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Short Communication

Order of draw practices in venous blood sampling at clinical biochemistry departments in the Danish health care system

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ABSTRACT

Background: Deviation in blood collection procedures is a central source of preanalytical variation affecting overall analytical and diagnostic precision. The order of draw of venous sampling is suspected to affect analytical results, in particular for coagulation analysis. Here we compare the procedures in venous blood sampling among clinical biochemistry departments to assess the uniformity of order of blood draw and adherence to international guidelines in the Danish health care system.

Methods: We collected venous order of draw procedures from 49 clinical biochemistry departments at 22 public hospitals in Denmark. Procedures were compared to the international guidelines from the Clinical Laboratory Standards Institute (CLSI) and World Health Organization (WHO), and assessed in relation to department ISO 15189:2012 accreditation.

Results: We observed seven different order of draw procedures related to citrate, serum, heparin, and EDTA tubes, and the use of discard tubes in relation to coagulation assays. 31 departments (63.3%) were found to adhere to CLSI and WHO guidelines. A majority of departments instructs the use of discard tubes before collection for coagulation assays in citrate tubes (44 departments; 89.8%). The citrate tube was the first sample tube to be drawn for most departments (35 departments; 75.5%); and the preferred order of non-citrate tubes was serum-heparin-EDTA (36 departments; 73.5%). Adherence to the CLSI and WHO guidelines was not associated with department ISO 15189:2012 accreditation ($p = .57$).

Conclusions: Venous order of draw procedures is diverse at Danish clinical biochemistry departments and show moderate adherence to international guidelines.

1. Introduction

The majority of errors (46.0%–68.2%) in the total process of laboratory medicine occur in the preanalytical phase [1–4]. An important step in this phase is venous blood sampling where the order of draw has been advocated as a potential source of errors. A recent systematic review of the available literature by the European Federation for Clinical Chemistry and Laboratory Medicine (EFLM) Working group for Preanalytical Phase [5] supported the importance of the correct order of draw to prevent contamination due to additive carryover.

Evidence-based guidelines have been developed by the Clinical Laboratory Standards Institute (CLSI) [6] and World Health

Organization (WHO) [7]. However, Danish compliance to international guidelines and inter-laboratory variation is currently not known. Therefore, the aim of this study was to assess the uniformity on venous order of blood draw and adherence to CLSI and WHO guidelines in the Danish health care system. In Denmark, order of draw decisions are not necessarily made at hospital level, and each clinical biochemistry departments follow their own local procedures on venous blood draw. Thus, the uniformity in procedures was analyzed at department level. Furthermore, we assessed whether departmental accreditation by ISO 15189:2012 (Medical laboratories - Requirements for quality and competence) was associated with adherence to international guidelines.

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2. Materials and methods

We systematically collected venous order of draw procedures from clinical biochemistry departments that perform blood sampling in all public hospitals in Denmark. We did not include health centers and psychiatric departments. The collection of procedures was performed in the period from February to April 2017. If a hospital had more than one clinical biochemistry department, then procedures were obtained for each department independent of whether or not the department had different procedures or management. If available, procedures were retrieved from hospital websites, otherwise departments were contacted by mail or phone. We also collected data on whether or not the department had received ISO 15189:2012 accreditation, which specifies requirements for quality and competence in medical laboratories [8].

We recorded and compared the order of draw for citrate, serum, heparin and EDTA tubes, as well as the use of discard tubes in relation to coagulation assays. No distinction was made as to whether or not the procedures recommended the use of specific clot activators or gels in the specific tube types. The collected Danish procedures were compared to the guidelines recommended by CLSI and WHO [6,7].

The association between department ISO 15189:2012 accreditation and the adherence to CLSI and WHO guidelines [6,7] was analyzed by chi² test using MS Excel 2010.

3. Results

3.1. Procedures collected

Venous blood order of draw procedures were collected from 49 clinical biochemistry departments at 22 public hospitals within the Danish public health care system.

