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## **Pediatric Eye Injuries by Hydroalcoholic Gel in the Context of the Coronavirus Disease 2019 Pandemic**

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1 **Title : Pediatric eye injuries by hydroalcoholic gel in the context of coronavirus Disease**  
2 **2019 pandemic**

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38 **Key points:**

39 **Question:** Is there an increase in severe ocular lesions related to alcohol-based hand sanitizer  
40 exposures in children since March 2020 ?

41 **Findings:** A national retrospective review from the French Poison Control Centers found a 7-fold  
42 increase of alcohol-based hand sanitizer-related ocular exposures in children in comparison with 2019,  
43 and a pediatric ophthalmology center reported 13% of patients requiring surgery for severe lesions.

44 **Meaning:** These findings support that despite the importance of alcohol-based hand sanitizers for  
45 controlling the spread of COVID-19, these agents should be used with caution, and likely kept away  
46 from young children.

47

48 **Abstract**

49 **Importance:** The COVID-19 pandemic has made alcohol-based hand sanitizers (ABHS) widely  
50 available in public places. This may warrant determining if cases of accidental ocular exposure are  
51 increasing, especially in children. **Objective:** To describe the epidemiological trend of pediatric eye  
52 exposures to ABHS, and to report the severity of the ocular lesions. **Design:** Retrospective case series  
53 from April 1<sup>st</sup> 2020 to August 24<sup>th</sup> 2020. **Setting:** Cases were retrieved from the national database of the  
54 French Poison Control Centers (PCC) and from a pediatric ophthalmology referral hospital in Paris.  
55 **Participants:** Cases of ocular exposure to chemical agents in children under 18 during the study period  
56 were reviewed. Cases of ABHS exposure were included. **Exposures:** The following data were collected:  
57 age, sex, circumstances of exposure, symptoms, size of the epithelial defect at first exam, time between  
58 the accident and re-epithelialization, medical and/or surgical management. **Main outcome and**  
59 **measure:** Comparison of the number of eye exposure to ABHS in children between April-August 2020  
60 and April-August 2019. **Results:** Between April 1<sup>st</sup> and August, 24<sup>th</sup> 2020, there were seven times more  
61 pediatric cases of ABHS eye exposures reported in the PCC database compared to the same period in  
62 2019 (9.9% of pediatric eye exposures in 2020 versus 1.3% in 2019, difference: 8.6% [IC95:7.4;9.9],  
63  $p < 0.0001$ ). The number of cases occurring in public places increased in 2020 (from 16.4% in May to  
64 52.4% in August). Similarly, admissions to our eye hospital for ABHS exposure increased at the same  
65 period (16 children in 2020 including 10 boys, mean age: 3.5 +/- 1.4 years, vs one boy of 16 months of  
66 age in 2019). Eight of them presented with a corneal and/or conjunctival ulcer, involving more than 50%  
67 of the corneal surface for six of them. Two cases required amniotic membrane transplantation.  
68 **Conclusions and Relevance:** These data support the likelihood of an increasing number of accidental  
69 ocular exposures to ABHS in the pediatric population. In order to maintain good public compliance with  
70 hand disinfection, these findings support that health authorities should ensure the safe use of these  
71 devices, and warn the parents and caregivers about their potential danger for children.

72

## 73 **Introduction**

74 Regular hand disinfection with alcohol-based hand sanitizer (ABHS) is one of the main barrier gestures  
75 to limit the spread of COVID-19.<sup>1,2</sup> The recent widespread use of ABHS has been associated with an  
76 increase in accidental exposures since March 2020, especially in children.<sup>3</sup> ABHS can be involved in  
77 eye injuries even though it is not a caustic solution but usually considered as irritant.<sup>3-5</sup> While cases of  
78 ABHS ingestion have been recently reported and detailed<sup>3,6</sup>, data is lacking regarding ABHS-related eye  
79 injuries.

80 Using the French Poison Control Centers (PCCs) database and a case series from a tertiary  
81 ophthalmologic referral center, the aims of this study are to assess the alarming increase in pediatric  
82 cases of ABHS ocular exposure and their circumstances, and to describe the ocular lesions and their  
83 management.

