in the literature confirms that this is the case in the HSP group. On the contrary, nondepolarising muscle relaxants carry a risk of exaggerated muscle relaxant response, as was the case in our patient history. This is very well illustrated by Dallman,⁷ who reported recurarisation after a well conducted rocuronium antagonism by prostigmine. Franco-Hernández *et al.*¹ reported the use of sugammadex in two cases because of the presence of moderate neuromuscular block at the end of surgery. After the use of sugammadex, no recurarisation was observed as in our case. Rocuronium appears to be the best choice when muscle relaxation is indicated, because of the possibility of antagonising its effects with sugammadex. Long-acting neuromuscular blockers should be avoided and a train of four ratio over 0.9 must be obtained before extubating. Reversal of neuromuscular blockade with neostigmine may risk recurarisation.

Our patient appeared to be more sensitive to hypnotic drugs; BIS values were low in spite of a low propofol dosage. Was this due to HSP? Five case reports involving the use of general anaesthesia have previously been published.^{1,3,5,7} Franco-Hernández *et al.*¹ described the case of a 43-year-old woman anaesthetised by TIVA (propofol 4 to 8 mg kg⁻¹.h⁻¹) for a subtotal colectomy and one case using a halogenated agent (sevoflurane with minimum alveolar concentration 0.6 in a 47-year-old woman undergoing cholecystectomy); in these cases, the BIS was monitored and the drug doses seemed to be low in the case involving halogenated anaesthesia. In the other cases, propofol was used for induction and maintenance was carried out with halogenated agents; depth of anaesthesia was not monitored. In all these case reports, no complications from hypnotic or opioid drugs were reported. The problem is that HSP is a heterogeneous group of genetic diseases and there is no certainty that anaesthetic drugs will have the same action in all variants. Anaesthesia depth monitoring may be the best approach in HSP patients.

Some authors prefer regional spinal anaesthesia to general anaesthesia.^{2,4,6} HSP is not known to increase the toxicity of local anaesthetics, and no complications have been reported.

Some patients may be unaware that they have HSP when undergoing anaesthesia. This idea is reassuring when we meet a patient whose diagnosis of HSP is known. The only advice we can give is to evaluate clinical pharmacodynamics intraoperatively by monitoring depth of anaesthesia and neuromuscular blockade.

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OPEN

A case series of life-threatening succinylcholine-induced anaphylaxis

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Editor,

Since 1952, succinylcholine has been widely used worldwide as the first choice of muscle relaxant to facilitate tracheal intubation in rapid sequence induction of anaesthesia. Despite its unique properties (i.e. short onset and offset and intense blockade), succinylcholine may induce some severe adverse reactions, such as anaphylactic reactions.^{1,2} Diagnosing anaphylactic reactions remains challenging.³ Although guidelines are available, the evidence base for the assessment and subsequent management of patients with anaphylaxis is weak due to the absence of randomised, controlled studies of therapeutic interventions performed during an anaphylactic reaction.^{4–6}

We report here the prevalence of clinical symptoms, the appropriateness of rescue therapy and the diagnosis difficulty of succinylcholine-induced anaphylaxis, based on the analysis of 21 case reports of life-threatening (Ring and Messmer grades III and IV) reactions. These cases were reported between October 2011 and January 2015 at

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two French university hospitals (Lariboisière-Saint-Louis University Hospital and Brest University Hospital). The role of succinylcholine was confirmed by two senior allergologists with much experience in diagnosing perianaesthetic anaphylactic reactions. Ethical approval for this study was provided by the Ethical Committee of *Société de Réanimation de Langue Française*, (No. CE SRLF 14-1).

This case series documents the acuteness, suddenness and severity of cardiovascular events in succinylcholine-related anaphylaxis and demonstrates the difficulty of diagnosing anaphylaxis, which led to frequent sub-optimal and/or inappropriate management at the time of anaesthetic induction. Patients had a median age of 64 years (range 27 to 81), 57% were women, 48% had a history of hypertension with 14% being treated with beta-blocker and 24% were obese. A total of 67% of cases occurred during scheduled surgery and 33% during emergent surgery. Indications for succinylcholine were in accordance with the French recommendations. Overall, clinical signs appeared immediately after IV succinylcholine administration and were graded as severe, with 21/21 cardiovascular collapse and 6/21 cardiac arrest. The systolic and diastolic arterial blood pressures rapidly decreased in all patients after the administration of

