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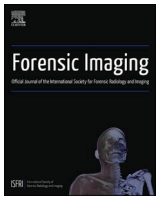

Short communication

Visual note - large vitreous hemorrhage in post mortem imaging

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ABSTRACT

The significance of vitreous hemorrhages detected after death, particularly in non-traumatic cases, currently seems largely unclear. This obscurity might arise partly because these hemorrhages may go undetected, especially when relying solely on traditional methods like external inspection and autopsy. In this case of an 80-year-old woman with a history of arterial hypertension, post mortem computed tomography (PMCT) showed intrabulbar findings indicative of a lateral vitreous haemorrhage of the left eye, which then appeared partly dark on susceptibility weighted post mortem magnetic resonance imaging (PMMRI). PMMRI also identified a dislocated membrane suggestive of retina detachment. Dissection of the enucleated eye revealed a dark red gel-like mass, visually identified as clotted blood, and a retinal tear. The finding is discussed as possible consequence of arterial hypertension. Further investigations into the significance of post-mortem vitreous hemorrhages on imaging are warranted, especially in the context of potential early indicators of acute stroke.

1. Case description

In this case of an 80 year old woman found dead in her locked apartment with a history of arterial hypertension, the externally decomposed appearance of her body motivated the investigating authorities to admit the body to our institute for identification. There, a full body post mortem computed tomography (PMCT) was performed on a dual source/energy computed tomography (CT) scanner (Somatom Definition Flash, Siemens, Erlangen, Germany) (protocols: [1,2]). Software for initial imaging evaluation was syngo.via (Siemens, Erlangen, Germany). As a vitreous hemorrhage was suspected on PMCT, a post mortem magnetic resonance imaging (PMMRI) of the anterior region of the head with the eyes was performed using a 3.0-T magnetic resonance scanner (MRI) (Achieva; Philips Healthcare, Best, The Netherlands) using an eight-channel SENSE-head-coil. The scanning parameters for PMMR included T1-weighted and T2 susceptibility weighted sequences (T1 Inversion Recovery Turbo Spin Echo [TR: 2000 ms; TE: 20 ms]; T2W FFE Haemo [TR: 346.4 ms; TE:16.1 ms]).

See also Fig. 1: Both eyes were shrunken and the corneae were of reduced transparency, presumedly in association with postmortem decomposition. There were no hemorrhages that could be discerned in the sclerae or conjunctivae. A routine PMCT showed a hyperdense lentiform finding in the left eye on its lateral side (see Fig. 1A and B). For better characterization, PMCT was supplemented with PMMRI of the region of the head that included the eyeballs. There, the susceptibility weighted sequence (see Fig. 1C) yielded a very low signal to characterize the PMCT-finding as a hemorrhage. Furthermore, membrane-like structures suggestive of retinal detachment were seen (see Fig. 1C and D). To further verify the imaging findings, the left eye was enucleated; no hemorrhage was visible externally. The eyeball was then carefully transcised. As a result, a ruptured membrane structure suggestive of a detached retina was found after a red elastic mass was very carefully removed from the globe and visually identified as a coagulated hemorrhage. The eye also contained what appeared to be an artificial lens. The PMCT findings were otherwise free of skeletal fractures and relevant hemorrhage elsewhere. Minimal coronary artery and general arterial calcifications were noted. There was no gas inside the skull cavity. The brain contained absent gray and white matter delineation in PMCT and absent delineation of sulci, whereas the lateral ventricles appeared extended as in cerebral atrophy; there was no finding indicative of an ischemic or hemorrhagic infarct. What appeared to be cerebral arteries were hyperdense. With absent focal pathology, also no hemorrhage could be delineated. With that, acute ischemic cerebral infarction was not excluded with certainty.

