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The role of EEG and CT scan in the assessment of criminal responsibility in homicide offenders or perpetrators of severe body injury

Wpływ badań EEG i TK na ocenę poczytalności sprawców zabójstw lub poważnego uszkodzenia ciała

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Abstract

Intoxication with ethanol is widely recognized as a risk factor for committing a crime, particularly for people who consumed alcohol 24 hours before committing homicide or causing serious injury to the victim's body. The study attempts to evaluate the relationship between additional tests: computed tomography and electroencephalography in ethanol intoxicated homicide offenders or perpetrators of severe body injury and the assessment of diminished criminal responsibility. The study group consisted of 90 individuals suspected of crime against life or health, classified as murder, attempted murder or grievous bodily harm, as in accordance with the criminal code. The perpetrators underwent a six-week forensic psychiatry observation between 2004 and 2008 in the Forensic Department of High Security Prison No. 2 in Łódź. Medical records, including the available medical documentation as well as categorical forensic psychiatric reports issued by two experts in psychiatry, were assessed retrospectively. A total of 77% of respondents underwent further extensive head computed tomography diagnostics. Head computed tomography abnormalities related to diminished criminal responsibility were detected in 37% of offenders. The lesions were described by radiologists as ischaemic lesions, ischaemic softening, developmental anomalies (with the most common being the cyst of transparent partition) as well as cortical, subcortical and cortical-subcortical brain atrophy with different locations. Deviations detected with electroencephalography were confirmed in 11% of defendants. However, these findings had no effect on the assessment of diminished criminal responsibility of offenders. According to the researchers, the additional tests performed for a forensic report were only complementary. Findings indicating significant brain lesions, which do not take into account the clinical state of the perpetrator, should not serve as a basis for a reduction or even abolition of the soundness of the perpetrator of the offense.

Key words: sanity, alcohol intoxication, EEG, CT, forensic psychiatric observation

Streszczenie

Intoksykacja alkoholem etylowym jest powszechnie uznawana za czynnik ryzyka dokonania przestępstwa, szczególnie u osób, które spożywały alkohol na 24 godziny przed popełnieniem zabójstwa lub poważnego uszkodzenia ciała ofiary. Podjęto próbę oceny poczytalności sprawców zabójstwa lub poważnego uszkodzenia ciała w stanie upojenia alkoholowego zwykłego w odniesieniu do przeprowadzonych badań dodatkowych – tomografii komputerowej głowy oraz elektroencefalografii. Grupę badaną stanowiło 90 osób podejrzanych o czyn przeciwko zdrowiu lub życiu, zakwalifikowany zgodnie z kodeksem karnym jako zabójstwo, usiłowanie zabójstwa lub ciężkie uszkodzenie ciała. Badani zostali poddani obserwacji sądowo-psychiatrycznej w latach 2004–2008 przez okres sześciu tygodni w Oddziale Obserwacji Sądowo-Psychiatrycznej w Zakładzie Karnym nr 2 w Łodzi. Analizowano retrospektywnie dokumentację medyczną, w tym dostępną dokumentację lekarską oraz wydane przez dwóch biegłych psychiatrów kategoryczne opinie sądowo-psychiatryczne. U 77% osób badanych przeprowadzono dalszą szczegółową diagnostykę pod postacią badania tomografii komputerowej głowy. U 37% podsądnych stwierdzono odchylenia od wyniku prawidłowego opisywane przez lekarzy radiologów jako mogące odpowiadać ogniskom niedokrwiennym lub malacjom poniedokrwiennym, anomaliom rozwojowym (najczęstszą zmianą była torbiel przegrody przeźroczystej) i zanikom korowym, podkorowym lub korowo-podkorowym, o różnej lokalizacji. Odchylenia od stanu prawidłowego opisywane w badaniu tomografii komputerowej pozostawały w związku w orzeczeniem przez biegłych psychiatrów znacznie ograniczonej poczytalności. Odchylenia w badaniu elektroencefalograficznym stwierdzono

u 11% podsądnych. Powyższy wynik nie wpłynął na orzeczenie o zmienionej poczytalności przez biegłych lekarzy psychiatrów. W ocenie badaczy przeprowadzone badania dodatkowe celem wydania opinii sądowo-psychiatrycznej mają znaczenie pomocnicze. Wynik badania wskazujący na znaczne zmiany, bez uwzględnienia stanu klinicznego, nie powinien przesądzać o zniesieniu lub ograniczeniu poczytalności sprawcy.

