Fitness to Drive After Syncope and/or in Cardiovascular Disease – An Overview and Practical Advice

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Abstract: The risk of syncope occurring while driving has implications for personal and public safety. Little is thought about the medical considerations related to the driving of motor vehicles. Physicians treating patients with cardiovascular disease need to acquire basic competences to be able to advise them about their fitness to drive. Current knowledge, governmental regulations, and recommendations concerning fitness to drive in patients with syncope and/or cardiovascular disease are presented. Narrative review with educational and clinical advice. Cardiovascular disease can make a driver lose control of a vehicle without warning and thereby lead to an accident. The main pathophysiological mechanisms of sudden loss of control are disturbances of brain perfusion (eg, syncope with or without cardiac arrhythmia, sudden cardiac death due to ventricular fibrillation or asystole, stroke, etc.) and marked general weakness (eg, after major surgery or in heart failure). Patients with syncope and/or cardiovascular disease should be properly advised by their physicians about their fitness to drive, and restrictions should be documented. (Curr Probl Cardiol 2021;46:100677.)

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Introduction

Although medical conditions are causing the minor part of motor vehicle accidents, the relationship between syncope and accidents is well known. The first known study started in 1958 collecting data on London Transport bus drivers.[1] More than 19 years and 6.3 billion miles later, 54 accidents (1 per 115,000,000 miles) were found to be due to a medical condition and syncope of undetermined etiology contributed to 14 accidents. Fatal road accidents in Finland and Switzerland were studied between 1984 and 1989 and 2.5% of road deaths in Finland and 6.4% of road deaths in a Swiss canton were related to a driver's sudden loss of consciousness.[2]

Syncope is the clinical manifestation of a temporary interruption of global cerebral perfusion that causes a relatively sudden onset and transient loss of consciousness and postural tone with spontaneous, complete recovery.[3,4] Several studies have shown syncope to be a common event; in the Framingham study, the cumulative incidence of syncope was estimated at 3%-6% over 10 years, and the recurrence rate was 9%-22%.[5,6] In the health care setting, syncope accounts for 3%-5% of visits to the emergency department and 1%-6% of hospital admissions.[7]

Cardiovascular disease is a main reason for syncope related death for motor vehicle drivers demonstrated by a German study.[8] In Japan, between 2004 and 2006, 211 cases of sudden incapacity to drive were notified; these were due to cerebrovascular disease (28.4%), cardiac and aortic disease (26.1%) and syncope (8.5%). In two-thirds of these cases an accident occurred. Thirty-six percent of the drivers died immediately of their illness.[9] A retrospective study in Finland estimates that in 20%-30% of all fatal road accidents involving persons over 65 years of age, impaired concentration due to disease may have been involved, and in most cases (70%) the disease is cardiovascular.[10] An autopsy study from Canada also suggests that coronary heart disease (CHD) in drivers over the age of 60 plays an important role in road accidents. In this age group, 86% of drivers who died at the wheel had significant CHD. Of these, 40% had been driving infrequently and the accident was inferred to be due acute myocardial ischemia.[11] It may be assumed that unexplained syncope plays an important role in cardiovascular disease as a cause of accidents and increases with age.[12,13]

Recommendations for driving with regard to syncope were made by the European Society of Cardiology and in a joint Scientific Statement from the American Heart Association and Heart Rhythm Society; these recommendations focused on patients with primary cardiac arrhythmias and neurocardiogenic conditions associated with syncope.[4,14,15]

In Austria, the ministry of traffic, innovation, and technology published in 2019 the latest version of their recommendations regarding fitness to drive.[16]

