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The Lucid Interval of Tsarevich Ivan Ivanovich Could Have Been Due to an Epidural Hematoma

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On November 15, 1581, during a dispute at the Alexandrova Sloboda fortress, Tsar Ivan IV of Russia, Ivan the Terrible, struck his 27-year-old son Ivan Ivanovich on the temple with his scepter (►**Fig. 1**). Boris Godunov, who witnessed the incident, attempted to intervene but himself received blows. The Tsar threw himself upon his son, trying to stop the bleeding, while repeatedly shouting: "Cursed be! I have killed my son!" The young man briefly regained consciousness and is said to have uttered: "I die as a devoted son and the humblest servant." Over the following days, the Tsar prayed for a miracle, but it was in vain, and the tsarevich died 4 days later, on November 19.[1–4]

Since the incident occurred at a time when detailed medical records were scarce, the specific injuries suffered by Ivan Ivanovich were never adequately documented. However, given the severity of the blow and the characteristic symptoms of the lucid interval (LI), it is plausible that he suffered a fatal epidural hematoma (EDH).

The LI is a distinctive feature of peridural hematomas, most notably of EDHs. After head trauma, the victim may experience a brief period of apparent improvement before rapidly deteriorating due to increased intracranial pressure. This phenomenon could have been observed in Ivan Ivanovich after the initial blow before lethal symptoms fully manifested.

Historical emphasis on the LI in cases of EDH made it one of the most remembered signs of the syndrome. It has been taken to mark the time needed for the hematoma to grow to proportions sufficient to produce brain compression and alter consciousness again.[5] Gallagher and Browder in their case series reported that the shortest period of lucidity lasted 10 minutes and the longest 26 days.[5]

James Hill (1703–1763) recorded the first mention of a genuine LI in his book "Cases in Surgery" in 1772. The injury occurred in 1750 from cranial trauma of a girl falling off her horse, after which she walked home, starting with amnesia, progressive headache, and vomiting. Five weeks later, she underwent trephination, where there was no EDH, but partially coagulated blood under the dura mater. Thus, the first recorded case of an LI was associated with a subdural hematoma and not an EDH.[6]

John Abernethy (1764–1831) described a series of 17 cases of traumatic brain injury. Case VII corresponds to a man struck by a crane hook. He felt dazed but then got up and walked home, whereupon losing consciousness, a surgeon was called who treated him surgically, finding a large EDH. This was the first description of an authentic LI in a patient with an EDH.[6]

Much debate has revolved around the pathophysiological mechanisms that may explain this LI after cranial trauma. In 1963, Ford and McLaurin, through experiments in dogs, described crucial findings on dura mater detachment. They established that when an adequate portion of the dura mater is separated from the skull, even in small areas of 6 to 8 mm in diameter, the arterial pressure generated by bleeding from a ruptured middle meningeal artery can further separate the dura mater from the skull. This finding supports the theories of Abernethy and Bell, who postulated that arterial pressure and the initial degree of dura mater detachment are crucial for further separation. Furthermore, the notion that venous bleeding in the epidural space can cause further dura mater detachment is refuted, arguing that venous force is insufficient for this. It is suggested that in nonsurgically treated cases, venous bleeding may fill the cavity created by dura mater separation but not expand its volume. In contrast, in surgically treated cases, once the skull is opened, bleeding resistance is reduced, allowing torn veins to continue bleeding. This analysis underscores the importance of understanding the differences in bleeding dynamics between arterial and venous sources in the context of EDHs and highlights the relevance of

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Fig. 1 Ivan the Terrible and his son. Ilya Repin, 1885. Oil on canvas. Tretyakov Gallery, Moscow, Russia.

experimental studies for understanding pathological processes in the human brain.[7]

Additionally, Ganz and Zwetnow studied the effects of two important factors on epidural bleeding using a porcine model: dura mater separation from the skull and the presence of an epidural arteriovenous fistula. They found that increasing the degree of dura mater separation increased the rate and volume of bleeding, further facilitating dura mater separation. The presence of the fistula reduced epidural pressure but increased bleeding pressure, and although in some cases it decreased the force causing further dura mater separation, it was never enough to prevent it completely. Larger fistulas were associated with a longer bleeding duration. It was concluded that the combination of dura mater separation and epidural fistula can explain the late expansion of an EDH and is consistent with the known variability of clinical EDHs, where the duration of the LI can range from minutes to days.[8]

On the other hand, Habash et al also investigated the probable role of developing an arteriovenous fistula in the genesis of EDH, by injecting water-soluble radiographic contrast medium into the epidural space of dogs during ongoing epidural bleeding. They found that the contrast medium moved from the epidural space through the diploic veins in the cranial bone to the neck veins. This finding suggests that epidural blood drainage through the arteriovenous fistula counteracts the intracranial pressure tamponade observed in intradural bleeds, thus prolonging bleeding. Essentially, these findings support a theory for EDH formation that involves the epidural fistula as a key determinant factor in the clinical outcome of epidural bleeding, including the variability in the time the patient is conscious during this LI, until they fall into coma again.[9]

As mentioned, after receiving the blow to the temple, Ivan Ivanovich falls unconscious, bleeding, and briefly regains consciousness to bid farewell to his father. After this LI, he remains in a coma for 4 days until he passes away. The exact cause of his death has been a subject of controversy for centuries, but suggesting an EDH may be a plausible explanation, considering the analyzed background. This interpretation not only sheds light on an intriguing historical event but also highlights the importance of considering modern medical advances when analyzing events from the past.

Conflict of Interest
None declared.

References

1 Bushkovitch P. Possevino and the death of Tsarevich Ivan Ivanovich. Cah Monde Russe 2014;55(1–2):119–134
2 Wikipedia contributors. Tsarevich Ivan Ivanovich of Russia. Accessed April 4, 2024 at: https://en.wikipedia.org/wiki/Tsarevich_Ivan_Ivanovich_of_Russia
3 Troyat H. Ivan le terrible. Paris: Flammarion; 1993:284
4 Krishnan P, Bhattacharya Ch, Ghosh N. Fatal head injuries in royals that changed the course of history. Indian J Neurotrauma 2022;19(01):54–56
5 Gallagher JP, Browder EJ. Extradural hematoma. Experience with 167 patients. J Neurosurg 1968;29(01):1–12
6 Ganz JC. The lucid interval associated with epidural bleeding: evolving understanding. J Neurosurg 2013;118(04):739–745
7 Ford LE, McLaurin RL. Mechanisms of extradural hematomas. J Neurosurg 1963;20:760–769. Doi: 10.3171/Jns.1963.20.9.0760
8 Ganz JC, Zwetnow NN. Analysis of the dynamics of experimental epidural bleeding in swine. Acta Neurochir (Wien) 1988;95(1-2):72–81
9 Habash AH, Zwetnow NN, Ericson K, Löfgren J. Arterio-venous epidural shunting in epidural bleeding radiological and physiological characteristics. An experimental study in dogs. Acta Neurochir (Wien) 1983;67(3-4):291–313