Słowa kluczowe: poczytalność, upojenie alkoholowe, EEG, TK, obserwacja sądowo-psychiatryczna

INTRODUCTION

Forensic evaluation for competence to stand trial and criminal responsibility is diagnostic judgment that influences the adjudication of criminal defendants. Individuals with schizophrenia and other psychotic illness have the highest rates of incompetence. Substance abuse and organic disorders are found as lower rate of insanity (Cochrane *et al.*, 2001). Currently, neuroimaging study as computed tomography and electroencephalography (EEG) is widely used as an additional method of evaluation of the perpetrator's criminal responsibility, referred to forensic psychiatric observation.

Changes in neuroimaging in patients with alcohol dependence are found in 30% of the population (Batts, 2009; Wilson, 2011). The most common is cortical atrophy, particularly the frontal lobes (Cochrane *et al.*, 2001; Cummings and Mega, 2003; Ehlers and Phillips, 2007; Fein and Allen, 2005; Fortier *et al.*, 2011; Scroop *et al.*, 2002) of both hemispheres of the brain, but also the temporal and parietal lobes (Frankle *et al.*, 2005; García-Valdecasas-Campelo *et al.*, 2007). Widening of the brain's fissure, extending the lateral ventricles and the third ventricle occurs (Frankle *et al.*, 2005; García-Valdecasas-Campelo *et al.*, 2007).

These changes are dependent on age and sex (Frankle *et al.*, 2005; Miller *et al.*, 2006; Scroop *et al.*, 2002). Cortical atrophy located in the cerebellum is also characteristic, manifested clinically as ataxia, impaired balance and gait abnormalities (García-Valdecasas-Campelo *et al.*, 2007). In case of alcohol abusers, white matter's degenerative changes are located around the lateral ventricles. According to the researchers, they resemble the changes that occur in multiple sclerosis (Fortier *et al.*, 2011). There is also reduced brain volume observed (Cochrane *et al.*, 2001; García-Valdecasas-Campelo *et al.*, 2007). In the Marchiafava-Bignami's disease demyelination occurs in the area of corpus callosum and hippocampal commissure (Fortier *et al.*, 2011). Addicted to alcohol incident accidental head injuries, which may result in subdural hematoma. In the imaging tests loss of brain and scars are reported after contusions (García-Valdecasas-Campelo *et al.*, 2007; Gurley and Marcus, 2008). Degenerative changes of central nervous system correlate with chronic addiction process, the amount of daily alcohol consumption, liver dysfunction, vitamin deficiencies, the presence of pro-inflammatory cytokines and nutritional status (Frankle *et al.*, 2005; Miller *et al.*, 2006). Women are often more sensitive to alcohol after shorter duration of addiction, cirrhosis and cardiomyopathy are diagnosed (Hoaken and Pihl, 2000; Hommer, 2003; Pfefferbaum *et al.*, 2001, 2004; Schweinsburg *et al.*, 2003). Reduction in the volume of prefrontal cortex, amygdala and cingulate gyrus in CT scan of violent offenders are frequently reported (Batts, 2009; Ratti *et al.*, 2002).

Changes in EEG were found among 24–78% presenting dissocial behaviour. In case of the most violent offenders the presence of slow waves, focal slow waves or records congruent to epilepsy are detected (Cummings and Mega, 2003). Among chronic alcohol abusers EEG changes in the form of waves with frequencies from 13 to 30 Hz recognised as increased beta activity (Fortier *et al.*, 2011; Ratti *et al.*, 2002) low-voltage of alpha activity recorded from the occipital region (Ehlers and Phillips, 2007), slow theta and delta waves recorded from frontal region secondary to CNS damage are described (Fein and Allen, 2005; Kamarajan *et al.*, 2004).