Risk Stratification

The Canadian Cardiovascular Society's "risk of harm"-formula has become the gold standard for the European Union to quantify the level of risk for drivers with cardiac disease.[17] This formula incorporates 4 components: (1) time spent driving (TD); (2) type of vehicle driven (V); (3) risk of sudden cardiac incapacitation (SCI); and (4) the probability that such an event will result in a fatal or injury-producing accident (Ac). Put together, the risk of harm (RH) = TD × V × SCI × Ac. TD is approximately 4% (0.04) for private automobile drivers and 25% (0.25) for professional drivers. Larger vehicles have a larger V value, with commercial heavy trucks (vehicles weighing >3.5 tons) having a V = 1.0 and standard-size passenger cars having a V = 0.28. SCI varies depending on the disease, but is assumed to be 1% for the general population. Ac is 2% (0.02) for all drivers. Using the formula, the average professional driver carries a risk of harm of 0.0005% or 1 in 20,000 ($0.25 \times 1 \times 0.01 \times 0.02$). If this is the acceptable societal risk, then the average private automobile driver could have a risk for SCI up to 22% [SCI = RH/(TD × V × Ac) = 0.000005/($0.04 \times 0.28 \times 0.02$)] to have a risk equivalent to that of the professional driver. This concept of "acceptable risk" is the balance of individual liberty and the potential to harm others from driving.[18] As a society, we already accept certain levels of risk by allowing for young and elderly drivers, who are more prone to motor vehicle accidents as a function of age.[19-21] The "risk of harm" formula has not been validated, but it provides a conceptual and objective framework for assigning risk to drivers. If we accept a risk of harm of 0.0005% overall (the risk of the average professional driver), it is certainly possible using this formula that some drivers may be considered acceptable under certain conditions, such as a shortened time of driving, smaller vehicle use, or when the risk of SCI is low enough (eg, after waiting a certain period following myocardial infarction). Given normal hours per day at the wheel (8 hours for professional drivers, 30 minutes for private drivers), unfitness to drive is assumed when the probability of sudden loss of control (syncope, sudden cardiac death, and stroke) is >1% per year for an professional driver and >22% per year for a private driver.[17]

Definition of Driver Groups

Most guidelines distinguish between private and commercial (professional and occupational) drivers. It goes without saying that commercial drivers are subject to stricter regulations because they potentially endanger a larger number of people in the course of a cardiac event. The definition of private and commercial drivers varies somewhat between countries but, in general, a private driver is a licensed driver who does not earn a living from driving and a commercial driver is a driver who earns a living from driving and/or is licensed to drive large passenger or goods-carrying vehicles. Categories for taxi drivers vary between groups 1 and 2 standards and may be locally determined.

The European Union defines Group 1 (private drivers) as drivers of motorcycles, cars and other small vehicles with or without trailers. Group 2 (professional drivers) includes drivers of vehicles weighing more than 3.5 tons or carrying more than 8 passengers, excluding the driver.[22] In Austria, a commercial driver is defined as one who drives a single vehicle weighing 26,001 pounds (=11.8 tons) or more, a truck with double or triple trailers, a truck with a tank or a truck carrying dangerous goods. This also includes passenger cars carrying 16 or more passengers (including the driver).[16]

Conditions and Specialties

Acute Coronary Syndrome and/or Stable CHD

After myocardial infarction, no distinction is made between a first myocardial infarction and a recurrence, nor between ST-elevation myocardial infarction (STEMI) and non-STEMI. The highest risk of dying of a myocardial infarction is during the first 10 days after the onset of the infarction.[23] It may be assumed that about one-third of cardiovascular deaths after myocardial infarction are sudden cardiac deaths.[24] Finally, an elevated risk was also suggested for patients with incomplete revascularization of the coronary vessels and for patients who did not receive beta-blocker therapy.[19,25,26]

Reduced Left Ventricular Function

The most important prognostic parameter in determining fitness to drive is left ventricular ejection fraction (LVEF). Since many large studies have set the primary preventive indication for an ICD at EF <35%, this threshold value for restricted ventricular function after myocardial infarction has also been chosen by the European Union Expert Advisory

Panel for unfitness to drive. Patients with group 2 driving licenses and an EF <35% are always unfit to be occupational drivers. Not only reduced left ventricular ejection fraction has been shown to have an impact on arrhythmic survival, but also impaired diastolic function.[27-29]

Impaired (Cardiac) Autonomic Function

It has been shown to lead to orthostatic intolerance but also to dizziness. This appears not only in multiple sclerosis but also in Parkinson disease and other neurological diseases and may be the first indicator in some patients.[30]