succinylcholine, associated with an increased heart rate (Fig. 1). In six cases, cardiac arrest appeared less than 5 min after succinylcholine administration and was preceded by cardiovascular collapse in all cases. For these six cases of cardiac arrest, one patient died in the operating room; one patient died in the ICU 2 days after the anaphylactic reaction from a refractory shock; one patient had a refractory cardiac arrest with extracorporeal membrane oxygenation assistance and died 12 days later in the ICU; and three of them survived with an ICU stay of 8, 12 and 30 days, respectively. All patients who did not suffer cardiac arrest survived. Although cardiovascular events were present in all patients, clinical diagnosis remains difficult as cutaneous and respiratory symptoms were lacking in half of the patients (cutaneous signs in 10/21 cases and bronchospasm in 11/21 cases) and as collapse is relatively frequent during anaesthesia. The difficulty of diagnosing perianaesthetic anaphylaxis probably led to suboptimal and/or delayed use of epinephrine, the recommended first-line therapy drug.⁴ Indeed, management of these severe anaphylactic reactions was heterogeneous, particularly for catecholamine administration. Only 6/21 cases received epinephrine as the first-line therapy, 12/21 received it as the second-line therapy and 3/21 did not receive epinephrine. These results are in accordance with a previous report.⁷ These results

Fig. 1

Individual data of heart rate, oxygen saturation, SBP, DBP for the 21 cases before induction (T1), at the time of anaphylactic shock (T2) and after resuscitation (T3). DBP, diastolic blood pressure; HR, heart rate; SBP, systolic blood pressure.

Table 1 Biological and skin tests

	Test performed	Positive result	Quantitative result
Plasma histamine (nmol l ⁻¹)	19/21 (90%)	15/19 (79%)	100 (67 to 1479)
Plasma tryptase (µg l ⁻¹)	19/21 (90%)	17/19 (89%)	95 (48 to 188)
Plasma IgE succinylcholine (kU l ⁻¹)	17/21 (81%)	16/17 (94%)	0.8 (0.3 to 4.9)
Skin test succinylcholine	14/21 (67%)	14/14 (100%)	
Positive test			Case
Skin tests (14/21)			14/14
Alone			1/14
And plasma histamine and/or tryptase and specific IgE			9/14
And plasma histamine and/or tryptase			3/14
And specific IgE			1/14
Skin tests not performed (7/21)			
Plasma histamine and/or tryptase and specific IgE			5/7
Plasma histamine and tryptase			1/7
Specific IgE			1/7

Values are expressed as *n* (%). Quantitative results are expressed as median (25–75 percentile). Histamine was considered positive if more than 15 nmol l⁻¹, tryptase if more than 15 µg l⁻¹ and IgE if more than 0.1 kU l⁻¹.

demonstrated that the rescue therapy was suboptimal and/or delayed in at least 70% of the reported patients. In only 55% of cases was the administered epinephrine dose in accordance with the French recommendations (i.e. 1 mg for cardiac arrest and 100 to 200 µg for hypotension). A total of 73% of cases with bronchospasm received inhaled salbutamol, and 18% of these patients received additional intravenous salbutamol.

It also emphasises the difficulty in determining the causality of succinylcholine in such adverse reactions. Patient history, clinical symptoms, histamine and tryptase measurements, IgE-specific assays and skin tests are the gold standard for diagnosing anaphylactic reactions. The diagnosis of anaphylaxis during anaesthesia should include different confirmatory tests rather than a single test and patients presenting an anaphylactic reaction during anaesthesia should be fully investigated. Results of biological (i.e. plasma histamine, plasma tryptase and specific plasma IgE) and skin tests are presented in Table 1. Skin tests (intradermal tests, succinylcholine 10 mg ml⁻¹), which remain the gold standard to prove drug-induced anaphylaxis, were performed in 14/21 cases and were systematically positive for succinylcholine. They were not performed in 4/21 cases because of death and in 3/21 cases because of loss of follow-up. Finally, only 9/21 cases were fully investigated with biological tests (i.e. plasma histamine and/or tryptase and specific plasma IgE) followed by skin tests. The three patients who died after cardiac arrest related to succinylcholine anaphylaxis had been fully investigated for biological tests (i.e. plasma histamine, plasma tryptase and specific plasma IgE) and had concordant positive results. The difficulty in obtaining the completeness of confirmatory tests and particularly skin tests explains the difficulty for allergologists to draw definite conclusions. Indeed, when a single test is negative, it is not possible to determine whether it is a false-negative test or whether the patient is tolerant to the tested agent. None of the available diagnostic tests demonstrates absolute accuracy.³ However,

physicians need definite conclusions to be able to adapt their practice to each patient.

