Journal of Biosciences and Medicines, 2022, 10, 35-44
https://www.scirp.org/journal/jbm
ISSN Online: 2327-509X
ISSN Print: 2327-5081

Intravenous-Accelerated Saline Particles to Unblock Partially Clogged Blood Vessels Using a Microcontroller

Stephon Stewart[1], Dineshen Chuckravanen[2]

[1]Idea formulation by Mr. Stephon Stewart, Los Angeles, USA
[2]British Association of Cognitive Neuroscience (BACN), Department of Psychology, University of Essex, Colchester, United Kingdom
Email: dineshen2013@gmail.com

How to cite this paper: Stewart, S. and Chuckravanen, D. (2022) Intravenous-Accelerated Saline Particles to Unblock Partially Clogged Blood Vessels Using a Microcontroller. *Journal of Biosciences and Medicines*, **10**, 35-44.
https://doi.org/10.4236/jbm.2022.1011003

Received: January 3, 2022
Accepted: November 6, 2022
Published: November 9, 2022

Abstract

This research assesses the speed of saline fluid in vein vessels using venipuncture medical kit as well as DC submersive pumps that are being controlled by a microcontroller. The microcontroller is monitored and governed using a software IDE interface installed on a powerful laptop. Saline solution is being pumped through a medical syringe at variable speeds up to a maximum of 18.39 cm/second to the vein. The novel technique in this research is the usage of two pumps called **Pump 1** and **Pump 2**. **Pump 1** is used to physically model the flow of "blood" in human vein and the second pump (**Pump 2**) is used to generate the accelerated saline particles that are used to break the yellow grease that is placed on the inside of the vein's wall. A tiny brush is briefly dipped into yellow grease, and then it is used to place one layer (one turn) of yellow grease on the inside of the vein's wall, and then this procedure is repeated to place consecutive layers of yellow grease onto the inside of the wall of the vein vessel using a tiny brush. It was found that accelerated saline particles can in fact destroy fats that are built up inside the veins' walls.

Keywords

Blood Clot, Fat Deposits, Fat Removals, Veins, Microcontroller, Saline Particles

1. Introduction

Thrombosis is a blood clot which is formed within blood vessels, and this blood clot reduces blood flow and obviously affects the health of a person. Both arterial thromboses as well as acute venous thromboses are the most common cause of

death especially in developed countries [1] [2] [3]. The highest percentage of thrombosis related deaths in the United States are cerebrovascular accidents and myocardial infarctions. The capability of the blood to flow freely in veins or arteries depends on complex homeostasis that occurs between plasma proteins, blood cells including platelets, inflammatory factors, cytokines, coagulation factors and also the endothelial lining inside the lumen of veins as well as arteries. Therefore, when there is no balance in the physiologic processes, there can be a drastic increase in the risk of having a thrombosis [2]. An understanding of the pathophysiology of thrombosis and the risk factors that can provoke such condition can help clinicians in their diagnosis, workup, and the management of this disease. Our lifestyle can cause imbalances in our physiological system and therefore induces stress to our day to day activities. This increased accumulation of stress affects our health. A person's veins or arteries become clogged by the accumulation of a substance known as plaque. It is not easy to melt away the plaque, but we can make key lifestyle changes to prevent this accumulation and thus improve our health. In severe cases, medical interventions such as surgeries can help in removing blockages within the blood vessels. Moreover, the clinician can prescribe medication such as statins (cholesterol-reducing drugs) or aspirins [3].

The state of science on venous and arterial thrombosis is always evolving together with the understanding of the risk factors, medical management and hypercoagulability testing [1] [2]. The model which is developed in this research aims at unblocking partially blocked blood vessels that contain fat deposits or small clots inside them. Based on a recent study [4], it was found that there is a possibility of breaking fat deposits using accelerated saline fluid particles that are thrusted onto those fat deposits along the inside wall of the vein vessels with the aim to break these fat deposits into smaller fat particles which can be later drained out easily from the human body system [1]. Therefore, in this research, a syringe pumping system is created to find out if the accelerated saline particles coming out of the syringe will in fact destroy those fat deposits or yellow grease pasted onto the inside wall of the vein's vessel. The next section provides a detailed methodology employed to achieve the aims and objectives of this research.