AIM OF THE STUDY

The aim of the study was to evaluate the results of CT head scans and EEG records provided during forensic psychiatric observation of offenders who had committed murder or serious bodily harm being in state of alcohol intoxication in relation to the diminished criminal responsibility.

MATERIAL AND METHODS

The study was approved by Bioethics Committee of the Medical University of Lodz (No. RNN/94/09/KE).

Study group consisted of 90 persons: 70 men and 20 women, suspected in the public prosecutor investigation of an offence classified, according to the criminal code, as murder (article 148 § 1 of the Polish Penal Code), murder with extreme atrociousness (article 148 § 2 of the Polish Penal Code), attempted murder (article 13 § 1 in conjunction with article 148 of the Polish Penal Code), grievous bodily harm resulting in severe disability or death (article 156 § 1 and § 3 of the Polish Penal Code), bodily injury causing health disorder for longer than seven days (article 157 § 1 of the Polish Penal Code), fatal battery (article 158 § 3 of the Polish Penal Code) (Marek, 1999).

Alcohol consumption by the suspects at the time of the offense was confirmed by concentration of alcohol in the exhaled air measured by police officers or prior alcohol consumption was ascertained by the testimony of witnesses or defendants. Court's experts in psychiatry field were not able to assess offenders' responsibility at the time of committing crime. The subjects in 2004–2008 underwent forensic

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Variable	Level	Criminal responsibility		Chi² (*df*)	*p*
		Full *N* (fraction)	**Diminished** *N* (fraction)		
CT of the head					
CT deviations	Not done Yes No	8 (0.23) 8 (0.23) 19 (0.54)	3 (0.21) 9 (0.64) 2 (0.14)	8.689 (2)	**0.001**
Ischaemic changes in CT	Not done Yes No	8 (0.23) 25 (0.71) 2 (0.06)	3 (0.21) 8 (0.57) 3 (0.21)	2.732 (2)	0.336
Developmental abnormalities in CT	Not done Yes No	8 (0.23) 3 (0.07) 24 (0.69)	3 (0.21) 3 (0.21) 8 (0.57)	1.559 (2)	0.501
Cortical, subcortical atrophy	Not done No Yes	8 (0.23) 24 (0.68) 3 (0.09)	3 (0.21) 5 (0.36) 6 (0.43)	8.233 (2)	**0.017**

Chi² – test of independence Chi²; ***df*** – degrees of freedom; ***p*** – exact two-tailed test probability for the test of independence Chi² – **underlining** indicates the presence of significant differences.

Tab. 1. Deviations detected in CT scan of the head comparing full criminal responsibility with diminished responsibility

psychiatric observation for a period of six weeks in the Forensic Department of High Security Prison No. 2 in Lodz. Subjects who were not under the influence of alcohol at the time of committing the offense, those who manifested psychotic disorder, meeting the criteria of pathological intoxication (1 person), and all defendants who committed a punishable offense with another classification (in accordance of the Penal Code) were excluded. The study was retrospective.

Presented data is based on the materials collected before the amendment in 2008 of the article 203 polish Code of Criminal Procedure. After conducting six-week observation the medical records of forensic observation were retrospectively analysed. Full medical record, forensic report and psychologist's opinion were parsed.

In statistical study of the gathered material descriptive methods and the methods of statistical inference were used. In order to describe study group in analysis of quality characteristics structure's indicators were assessed. To characterize the average value of quantitative traits arithmetic mean (*Scr*) and median (*Me*) were calculated. As a measure of the dispersion, standard deviation (*SD*) was assumed, the minimum, maximum values, and coefficient of variation (*CV%*) are specified, as a ratio of the standard deviation relative to the average.

Analysis of the results was performed using the statistical packages SPSS 12.0 PL for Windows and Statistica 7.1 PL for Windows licenses held by the Department of Affective and Psychotic Disorders Medical University of Central Teaching Hospital of Lodz.

