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Long persistence of rigor mortis at constant low temperature

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Abstract

We studied the persistence of rigor mortis by using physical manipulation. We tested the mobility of the knee on 146 corpses kept under refrigeration at Torino's city mortuary at a constant temperature of +4 °C. We found a persistence of complete rigor lasting for 10 days in all the cadavers we kept under observation; and in one case, rigor lasted for 16 days. Between the 11th and the 17th days, a progressively increasing number of corpses showed a change from complete into partial rigor (characterized by partial bending of the articulation). After the 17th day, all the remaining corpses showed partial rigor and in the two cadavers that were kept under observation "à outrance" we found the absolute resolution of rigor mortis occurred on the 28th day.

Our results prove that it is possible to find a persistence of rigor mortis that is much longer than the expected when environmental conditions resemble average outdoor winter temperatures in temperate zones. Therefore, this datum must be considered when a corpse is found in those environmental conditions so that when estimating the time of death, we are not misled by the long persistence of rigor mortis.

Keywords: Rigor mortis; Postmortem interval; Time of death; Environmental temperature

1. Introduction

All main authors state that at room temperature, in normal circumstances, rigor mortis lasts between 2 and 4 days [1–28] and as everyone knows, low temperatures make rigor last longer [4–7,9–14,16–19,25,27–34]. Recent studies concerning this phenomenon were mostly preformed on animals [14,16,17,32], while studies made on humans do not give accurate directions. In particular, there are no systematic studies made on human case histories concerning the duration of rigor at low temperatures. This is probably because only in recent times has it become possible to keep corpses at strict and constant temperatures in modern refrigerators, and also because corpses are usually kept in mortuaries for only a few days.

Our study is about the resolution of rigor mortis in corpses that were kept at a constant low and even temperature, and was made on case histories taken from the city mortuary of Torino (Italy) during 2001–2002.

2. Material studied, methods, techniques

Between November 2001 and December 2002, 541 corpses came into Torino's city mortuary. We rejected the following cadavers:

- that had complete or resolved rigor on first observation;
- that had damaged lower limbs;
- that had bent knees on first observation;
- that had been in the mortuary for less than 3 days;
- infants.

After taking into account the Court's reasons for death, we finally considered 146 corpses, all with variable time since death. All were placed in refrigeration units at a strict and constant temperature of +4 °C. Rigor of the lower limbs was checked daily at 09:00 using the following procedure: with each corpse on its back, the knee was raised by lifting the thigh firmly up, thus testing the mobility of the knee.

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We obtained three different results:

- Complete extension of the articulation (complete rigor or R1).
- Partial bending of the articulation of just a few degrees (partial rigor or R2).
- Complete bending of the articulation, with the leg dropping onto the table (resolution of rigor).

In the considered cases, the observations lasted between 3 and 30 days.

Table 1
Persistence of complete (R1) and partial (R2) rigor mortis in corpses kept at a constant temperature of +4 °C

Days	Total cases	Cases R1 (%)	Cases R2 (%)
3	146	146 (100)	0
4	94	94 (100)	0
5	56	56 (100)	0
6	35	35 (100)	0
7	29	29 (100)	0
8	28	28 (100)	0
9	17	17 (100)	0
10	15	15 (100)	0
11	9	8 (89)	1 (11)
12	9	7 (78)	2 (22)
13	9	6 (67)	3 (33)
14	8	5 (62.5)	3 (37.5)
15	6	2 (33)	4 (67)
16	5	1 (20)	4 (80)
17	5	0	5 (100)
18	3	0	3 (100)
19	2	0	2 (100)
20	2	0	2 (100)
21	2	0	2 (100)
22	2	0	2 (100)
23	2	0	2 (100)
24	2	0	2 (100)
25	2	0	2 (100)
26	2	0	2 (100)
27	2	0	2 (100)
28	2	0	0

This table shows the results of our study. The first column "days" shows the number of days observations were carried out. The second column "total cases" shows the number of cadavers we observed. The third column "cases R1" shows the number of cadavers with complete rigor, showing the approximate percentage in brackets. The fourth and last column "cases R2" shows the number of cadavers with partial rigor. Notice that on the 10th day of observation, all cadavers that remained in the mortuary showed complete rigor. Between the 11th and 17th days, we discovered a change from complete to partial rigor of the corpses still under observation. On the 17th day, the remaining cadavers kept in the same conditions at the mortuary showed partial rigor. Unfortunately, we could only keep two cadavers under observation for as long as we wanted; they both showed absolute resolution of rigor on the 28th day at the constant low temperature of +4 °C.

3. Results

Table 1 shows the results of our study. As can be seen, during the first 10 days of observation, all corpses showed complete rigor (R1). Between the 11th and the 17th days, a progressively increasing number of corpses passed from complete into partial rigor (R2) without any case of resolution. Between the 17th and the 27th days, all corpses showed partial rigor, but still no case of resolution was observed. On the 28th day, the remaining two cadavers displayed complete resolution of rigor mortis.

4. Discussion

The method we chose in testing for rigor is simple and is easy to replicate. Using this method, it is impossible to make a quantitative analysis of the phenomenon of rigor mortis, as described in some literature, but this is the method most commonly used during the routine examination of corpses. We considered the articulation of the knee only because the great majority of cadavers are found with extended lower limbs and also because this position is neither changed during the undressing of the corpse nor later during the post mortem. Considering the results, it is necessary to take into account the fact that observations varied in length of time because the number of cases decreased daily as funeral arrangements were made. In fact, during the first 10 days, we lost the great majority of corpses (137), when still showing complete rigor (R1). Therefore, the exact time of the onset of changes could not be established. Unfortunately, we were able to make longer observations on only a few cases and thus it was impossible to draw statistical conclusions. In spite of these limitations, we obtained results that are interesting for several reasons. Having kept our subjects at an even and constant temperature of +4 °C, which resembles average outdoor winter temperatures in temperate zones, we observed the persistence of complete rigor lasting for at least 10 days, and of partial rigor until the 28th day. All medical authors agree that low temperatures make rigor last longer, but our findings prove a persistence of that phenomenon for even longer than stated (notice, for example, that one of the corpses showed complete rigor for 16 days). This datum deserves great attention because it shows reliably that in wintertime or in other conditions of low environmental temperature, it is possible to find a persistence of rigor of a much longer duration than usually indicated by forensic medical texts. Furthermore, our data is consistent throughout; all the corpses under consideration stayed at the mortuary for at least 3 days and all still showed rigor at the end of the observation period, except the two corpses that we could keep into refrigerators as long as we wanted, until we found out the complete resolution of rigor (on the 28th day). It is evident that this data is very important for the estimation of the time of death. Thus, we believe, it is justified to use our data in the practice of forensic medicine.