Fitness to Drive After Syncope

Patients with syncope are a very heterogeneous group. Causes of loss of consciousness include the vasovagal, cardiac, orthostatic, and neurological syncope, as well as those not otherwise classified.[6] It may be assumed that patients who experience syncope at the steering wheel have the same range of causes of syncope as those who experience syncope in other circumstances.[15] About 87% of patients with syncope at the wheel experience prodromal symptoms, which if correctly interpreted can allow them to find a safe place to stop.[31] Syncope patients should be informed about the possibility that their syncope may recur, so that if they experience prodromal symptoms they can stop their vehicle. A defensive driving style should always be recommended. According to a Danish study, it may be assumed that the accident risk of individuals with syncope is double that of the general population for at least the 2 years following hospital admission for syncope.[32] Individual assessment may result in a judgment that the patient may be fit to drive despite recurrent syncope, if the syncope is not associated with driving. This is the case, for example, for syncope associated with medical procedures (eg, blood draw) or after being situation related (only while standing, micturition, defecation).

Implantable Cardioverter Defibrillator: Implantation or Change

In the course of several clinical trials, attempts were made to identify predictors for the occurrence of cardiac events in ICD patients. An increased risk for the occurrence of arrhythmia and implantable cardioverter defibrillator (ICD) intervention was described for patients with reduced left ventricular function and for patients suffering from heart failure in NYHA classes III-IV, among others. There is also evidence, that

the type of implanted device (single versus multichamber device), programming strategy and gender has an influence on appropriate and inappropriate device discharge.[33-35] Since professional drivers carry a significantly higher overall risk according to the RH (risk of harm) formula due to the type of vehicle, the time spent driving and the frequently greater number of passengers, most guidelines recommend a permanent driving ban after ICD implantation for both primary and secondary prevention. According to the EHRA (European Heart Rhythm Association) Task Force, the same should apply to professional drivers who refuse ICD implantation for primary or secondary prevention.[22]

Different Conditions in Detail

For practicability reasons the order of the following conditions sticks to the order of the 2019 ministry of health published recommendations (3.6ff, pages 142-165).[16]

Abbreviations: group 1 drivers (1), group 2 drivers (2)

I. Fit if Treated Successfully and Favorable Opinion by Specialist

Bradycardia (sinus node or conduction system dysfunction) and Tachycardia (supra- and ventricular arrhythmias) with syncope

Fit: successfully treated (PM/ICD), no syncope any longer (1,2)

Unfit: until successfully treated (1,2)

Bradycardia with AV-Block Mobitz II, AV-Block III, alternating bundle branch block

Fit: successfully treated (drugs, PM), no syncope any longer (2)

Unfit: no therapy, independent from syncope (2)

Tachycardia (supra- and ventricular arrhythmias)

Structural heart disease and sustained ventricular tachycardia

Fit: successfully treated (drugs, ablation, ICD), no syncope (any longer (1) in the last 3 months (2))

Unfit: until successfully treated (1), syncope relapse within 4 weeks after syncope (2)

Polymorphic, nonsustained VT or sustained VT with ICD indication

Fit: successfully treated (drugs, PCI, ICD), no syncope any longer (2)

Unfit: syncope; sustained VT or ICD indication without therapy (2)

Angina pectoris

Fit: successfully treated (drugs, PCI) (1,2)

Unfit: until successfully treated (1,2)