2. Methodology

Two DC submersive pumps are utilized so that the first pump (Pump 1) is used to pump saline solution through the vein vessel and the second pump (Pump 2) is used to push saline particles through a 21-gauge syringe as shown in **Figure 1**. The speed of flow of the saline solution by the Pump 1 is set to 7.0 cm/second while the speed of flow of the saline particles emanating from the syringe ranges from 7.0 cm/second to 18.39 cm/second. The green layers that are found in the inside of the vein's vessel represent fat deposits or plaques, and the length of the fat deposit is about 2.0 cm which coincides with the width of the tiny brush [5] which is used to paste very thin layer(s) of yellow grease.

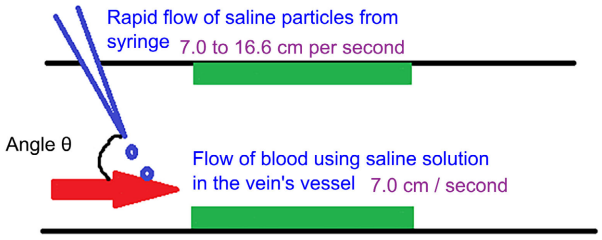

Figure 1. Schematic diagram showing the angular placement of the syringe and the vein's vessel.

These submersive pumps are controlled by a microcontroller. The microcontroller which is used is called the Arduino Uno R3 as well as it is a flexible and a programmable open-source microcontroller board which can be integrated in electronic projects such as projects related to water level control [6]. The microcontroller board consists of the following components that are the ATmega328 (the brain of the board in which the program is stored), Ground Pin, PWN pins whereby PWN means Pulse Width Modulation which can control the speed of the servo motor, DC motor and brightness of the LED. There are 14 digital (0 - 13) I/O pins that are available on the board which can be connected with external components. There are six analogue pins that are integrated on the board and these pins can read the analogue sensor as well as they can convert it into a digital signal. Moreover, the USB interface is utilized to connect the microcontroller board with the computer/laptop in order to upload the microcontroller software programs. The Power LED lights up when the board is connected with the power source. The Arduino program consists of two main parts: **void setup()**—this part sets up the actions that need to be done once and they do not occur again in the running program and the **void loop()** consists of instructions which get repeated again and again until the board is switched off.

Two DC submersive pumps using voltage of 12 V and power of 3 W respectively are employed in this research project, and the maximum pumping capacity of each pump is 200 litres per hour which is about 55.5 cm^3 per second.

2.1. Setup of the Experiment

A powerful laptop intel core i7 vPro 7^{th} Gen is used to write the microcontroller programs and these programs are sent to the microcontroller board. One pump is connected to the vein (using the practice phlebotomy kit as shown in **Figure 2**) which pumps saline solution at a speed of 7.0 cm/second while a second pump is used to eject saline particles from a 21-gauge syringe needle inserted in the "practice medical kit" arm's vein. The speed of the second pump is varied from 7.0 cm/second to 16.6 cm/second to send accelerated saline particles to the inside of the vein such that these particles bump into the fat deposits (plaques) that are artificially placed on the inside of the wall of the vein's vessels (see **Figure 2**). The angle the syringe makes with the horizontal surface is also monitored using a protractor and the angle is varied from 30˚ to 90˚ with 15˚ increment. Layers of yellow grease are also monitored and one turn of yellow grease