RESULTS

In 77% of the subjects a detailed diagnostics in the form of computed tomography of the head was conducted. In the remaining 13 patients this test was not performed for reasons unknown to researchers. In 37% of defendant subjected to this diagnostic method deviations from the correct result were found. In 9% lesions, reported by radiologists

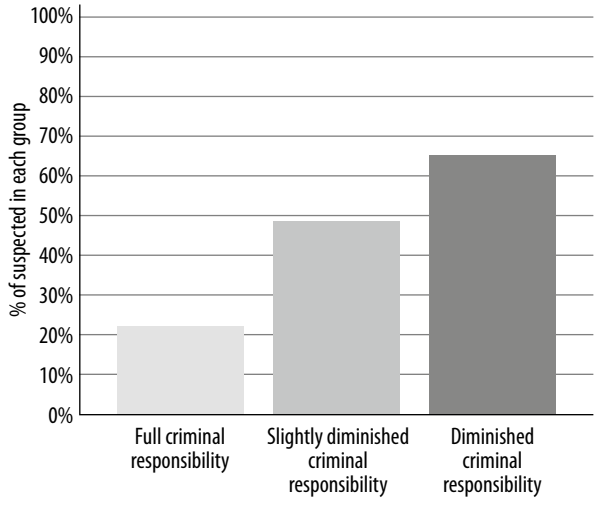

Fig. 1. Deviations in head's CT scan

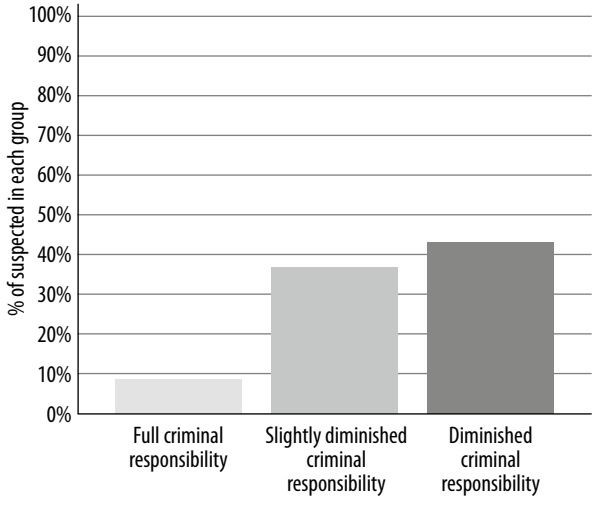

Fig. 2. Presence of brain atrophy in CT head's scans in different groups

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Variable	Level	Responsibility		Chi2 (*df*)	*p*
		Full *N* (fraction)	**Diminished** *N* (fraction)		
EEG test					
EEG deviations	No Yes	30 (0.86) 5 (0.14)	10 (0.71) 4 (0.29)	1.361 (1)	0.415

Chi² – test of independence Chi²; ***df*** – degrees of freedom; ***p*** – exact two-tailed test probability for the test of independence Chi² – **underlining** indicates the presence of significant differences.

Tab. 2. Changes in the EEG detected in the offenders of full criminal responsibility and diminished responsibility

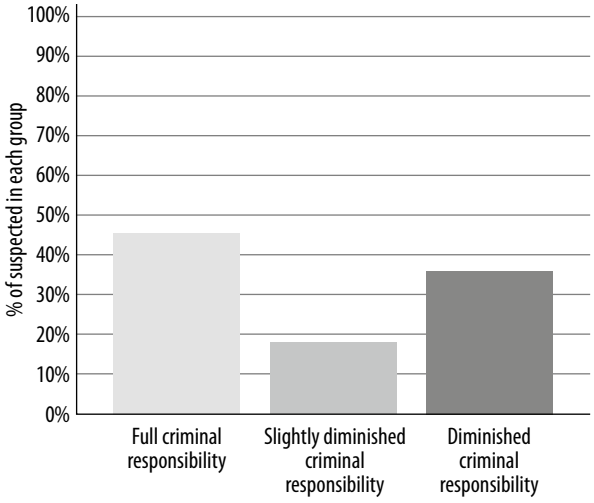

Fig. 3. Occurrence of EEG changes in examined groups

as likely correspond to the ischaemic focus or after-ischaemic malacia, were established. In 16% of the observed, developmental anomaly were found, the most common change was the cyst of the septum pellucidum. In 27% of the respondents cortical, subcortical or cortico-subcortical atrophy in different location, which were described as diffuse. The variables are listed in Tab. 1.