Close collaboration between the allergologist and the anaesthesiologist is a key issue when investigating anaphylactic reactions.

In conclusion, when using succinylcholine to induce general anaesthesia, our study strongly suggests that, in cases of collapse resistance to ephedrine and phenylephrine, epinephrine should be quickly used. Final diagnosis remains difficult, and biological and skin tests should be fully performed.

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Mobile phone text messaging reminder decreases the rate of nonattendance at a preoperative anaesthesia clinic

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Editor,

In healthcare, non-attendance for appointments is a main cause of inefficiency in wasted resources and disturbs the planned work schedules. Moreover, in several countries, optimising the anaesthesia medical time is important because the anaesthesiologist's resources are limited. Mobile phones and text messages (short message service, SMS) are of growing use in the medical field. Several studies, excluding anaesthesia, showed that SMS reminders increase attendance at healthcare appointments.¹ Therefore, we hypothesised that SMS reminders could reduce the rate of non-attendance for preoperative anaesthesia clinics (PAC).

The current single centre, retrospective study was conducted at Rouen University Hospital from January 2013 to March 2015. Two stages were determined: before the use of SMS reminders, from January 2013 to April 2014, and after using SMS reminders (sent to patients' mobile phones the day before an appointment), from May 2014 to March 2015. Ethical approval for this study (protocol no. E2015-38) was provided by the ethics committee for non-interventional research (CERNI = Comité d'Ethique de la Recherche Non-Interventionnelle) at Rouen University Hospital, Rouen, France (Chairperson: Prof LM Joly; Luc-Marie.Joly@chu-rouen.fr). The primary endpoint was the non-attendance rate. The secondary endpoint was the cancellation and the new appointment rates. Direct costs relating to efficiency were calculated.

Values presented are as percentages. Pearson's Chi-square test ($df=1$) was used to determine statistically significant differences for qualitative variables (α risk of

5%). Statistics were performed using GraphPad Prism (GraphPad Software; La Jolla, California, USA) software.

A total of 14 316 patients were included in the study over a 26-month period. In the first stage (before SMS) 7177 patients were included and 7139 in the second (after the SMS). The total number of non-attenders from January 2013 to March 2015 was occurred in 719 patients (5%). The SMS reminder decreased the rate from 6.2% ($n=448$) to 3.8% ($n=271$) ($P<0.001$). Moreover, there was a lower cancellation rate ($P<0.001$) in the group with SMS (9.1%, $n=652$) compared with the control group without SMS (10.4%, $n=745$). A new appointment occurrence decreased ($P<0.001$) in SMS group (14.8%, $n=1058$) compared with the control group (19.7%, $n=1415$). No efficiency for PAC is expensive (about 27 000 Euros for first stage), and the cost decreased by 10 791 Euros with SMS reminder.

In our study, the overall rate of non-attendance was 5% (719/14 316), and it decreased from 6.2 to 3.8% with an SMS reminder. Moreover, the cancellation and new appointment rates were also improved after an SMS reminder. It could be estimated that SMS reminders resulted in 900 Euros saved every month. Our results deserve several comments. The lack of randomisation and the potential for bias must be taken into account. Despite its retrospective design, the current study included 14 316 patients (fourth biggest study according to a systematic review).² In addition, the study was conducted over a short period of time, which allowed us to observe the direct impact of the SMS reminders and limits other compounding factors. Another bias was the single-centre design. This study took place in the anaesthesia department of the Rouen University Hospital, which benefits from a central board of consultation, thus limiting bias during the period of the study such as changes in scheduling policy, as this would impact all the patients included in the study.

The rate of non-attendance in the control group (before SMS reminder) was lower than those found in previous studies (ranging from 23 to 32% and even up to 72.5%)¹ but these included mainly follow-up consultations and screening consultations and not the PAC. The factors usually causing non-attendance are forgetfulness and erroneous scheduling.³ Hasvold and Wootton² showed that appointment reminders (operator messaging, automated voice message or SMS) decreased the non-attendance rate from a median of 23.1% to 12.5%. In our study, the SMS reminders also decreased the non-attendance rate at the PAC. This result is in agreement with a recent meta-analysis that focussed on SMS reminders and other means of communication such as phone calls or postal reminders.¹ The better results of SMS reminders versus postal reminders could be explained by the risk of incorrectly addressing printed reminders. SMS are generally