2. Discussion

Post-mortem computed tomography (PMCT) has emerged as a valuable tool in the medicolegal field, also providing a non-invasive means of detecting findings that are suspicious of hemorrhagic events

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in the eye [3–6]. Easily identifying or even just suspecting such hemorrhages through conventional methods may not always be feasible, particularly in cases of post mortem decomposition with hazy, cloudy or opaque corneae [7]. So far, forensic pathologists had no easy-to-use screening technique to reliably examine intraocular lesions routinely [8]. And so, routine examination of the eyes and consideration of ocular hemorrhages in forensic autopsies so far occurred mainly (if not only) in cases of suspected abusive head trauma [7,9–11].

For imaging of the eyeball or globe, CT and MRI are regarded as complimentary techniques [12]. Thereby, CT provides a clear view of orbital structures due to the natural contrast among bone, soft tissues, air, and fat. It excels in assessing traumatic injuries and detecting foreign substances, especially when MRI is problematic, such as with metallic objects. On the other hand, MRI is important for specific eye conditions whose characterization requires better visualization of subtle soft tissue contrast, particularly in cases of retinal detachments.

However, the detection and diagnosis of vitreous or bulbar hemorrhage post mortem may indicate a traumatic event, but it also may be associated with an underlying relevant pathology. A vitreous hemorrhage may be found in traumatic deaths such as vigorous shaking [13], but also in accidental injuries, after surgery [14], or they may concern medicolegal aspects of traffic medicine [15]. Discriminating traumatic from non-traumatic causes may be challenging in some cases [16]. Their occurrence was furthermore discussed as complication of resuscitation [17,18], however, their detection after resuscitation had not been preceded by proof of absence before resuscitation [17–19]. Spontaneous vitreous hemorrhages are reported to occur with an incidence of around 7 per 100,000 [20]. Retinal tears (30%) and proliferative diabetic retinopathy (32%) are the most frequent causes. Arterial hypertension (as in this instance) is known to entail retinal vasculature changes. Hemorrhage into the vitreous gel may result in rapid clot formation and is followed by slow clearance of approximately 1% per day [20].

Vitreous hemorrhages are described in cases of cerebral aneurysm rupture, but also in acute stroke [21,22]. In that context, it may be relevant to consider that early brain findings of acute stroke may be apparent on MRI as early as one hour after the event in some cases, but to capture all or almost all patients, a survival of two to three hours after an acute stroke may be necessary before an acute stroke can be reliably detected on MRI [23,24]. After death, earliest histopathologic changes are described to be visible 20 min after a stroke [25].

The importance of understanding ocular hemorrhages becomes even more important during post-mortem examinations, particularly when differentiating between intravital hemorrhage and postmortem hemorrhage [26]. In this case, there were no hemorrhages in the sclera or