In the group of full criminal responsibility offenders (P) the result of CT head scan brain atrophy was the least numerous – 9% of the subjects. In the group of slightly diminished responsibility* (NOP) atrophy were reported in 36% of suspects, while in the group of adjudicated diminished responsibility (ZOP) there were changes in the CT scan (cortical, subcortical, or cortico-subcortical atrophy) in 43% of defendants. Statistically significant variables in three groups of subjects (P, NOP, ZOP) are shown on Figs. 1–2.

EEG deviations were found in 11% of defendants. Only changes reported such as moderate or significant were taken into account. Wave patterns as: irregular theta waves, delta waves and sharp waves were reported. In two suspects EEG evaluations were not conducted due to equipment failure. EEG deviations in the test groups are presented in Tab. 2 and Fig. 3.

* This term has only customary meaning and has no reference in Polish Penal Code.

DISCUSSION

In Heitzman' study 35 perpetrators of murder and grievous bodily harm were examined. In the years 1979–1998 offenders were referred for psychiatric evaluation by the court or the prosecutor in due to doubts about their mental state at the time of the offense. Studies were carried out in connection with occurrence of a particular kind of physical and psychological burden. The aim of the study was to evaluate the stress in the ethology of violent crimes. In this study, computed tomography was performed in 27 offenders which accounted for 77.1% of the subjects. In 14.3% percent of defendants result of the test was in the normal range. Among found atrophies the cortical outnumbered subcortical and mixed. Atrophy on the frontal location was found in 10 subjects, the temporal location in 1 person and another location in 10 subjects (Heitzman, 2002). Connection between changes appearing in the CT of the head and the ruling of the diminished responsibility was not assessed.

Heitzman investigating the perpetrators of murder analysed the EEG which was carried out as an additional test. In 54.6% of the examined group demonstrated organic pathology resulted in disturbance of the brain bioelectrical processes. Pathological record with generalized changes predominated in 45.7% of the subjects. Epileptiform activity was found in 8.6% of cases. In 45.7% of the population recordings ranged standards. Location of changes was related to the temporal region bilaterally or unilaterally in 45.8% of subjects, the frontal area in 5.7% of patients, occipital part of the brain in 2.8% of the defendants (Heitzman, 2002).

Majchrzyk examining 60 murderess analysed EEG record conducted among all of them. Pathology was shown in 30% of women (Majchrzyk, 2004).

The connection between changes in the EEG of the perpetrators and the evaluation of the diminished responsibility by court experts was not found. Additional tests carried out for a forensic report had complementary importance. The results of the additional tests can not determine the judgment of perpetrator's responsibility, without assessment of mental state. Lack of EEG abnormalities does not necessarily imply the absence of organic changes. They could be confirmed by neuropsychological and psychological testing methods, or could be diagnosed in a clinical examination conducted by psychiatric experts.

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CONCLUSIONS

1. In the present study, the majority of perpetrators underwent CT of the head. In 41% of them abnormalities were found. In 27% of defendants cortical or subcortical atrophy was described. Deviations described in the CT head scan and cortical or subcortical atrophy confirmed by tomography were related to the diminished responsibility assessed by psychiatrists. There was no relationship between the ruling of the diminished responsibility and the finding in CT scan of the head ischaemic lesions and developmental changes.
2. The presence of EEG changes did not influence evaluation of diminished responsibility of perpetrators of murder or grievous bodily harm in state of alcohol intoxication.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations which might negatively affect the content of this publication and/or claim authorship rights to this publication.

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