PM (implantation, exchange)
Fit: PM-dependent: after 4 weeks, otherwise 1 week (2)
ICD (implantation, exchange), ICD shock (appropriate, inappropriate)
Fit: primary prevention: after 1-2 weeks, secondary prevention, ICD shock: after 3 months (1)
Syncope
Fit: successfully treated, 1st episode (1), low probability of relapse (2)
Unfit: recurrent unexplained syncope (2): 6 months (1)
Acute coronary syndrome
Fit: EF>35%; EF<35% or decompensation: 4 weeks (1); EF>35% 6 weeks (2)
Unfit: EF <35% (2)
Stable angina pectoris
Fit: successfully treated (1,2)
Unfit: angina pectoris at low excursion (2)
Percutaneous coronary intervention (PCI)
Fit: successfully treated (1) after 4 weeks (2)
Aortocoronary bypass
Fit: after 2-4 weeks (1) 3 months (2)
Stroke, transient ischemic attack
Fit: successfully treated (1,2)
Significant cerebral artery disease
Fit: successfully treated after 4 weeks (2)
Aortic aneurysm above 5.5cm
Fit: successfully treated (surgery) (2)
Heart failure, NYHA I-III
Fit: successfully treated (NYHA I-III)(1) (NYHA I-II)(2)
Heart transplantation
Fit: successfully treated (surgery) (1), after 6 months (2) no syncope any longer (2)
Unfit: clinically unstable (1), within first 6 months (2)
Heart assist devices
Fit: continuous adequate function (1)
Heart valve surgery
Fit: successfully treated 2-4 weeks (1) 3 months (2)
Malign hypertonia (<180/110 mmHG)
Fit: successfully treated (1,2)
Malign hypertonia (>180/110 mmHG)
Fit: successfully treated (2)
Unfit: possible progressive organ damage (2)

Congenital heart disease
Fit: successfully treated (1,2)
Hypertrophic cardiomyopathy, no syncope
Fit: individual assessment (1)
Long QT syndrome with syncope, Torsade de Pointes or QTc > 500 ms
Fit: individual assessment (1)

II. Fit Under Special Circumstances and Only With Favorable Opinion by Specialists and if Reassessed by Public Health Officers Usually Limited for 1 Year

ICD implantation
Fit: if re-assessed by public health officers (2)
Peripheral aortic disease, thoracic und abdominal aortic aneurysm with high risk for ruption
Fit: if re-assessed by public health officers (1,2)
Heart failure, NYHA III, IV
Fit: NYHA IV: if re-assessed by public health officers (1)
NYHA III, IV (2)
Heart assist devices
Fit: if re-assessed by public health officers (2)
Heart valve disease, NYHA IV and syncope
Fit: if re-assessed by public health officers (1)
Heart valve disease, NYHA III, IV and EF<35%
Fit: if re-assessed by public health officers (2)
Structural or electrical cardiomyopathy and syncope with 2 or more of the following: interventricular septum >3 cm, nonsustained VT, sudden cardiac death familial history
Fit: if re-assessed by public health officers (2)
Long-QT with syncope, Torsade de Pointes and QTc>500ms
Fit: if re-assessed by public health officers (2)
Brugada syndrome with syncope or after sudden cardiac death
Fit: if re-assessed by public health officers (1,2)

III. Other Diseases Than Listed in I and II. Fit Under Special Circumstances and Only With Favorable Opinion by Specialists and If Reassessed by Public Health Officers

Arrhythmogenic right ventricular cardiomyopathy

Fit: no symptoms or tachycardias (1) and no ICD indication (2)
Noncompaction cardiomyopathy
Fit: individual assessment (1,2)
Catecholaminergic, polymorphic cardiomyopathy
Fit: no syncope, ICD implanted (1,2)
Short-QT-syndrome
Fit: no syncope, ICD implanted (1,2)
Other nonlisted cardiomyopathy
Fit: individual assessment (1,2)

Confidentiality and the Duty to Inform

In most countries treating physicians are under an obligation to tell their patients if they believe they are unfit to drive, and to record that they have done so. Vice-versa, withholding such an information is held to be a medical treatment error.

Practical Advice

The following Table summarizes the most important questions in daily clinical practice. Therefore, in terms of practicability it is condensed to the essence. The goal is a A4 format sheet, which can be fixed at a place to quickly look up in daily routine. The order of conditions does not stick to the order of a certain recommendation. The order of different conditions results from importance, relevance and resulting waiting times based on recent literature and recommendations.[4,16,36-40] Importantly, the differentiation between group 1 and group 2 drivers from the Austrian is not compliant with the European Society recommendations. Therefore, the following tables distinguishes between private (Group 1) and professional drivers (Group 2) which is concordant with recommendations made by the European Society of Cardiology and has therefore more practicability for the outpatient or ward setting where exactly these questions often arise.[41,42]

