E., M.A., Concept: S.T., H.Ö.Ö., Design: S.T., H.Ö.Ö., A.A., Data Collection or Processing: S.T., H.E., M.A., Analysis or Interpretation: S.T., A.A., M.A., Literature Search: S.T., H.E., H.Ö.Ö., Writing: S.T.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The cost of the trial's test kits was covered by the Adult Vaccination Association.

Kaynaklar

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