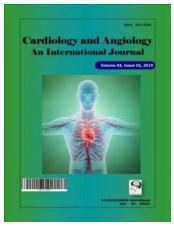

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Complicated Coronary Artery Angiography with Transient Cortical Blindness

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

Coronary artery angiography became the golden tool for coronary artery disease management. Transient cortical blindness following coronary angiography (TCBCA) is a rare complication of coronary artery angiography, in comparison with the other common complications. The neurotoxic effect of contrast medium is the possible cause of this clinical phenomenon, by disrupting blood brain barriers (BBB). TCBCA usually occurs during or immediately after coronary artery angiography. The clinical picture includes loss of vision that progressively resolves within hours or days. Ophthalmologic examination reveals normal structural findings, while computed tomography scan (CT scan) may show contrast accumulation in the occipital area. No current clinical protocols to manage this condition, except of excluding other possible causes of blindness after coronary artery angiography. Further well-organized studies are recommended to understand this clinical phenomenon, and more effort is needed to set a variety of interventional strategies regarding TCBCA management.

Keywords: Cortical blindness; coronary angiography; catheterization; contrast medium.

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1. BACKGROUND

Coronary artery angiography is the headmost clinical tool for both diagnosis and management of coronary artery disease (CAD), and therefore, this procedure occupy a huge space in modern healthcare practices. At the same time, the recurrent complications that result from coronary artery angiography procedures are extensively investigated. Such these complications are allergy to contrast, infection, nephropathy, embolism, local vascular injury, great vessel dissection, arrhythmias, myocardial infarction, and even death [1].

Transient cortical blindness following coronary angiography (TCBCA) is scarcely documented in the literature, and poorly studied. TCBCA is infrequently encountered in clinical settings, however, this rare complication has a devastating effect, because it leads to an unpredictable function disability for coronary angiography patients [2,3].

Early recognition of TCBCA was in 1970 by Fischer-Williams and his colleagues. Fischer-Williams and co-workers published their paper in effort to explain the difference between the hysterical blindness that rarely follows coronary artery angiography procedures, and the TCBCA, which was unusually encountered in the same patients [4].

The purpose of this clinical paper is to introduce an educational material for healthcare workers in cardiac care units about TCBCA, in form of a thorough summarization about this clinical phenomenon using the available published literature.

Searching criteria included three major databases (CINAHL, Medline, and PubMed); published papers since first identification of TCBCA in 1970, from peer-review and English language journals.

2. DEFINITION AND INCIDENCE

Cortical blindness is defined as visual impairment or loss, despite normal ophthalmologic examination findings regrading eye structures, pupillary characteristics and responses [5]. Also, coronary artery angiography is defined as “the radiographic visualization of the coronary arteries after direct opacification with contrast media” [6].

The incidence rate of TCBCA differs from one study to another, but in general, it ranges from 0.2% to 0.5% [7-9]. However, majority of the published scientific papers are neither surveillance nor national survey studies.

3. MECHANISMS

Many hypotheses try to explain the pathophysiological process that sits behind the development of TCBCA. Contrast medium which is used in coronary artery angiography procedure has a neurotoxic effect on blood-brain barriers (BBB), especially on the occipital cortex [10], which has a selective vulnerability for contrast medium [11], that may lead to a reversible visual impairment or loss.

Computed tomography scan (CT scan) for TCBCA patients shows an accumulation of contrast medium in this anatomical area [7]. Keeping in the mind the nature of coronary artery angiography procedure that requires the patients to stay at supine position during the procedure and the few hours follow [12], which supports the previous hypothesis.

Schwartz et al. [13] suggest the hypertensive encephalopathy as possible mechanism for the development of TCBCA. Hypertensive encephalopathy is a sudden increase of blood pressure during or after the coronary artery angiography, that interrupts the autoregulation of cerebral arteries, especially the occipital area, which in turn forms vasodilation and local congestion, then rapidly, leads to disruption of BBB and leak of fluid into the occipital lobe, and finally forming edema that reaches to the cortical surface.

Another possible explanation is the immunological reaction process [14]. In fact, the endothelins, particularly, ET-1, ET-2 and ET-3 increase the permeability of brain endothelial cells, which leads to cerebral edema formation [15]. Endothelins are strong vasoconstrictors and are released from the endothelial cells, as well as other organs, including the brain, lungs and kidney [16]. It is believed that these chemical substances are released in some pathological circumstances also, such as developing sensitivity to contrast medium during coronary artery angiography procedure [17,18].