Clinical Perspective

There are national variations in regulation of fitness to drive in patients at risk of sudden incapacitation, and the approach to its implementation. Much of the scientific data that back up current recommendations are historical and may not accurately reflect changes in vehicles and the driving environment. In future, methods to estimate the individual risk of harm while driving may prove useful. The development of new technologies

TABLE. Fitness (Fit) or non-Fitness (nFit) to drive for Group (Gr) 1 or 2 drivers with recommended waiting times (6M (months) to 1W (week))

Condition	Gr	Fit	nFit	6M	3M	4W	1W	Condition
Hypertension	1	✓						Proper treated
	2	✓						<180/110 mmHG
Acute coronary syndrome	1	✓				✓[b]		
LVEF>35%(a) <35%(b)	2	✓[a]	✓[b]			✓[a]		a=or 6 weeks
Stable angina pectoris	1	✓						
	2		✓					At low level
Percutaneous coronary	1	✓						
Intervention (PCI)	2	✓				✓		
Coronary artery bypass	1	✓				✓		
graft (CABG)	2	✓			✓			
NYHA I or II	1	✓						
	2	✓						If LVEF>35%
NYHA III	1	✓						If stable
	2		✓					
Heart Transplant (HTX[a])	1	✓						Individual
assist devices (LVAD)	2		✓	✓[a]				Individual
Heart valve intervention/	1	✓				✓		
surgery	2	✓			✓			Individual
c/pavK intervention/	1	✓					✓	
surgery	2	✓				✓		
Syncope, first episode	1	✓						
(typical vasovagal)	2	✓						Low risk, not sitting
Syncope, multiple or	1	✓		✓				
unexplained	2		✓					
Syncope presumed due to	1		✓					
VT with a genetic cause*	2		✓					
Syncope in nonstructural	1	✓			✓			After ablation
heart disease (R/LVOT)	2	✓		✓				After ablation
SA/AV-I-Block, no syncope	1	✓						
	2	✓						
LBBB/RBBB/Hemiblock	1	✓						
	2	✓						
Altern./ bifascicular block	1		✓					
	2		✓					
AVNRT/EAT/WPW (no syn-	1	✓						
cope, no AFIB)	2	✓						
Atrial fibrillation/flutter	1	✓						
(no syncope)	2	✓						
Pacemaker Implant/change	1	✓					✓[a]	+PM-Test
(a=PM dependent/syncope)	2	✓				✓[a]		+PM-Test
ICD Implantation (a=sec.	1	✓			✓[a]	✓[b]		b = 1-2 weeks
prev., b = prim. prev.)	2		✓					
ICD box change	1	✓					✓	
ICD lead change	1	✓				✓		
ICD therapy appropriate	1	✓			✓			
ICD refused (a=sec. prev.)	1	✓		✓[a]				prim. prev. fit

*Untreated in: Brugada-syndrome, hypertrophic cardiomyopathy, long-QT-syndrome, arrhythmogenic right ventricular cardiomyopathy, noncompaction - cardiomyopathy, catecholaminergic polymorphic ventricular tachycardia, short-QT-syndrome.

such as autonomic driving assistance level 2 or 1 will have an impact on society's willingness to accept excess risk as a result of medical conditions.

Future Impact on Developments in Traffic Medicine

From the above mentioned, a number of priority issues seem important for consideration in Europe as listed below[39]:

1) The need for a standardized process across all Member States in assessing a driver's fitness to drive is warranted, based on international best practice.
2) Consistent guidelines for medical practitioners and promotion of materials to support self-regulation towards reduced driving and cessation would further help people make the decision when to cease driving themselves.
3) A wider use of Medical Assessment Boards to ensure the licensing authorities have more of a major say in removing a person's right to be licensed would also help to take away some of the medical practitioners' concerns of patient blame.
4) The development of an effective and transparent screening protocol for use across Europe for testing the functional capabilities of at-risk drivers is warranted.

Conclusion

Patients with syncope and/or cardiovascular disease should be properly advised by their physicians about their fitness to drive, and restrictions should be documented. There is need for consistent, European, uniform recommendations. Future developments in autonomous driving technologies may facilitate this approach.

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