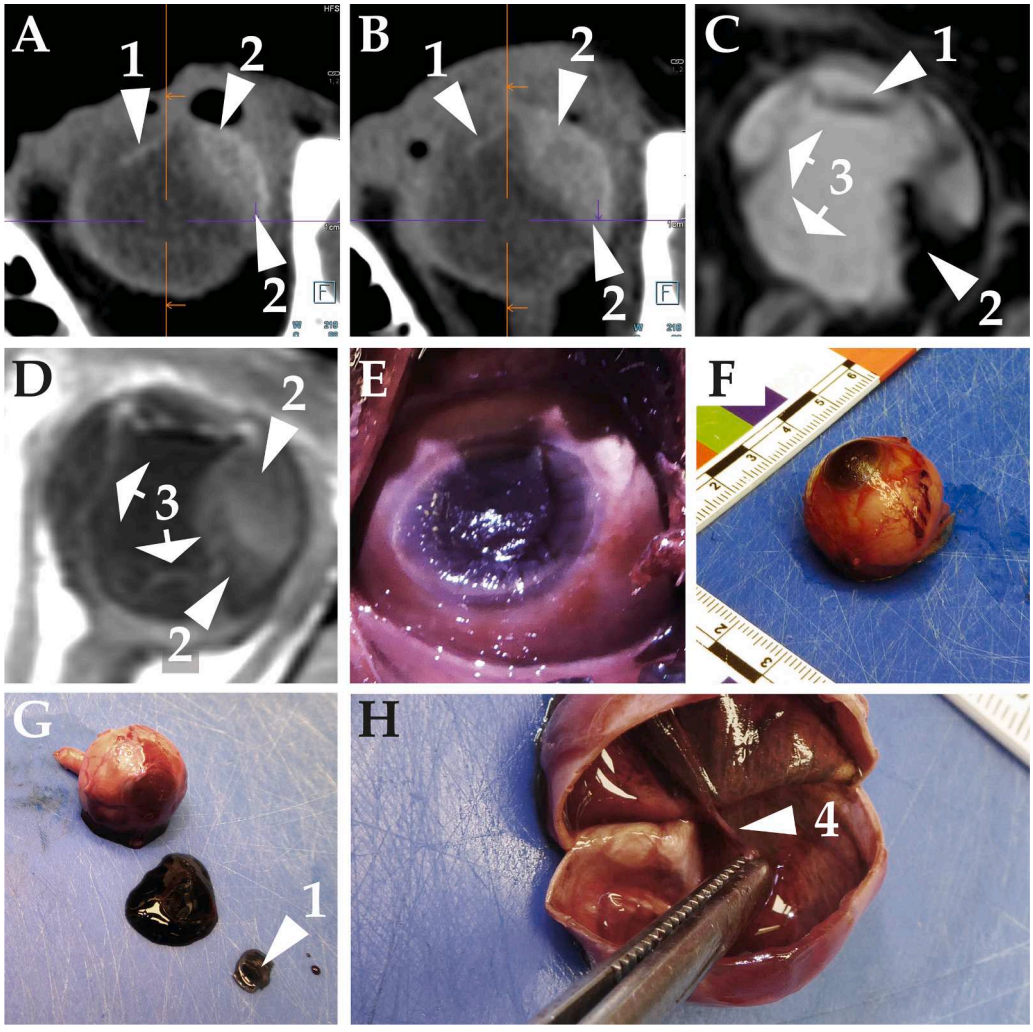

Fig. 1. Left eye. **A, B**: PMCT images of left eye (two axial slices at different locations within the same eye) with an **1** artificial lens and a **2** lentiform hyperdense finding suggestive of lateral vitreous haemorrhage. **C, D**: PMMRI of left eye (sequences: **C**: T2W FFE Haemo; **D**: T1W IR TSE) with **1** artificial lens and **2** finding suggestive of lateral hemorrhage with what appears to be a curved sedimentation line. In **C** and **D**, there is a **3** membrane-like structure suggestive of detached retina. On dissection of that eye (photos **E** through **H**), the sclera **F** was inconspicuous, but when **G** transsecting the bulb, the **1** lens and a dark red gel like coagulated mass visually identified as blood were retrieved from the bulb, that then **H** revealed a **4** torn retina.

conjunctiva [27]. Careful dissection confirmed a retinal tear that had been suspected in PMMRI, where the membrane had appeared significantly dislocated (Fig. 1). This aspect of a dislocated torn retina could be considered a possible consequence of prior ocular movement [28], thus possibly serving as a vital sign for the retinal tear. There was no indication that the deceased had been suffering from diabetes, and there was no suspicion of preceding surgery, shaking, or other trauma; this leaves arterial hypertension as a likely explanation. No findings of an acute stroke (possibly in conjunction with a hypertensive crisis) were discernible on PMCT or PMMRI in this case.

Routine screening for ocular hemorrhage after death may be relevant for future research into identifying cases of potential fatal peracute ischemic stroke.

CRediT authorship contribution statement

Wolf Schweitzer: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. **Dominic Gascho:** Data curation, Investigation, Methodology. **Michael Thali:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources. **Sebastian Eggert:** Conceptualization, Data curation, Investigation, Methodology, Validation, Supervision, Visualization. **Garyfalia Ampanozi:** Conceptualization, Formal analysis, Investigation, Supervision.

Declaration of competing interest

The authors declare that they have no competing interests.

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