84

## 85 **Methods**

### 86 *National epidemiological data*

87 Cases of ocular exposure to chemical agents in children under 18 were reviewed using data from the  
88 French National Database of Poisonings (FNDP) between April 2020 and August 24<sup>th</sup> 2020, and  
89 between April 2019 and August 24<sup>th</sup> 2019. In France, eight PCCs manage toxic exposures reported by  
90 the public, caregivers and health professionals. Chemical agents are referenced in the national database  
91 of products with compositions, and classified by use. Cases of ocular exposure to ABHS were included  
92 in the study. For each case, the following data were collected: age, sex, circumstances of exposure,  
93 symptoms and severity of the lesion (according to the poisoning severity score<sup>7</sup>).

94

### 95 *Case series*

96 Electronic records of all children under 18 consulting the emergency department of a referral center in  
97 pediatric ophthalmology for ocular exposure to a chemical agent between April 2019 and August 24<sup>th</sup>  
98 2019, and between April 2020 and August 24<sup>th</sup> 2020 were reviewed using the Query® software<sup>8</sup>. Cases  
99 exposed to ABHS were included and the following data were collected: age, sex, context of exposure,

100 size of the epithelial defect at first exam, time between the accident and complete re-epithelialization,  
101 medical and/or surgical management.

102 Both parts of the study followed the tenets of the declaration of Helsinki and the French regulation on  
103 consents and sharing (*Commission Nationale Informatique et Libertés*), and received the approval of  
104 our institutional committee. Statistical analysis was performed with the R software, using Chi<sup>2</sup> test or  
105 Fischer's exact test. Differences are given with a 95% confidence interval (IC95).

106

## 107 **Results**

### 108 *National epidemiological data*

109 Between April 1<sup>st</sup> and August, 24<sup>th</sup> 2020, the proportion of calls to the PCCs related to chemical eye  
110 splatter in children was significantly lower compared to the same period in 2019: 2336 cases (2.2% of  
111 pediatric calls) in 2020 versus 2553 cases (4.2% of pediatric calls) in 2019 (difference:2.0%,  
112 [IC95:1.9;2.2], p<0,0001). The proportion of ABHS eye exposures significantly increased from 1.3%  
113 in 2019 (33 cases, mean age: 3.4 years old +/- 3.8) to 9.9% in 2020 (232 cases, mean age 4.5 years old  
114 +/- 3.5)(difference:8.6% [IC95:7.4;9.9], p<0.0001). The proportion of ABHS eye splatters significantly  
115 increased during the study period from 5% in April 2020 to 9%, 10%, 11% and 15% in May, June, July  
116 and August 2020 (highest p value = 0.02)(Figure 1). Most cases were of null or mild severity (n=269,  
117 97.8%), where the symptoms reported were pain, tingling sensation or conjunctival hyperemia. Six cases  
118 of moderate severity were reported, with limited keratitis.

119 In 2020, 63 cases of ABHS exposure occurred in a public place, while none was reported in 2019. The  
120 locations frequently found were stores and malls (n=47), restaurants (5 cases), open public places (5  
121 cases), sports arena (1 case), movie theater (1 case), swimming pool (1 case), and other in the last 3  
122 cases. Cases of ABHS exposures in public places are continuously increasing, from 5 in May (1.0% of  
123 eye exposure, 12.2% of ABHS), 9 in June (1.8% of eye exposure and 16.4% of ABHS), 16 in July, to  
124 33 in August (up to 24<sup>th</sup>, 8.0% of eye exposure and 52.4% of ABHS). All cases were related to ABHS  
125 devices made available to the public in the context of COVID-19 (automatic or foot-controlled  
126 dispensers).