3.2. Order of draw

We observed seven different variations of order of draw procedures related to citrate, serum, heparin, and EDTA tubes, and the use of discard tubes related to coagulation assays (Table 1). The most frequent order of draw procedure covering 31 departments (63.3%) were in line with the CLSI and WHO guidelines. However, the remaining 18

Table 1

Venous order of draw guidelines from the Clinical Laboratory Standards Institute (CLSI) and the World Health Organization (WHO) [6,7] and procedures in clinical biochemistry departments (n = 49) from 22 public hospitals in Denmark obtained between February to April 2017; for the order of draw of citrate tubes, serum tubes, heparin tubes and EDTA tubes, and the use of discard tubes related to coagulation tubes.

Guidelines	Recommended order of blood draw						
	Use of discard tube	1st tube	2nd tube	3rd tube	4th tube		
CLSI [6], WHO [7]	When coagulation tubes are collected as the first or the only tube Using a straight needle: Not for INR and PT Using a winged blood collection set: Always.	Citrate	Serum	Heparin	EDTA		
Procedures							
Departments grouped by procedure)	Departments (% of total, n = 49)	Achieved department accreditation of ISO 15189:2012) (% of total)	Use of discard tube	1st tube	2nd tube	3rd tube	4th tube
Group 1	31 (63.3)	23 (74.2)	Always, if coagulation tubes are collected	Citrate	Serum	Heparin	EDTA
Group 2	6 (12.2)	3 (50.0)	Always, if coagulation tubes are collected	No specified order for the remaining tubes			
Group 3	4 (8.2)	4 (100.0)	Not specified	Heparin	Citrate	EDTA	Serum
Group 4	3 (6.1)	0 (0.0)	Always	Citrate	Heparin	Serum	EDTA
Group 5	2 (4.1)	2 (100.0)	Always	Citrate	Serum	Heparin	EDTA
Group 6	2 (4.1)	2 (100.0)	Always, if coagulation tubes are collected (except for INR or PT)	Serum	Citrate	Heparin	EDTA
Group 7	1 (2.0)	1	Never	Citrate	Serum	Heparin	EDTA

Prothrombin time (PT), International normalized ratio (INR).

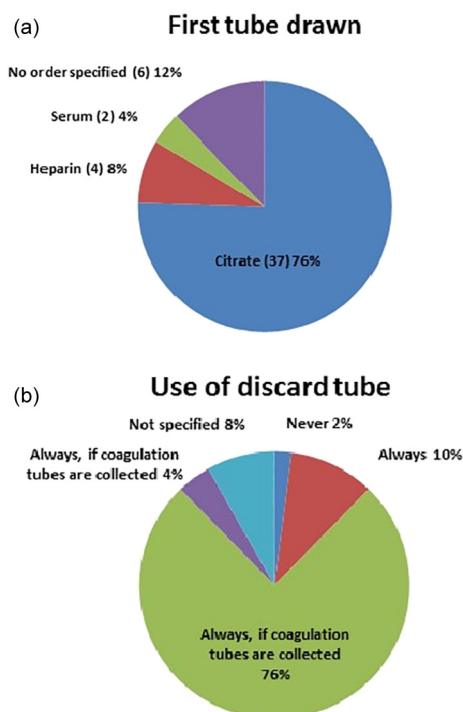


Fig. 1. (a–b) The distribution of procedures of order of draw according to the use of a first draw and use of a discard tube. Achieved from 49 clinical biochemistry departments, covering 22 public hospitals in Denmark.

departments (12.2%) were found to have diverse procedures with six different order of draw policies.

43 of 49 departments (87.8%) gave procedures for order of draw with 37 (75.5%), 4 (8.2%), and 2 (4.1%) departments recommending the first draw to be citrate, heparin, or serum tube containers, respectively (Fig. 1A). When addressing the order of draw for non-citrate tubes, the most frequent order was serum-heparin-EDTA for 36 departments (73.5%), followed by heparin-serum-EDTA and heparin-EDTA-serum for 4 (8.2%) and 3 (6.1%) departments, respectively.

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