MINA: Monitoring of INtravenous Anaesthesia

A system to monitor the infusion of 4 intravenous drugs under the control of a personal computer

F. Cantraine¹, E. Coussaert¹, A. d’Hollander² & L. Barvais³

¹ Data Processing Department; ² Department of Anesthesia, Erasmus Hospital, Brussels School of Medicine, Free University of Brussels (U.L.B.), Brussels, Belgium

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Introduction

For numerous reasons, the control of total intravenous anesthesia with anesthetic drugs with high plasma clearance is made easier by continuous IV administration in comparison to the more conventional technique of repeated boluses. Usually, total intravenous anesthesia requires more than one drug. The performances of microcomputers and the availability of infusion devices (ID) with serial ports permit the design of a PC based system for the simultaneous control of several i.v. drug administrations. The system presented in this work ensures accurate drug titration, allows the coordination of 4 IDs according to time and external events, informs the user about the current and future status of a drug infusion scheme and records the delivered flow rates.

Material and method

The system consists of a central data line sharing device (DLSD) linked to an IBM compatible personal computer with 256 KRAM-operating under MSDOS 2.1 – and to 4 infusion devices (ID) equipped each with one serial port RS232. These connections allow information exchanges between the DLSD and each infusion device at 1200 bauds. Fig. 1 sketches the communication network of MINA. Fig. 2 illustrates the technical features of the 4 commercialized ID in use during the development phase of the system. The communication network configuration and the softwares allow to reserve the computer for other tasks even during a drug administration session (DAS). Fig. 3 represents the equipment, gathered on a trolley, for its use in an Operating Room (O.R.): one personal computer with an incorporated printer, an uninterruptible power supply unit, the DLSD, one Imed 929 volumetric pump and three Perfusor Secura E automatic syringes.

Two independent programs MINA 1.0 and DRIVER INFU 1.0 enable to control the IDs via the personal computer keyboard. Schematically, MINA 1.0, programmed in Basic, represents the link between the keyboard and DRIVER INFU which translates the commands of MINA 1.0 into the units of any RS232 selected infusion device. DRIVER INFU, programmed in C, permits to dedicate any connectable infusion device to any port of the Data Line Sharing Device.

The DLSD is a communication concentrator. It possesses one primary port connected to the per-
personal computer and 1 to 16 secondary ports connectable to IDs. Each secondary port is assignable to one infusion device. This kind of port can function in receiving or emitting mode. During emission, the messages issued from the infusion device are transmitted to the PC; during reception, the messages coming from the PC are addressed to the ID.

**Pre drug administration configuration procedure**

Before any drug infusion, once the MINA program has been loaded the anesthetist has to enter the name and weight of the patient. Thereafter, he has to verify the connection of each ID to the corresponding port of the DLSD. An error message is displayed by the system in case of inappropriate ID connection.

**Infusion sheet (IS) description**

For each ID, MINA allows the composition or the loading of ISs. Each IS is a specific ASCII disk file corresponding to one drug and one ID. Fig. 4 illustrates an IS foreseen to administer atracurium via a Perfusor E. When the IS is retrieved from the disk it is selected through the catalog and load function (F4, F5 see later). Each of these IS has been composed and checked for compatibility of the scheduled infusion steps, drug reservoir concentration and ID characteristics with CINA [1]. The theoretical adequacy of the infusion scheduling being, already verified with SPINA, a software dedicated to the two and three compartment pharmacokinetics simulation [2]. SPINA has been specially designed to build optimal infusion sequences and, to avoid overload and side effects.

One IS can be composed or modified directly from the keyboard with the editing functions of the MINA main menu – see Functions section: F7, F8, F9 –. In case of keyboard edition, the user must enter the drug name, the concentration of the ID reservoir, the flow rate (µg/kg/min) and the duration (minutes) of each of the consecutive infusion steps. MINA gives notice of any incompatibility between the prescribed flow rates, the concentration of the drug reservoir, the patient characteristics and the performances of the selected ID. Then, MINA converts the flow rates into the flow units of the selected ID. A bolus step of predetermined size related to the patient’s body weight may also be introduced. This bolus step may be superimposed to any executive step.

**Drug administration session (DAS)**

During drug delivery, MINA provides the control of the 4 IDs via the keyboard. The control of an ID is organized either manually via the keyboard by selecting a number from 1 to 4 associated with that ID or, depending of the DAS organization, the control of each ID is organized directly via the coordination table (see the display commands). In the general screen, which provides informations about the 4 IDs, the highlighted zone indicates which ID remains under the direct control of the keyboard for the immediate execution of the different function keys.