127

128 **Case series**

129 Between April 1<sup>st</sup> and August, 24<sup>th</sup> 2020, 1657 children were admitted to the ophthalmology emergency  
130 department of our hospital, including 80 (5%) for a chemical eye splatter. During the same time-period  
131 in 2019, 98 cases of eye splatter were registered among 2469 pediatric consultations (4%). There was  
132 no difference between the two periods regarding the proportion of chemical eye exposures among total  
133 pediatric consultations (difference:0.9% [IC95:-0.4;2.1], p=0.18). In 2019, only one boy (16 months  
134 old) was admitted for an exposure to ABHS (1% of chemical eye exposures). Comparatively, 16 cases  
135 of ABHS eye splatter (10 boys, mean age: 3.5 +/- 1.4 years) were admitted in 2020 (20% of chemical  
136 eye exposures)(difference:19% [IC95:8.9;29.1], p<0.0001). Eight children had a corneal and/or  
137 conjunctival ulcer, involving more than 50% of the corneal surface for six of them. Two of these children  
138 (12%) required amniotic membrane transplantation (AMT) under general anesthesia after a median time  
139 of three days of medical treatment, because of delayed re-epithelialization. One case required this  
140 procedure twice because of an incomplete re-epithelialization ten days after the first AMT (Figure 2).  
141 The median time between exposure and complete re-epithelialization for children with corneal ulcers  
142 was 13 days.

143

144 **Discussion**

145 This joint study of ophthalmologists and toxicologists illustrates collateral damages of the wide use of  
146 ABHS during the COVID-19 pandemic and led to a National Public Health alert.<sup>9</sup> Using two  
147 complementary datasets, we showed a 7-fold increase in the number of ABHS eye exposures in children  
148 with several cases of serious corneal lesions, while such exposures were anecdotal before. This increase  
149 was especially noted after the end of the lockdown in France and related to an increasing number of  
150 freely available ABHS devices in public places.

151 The pediatric specificity of this outbreak is most likely due to the emplacement of the gel dispenser in  
152 the proximity of children's faces. Dispensers, often pressure-operated via a pedal, allow the delivery of  
153 unit doses of ABHS. However, these devices are usually around 3-foot high, delivering ABHS at the



154 level of small children's eyes. In addition, the delay in washing the eyes, due to a lack of access to a  
155 water supply or to the viscosity of certain preparations, is very detrimental to the ocular surface.

156 The composition of ABHS is highly variable. Usually, it follows World Health Organization  
157 recommendations and contain 80% ethanol or 75% isopropanol,<sup>10</sup> which are irritating products. Ethanol  
158 is widely used in corneal and refractive surgery to facilitate epithelial debridement. However, the  
159 protocol generally used by ophthalmologists involves a 20% diluted ethanol solution applied for 30  
160 seconds maximum. A study has shown that ethanol not only has an immediate cytotoxic effect on  
161 corneal epithelial cells, but also reduces proliferation and induces apoptosis.<sup>11</sup> Moreover, other irritant  
162 additives, including hydrogen peroxide, polyethylene glycol (to increase viscosity), perfumes or  
163 essential oils may increase the ABHS ocular toxicity.

164 In order to maintain good public compliance with hand disinfection, these findings support that health  
165 authorities should ensure the safe use of ABHS. Caution in positioning the dispensers in public places,  
166 in addition to informative illustrations emphasizing the risk of accidental exposures in children are  
167 required in all countries in order to prevent further severe ocular injury.

168

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204 All of the authors contributed equally to this work.

205 The authors confirm that these patients have not been reported elsewhere.

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217

218

219 Figure 1:

220

221 Title : Proportion of ocular exposures related to ABHS among pediatric chemical eye splatters reported  
222 to the French Poison Control Centers between April 1<sup>st</sup> and August 24<sup>th</sup> 2019 and April 1<sup>st</sup> and August  
223 24<sup>th</sup> 2020.

224

225 Legend : While there were less calls for chemical eye splatters (whole bars) in 2020 compared to 2019,  
226 the proportion of ABHS exposures was more important in 2020 (black shadings).

227

228

229 Figure 2:

230

231 Title: Severe ocular lesions and delayed re-epithelialization following ABHS eye exposure

232

233 Legend:

234 Two days after the accident, pain can be absent and eye redness can be the sole sign of corneal and  
235 conjunctival lesions (a), revealed during ophthalmological examination with fluorescein staining of the  
236 burnt surface (b). Twelve days after the splatter, despite an amniotic membrane transplantation  
237 performed at day 2, the cornea is not completely re-epithelialized (c), requiring another amniotic  
238 membrane suture under general anesthesia.

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