Another important point is the amount of contrast medium that may play a significant role in developing TCBCA, and the effect might be

exhibited by prolonging or accelerating clinical picture of this clinical complication. Usually, the amount of contrast medium used in coronary artery angiography procedures ranges from 80 ml to 400 ml, however, Yazici et al reported one case of TCBCA with smaller amount (75 ml) of contrast medium [19].

Also, hyper-osmolar or ionic contrast medium holds a greater risk to disrupt BBB in comparison with hypo-osmolar or non-ionic contrast medium [19]. But, many cases of TCBCA were reported when non-ionic or low osmolarity contrast medium was used in coronary artery angiography procedure [20,21].

4. RISK GROUPS

One third of renal impairment patients have CAD [22], therefore, those patients who need coronary artery angiography are vulnerable for developing TCBCA, and may suffer from longer period of this clinical condition because of the impaired clearance function of kidney.

Frantz observed 12 cases of transient cortical blindness for patients who were underwent a left internal mammary artery (LIMA) graft angiography for post coronary artery bypass graft patients. The researcher argued that contrast medium may pass through the subclavian artery to left vertebral artery, because both arteries are proximal to each other, and then to the posterior circulation [23].

Other risk factors for initiating or even intensifying the clinical picture of TCBCA include conditions with BBB disruption, as seen in eclampsia or patients who use immunosuppressive substances [19].

5. CLINICAL FEATURES

Positive findings include visual field defect bilaterally, that sooner became a total blindness, in addition to hypertensive retinopathy with fundi examination [24-26]. Alp et al. [27] stated that neurological examination reveals normal findings, particularly, cranial nerves, sensory and motor function. In the same study by Alp and co-workers, they found normal extraocular movements and pupillary reflexes when applying ophthalmological examination.

Typically, symptoms of TCBCA start during coronary artery angiography, or the few hours after the procedure, and last for 48 hours [25], but it may rarely extend for five days [23]. Clinical picture improves as BBB restore its protective function and patients start to return their normal visual function gradually as following; first light perception is restored, followed by color vision, and eventually full sight and normal vision [19].

6. DIAGNOSTIC PROCEDURES AND DIFFERENTIAL DIAGNOSES

Careful radiology examination such CT scan and magnetic resonance image (MRI) are highly recommended, in addition to the routine neurological and ophthalmological examinations to confirm TCBCA [28,29]. Indeed, these routine diagnostic techniques are usually used to exclude other possible causes of visual impairment after coronary artery angiography.

In fact, many researchers emphasize the use of CT scan procedure to provide a clinical judgment about whether there is a cerebral embolism or contrast enhancement in the occipital lobes as the possible cause of TCBCA [24,27].

Other possible causes of the blindness after coronary artery angiography are hysterical blindness, hypotension, embolism, and cerebral arteries vasospasm [23]. Considering these differential diagnoses is crucial before giving final decision about this clinical complication.

7. MANAGEMENT AND PROGNOSIS

Restoring normal vision is the ultimate goal for TCBCA management, and current therapy tends to exclude other possible etiologies behind blindness after coronary artery angiography, especially major cerebral focal injuries.

Meanwhile, no specific treatment is tested or approved for this type of blindness, but the available recommendations suggest maintaining normal blood pressure and enhancing diuresis to accelerate contrast medium clearance [30].

Fortunately, TCBCA has a favorable prognosis, and most patients restore their normal vision after 24 - 48 hours of event [10]. Although, the unpredicted and disabling nature of this condition should be carefully considered, rather than how minor is the percentage of TCBCA cases among coronary artery angiography patients.

8. DISCUSSION

Further discussion about this clinical phenomenon is built to exclude other possible causes of blindness after coronary angiography, and subsequently addresses more clinical challenges in diagnosing and managing this clinical phenomenon.

Transient cortical blindness was reported in many different procedures. Few cases were documented after CT scan with contrast procedure, spinal surgery, vertebral and cerebral angiography [31-34].

Majority of recent studies about TCBCA address the temporary and reversibility nature of this clinical phenomenon, particularly, by case-report studies [24,30,35,36], and up to my knowledge, there are no specific published studies about management or prevention of this clinical complication.

9. CONCLUSION

This clinical review paper about TCBCA demonstrates the remarkable gap in current knowledge and practice regarding this rare clinical phenomenon. More research efforts are on demand to achieve better understanding of this clinical complication, and therefore, healthcare providers as nurses, cardiologists and radiographers in catheterization and cardiac care units will not rely only on limited experiences and recommendations.

Also, proper protocols and guidelines for patients who undergo coronary artery angiography procedures including clear assessment, intervention and education skills can minimize the occurrence of TCBCA, in addition to prepare patients and healthcare providers for such unpredictable and dramatic vision disability.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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