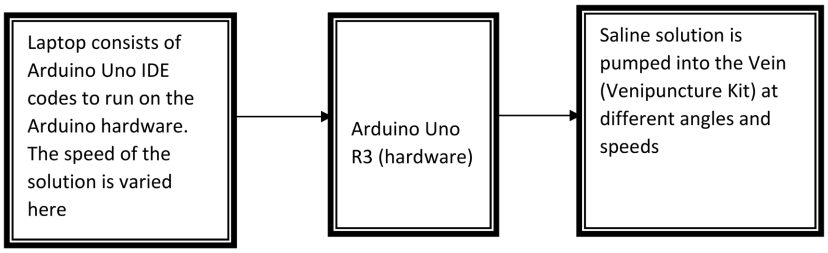

Figure 2. Work process of the Experimental set-up.

around the inside wall of vein is called one layer, and two turns of yellow grease around the inside of the vein's wall is called two layers and so forth (see **Figure 2**). The layers of grease are placed near the outlet of the vein's vessels for ease of the experiment.

The microcontroller sketch codes that were used for the simulation of this experiment are as follows: The **pump 1** and **pump 2** are configured to appropriate pins on the microcontroller board. The LCD display pins are configured in such a way that the speed of the Pump 2 is displayed on the LCD, and the speed of pump 2 is varied using the microcontroller (see **Appendix 1** for the microcontroller codes).

2.2. Calculation of the Final Speed of the Saline Particles

Final speed of the flow of saline solution before impact with layer(s) of grease is depicted in the following Equation (1):

$$\text{Final Speed} = \sqrt{SS^2 + 2 * SS * SN * \cos\left(\frac{\theta}{180} * \pi\right) + SN^2} \quad (1)$$

SS represents the speed of flow of saline solution in the vein's vessel.

SN represents the speed of flow of saline solution from the syringe to the vein's vessel.

θ represents the oblique angle of the syringe needle with the horizontal.

This equation is derived by Dr. Chuckravanen through the use of cosine rule to compute the final speed of the saline particles. This equation takes into consideration the speed of flow of the saline solution in the vein's vessel and the speed of flow of saline solution from the syringe to the vein's vessel.

2.3. Statistical Methods

In this research, collected data will be tested for normality in order to identify appropriate statistical tests such as parametric tests or non parametric test. The respective correlation statistical test will be employed (whether the data is parametric or not). Significant correlation will be computed based on a 95% confidence level. Moreover, a predictive regression equation will be formulated to predict the amount of fat deposits that are destroyed based on the speed of the saline particles and the number of layers of fat deposits on the vein's inside walls.

3. Results

The speed of the saline solution flowing through the vein vessel is kept constant at 7.0 cm/second by keeping the speed of the pump 1 constant (Table 1). The speed of the second pump which is used to pump saline particles at oblique angles (30˚, 45˚, 60˚, 75˚, 90˚) is varied from 7 cm/second to 12 cm/second. The final speed of flow of the saline particles is calculated using the formula (Equation (1)).

Table 1. Datasets of speeds of the pumps, angle of the syringe needle, the computed final speed, number of layers of fat deposits and whether the fats on the inside of the vein's wall are destroyed or not.

Speed of saline solution from syringe (cm/s)	Speed of saline from pump 1: speed through vein (cm/s)	Angle (θ) (measured in degrees)	Final Speed (cm/s)	Number of layers of fat deposits (yellow grease)	Fat destroyed (yes or no) Yes = 1 No = 0
7.0	7.0	90	9.90	1	**1**
7.0	7.0	75	11.1	1	**1**
7.0	7.0	60	12.1	1	**1**
7.0	7.0	45	12.9	1	**1**
7.0	7.0	30	13.5	1	**1**
8.0	7.0	90	10.63	2	**0**
8.0	7.0	75	11.91	2	**1**
8.0	7.0	60	13.00	2	**1**
8.0	7.0	45	13.86	2	**1**
8.0	7.0	30	14.49	2	**1**
9.0	7.0	90	11.40	3	**0**
9.0	7.0	75	12.75	3	**1**
9.0	7.0	60	13.89	3	**1**
9.0	7.0	45	14.80	3	**1**
9.0	7.0	30	15.46	3	**1**
10.0	7.0	90	12.20	4	**0**
10.0	7.0	75	13.61	4	**1**
10.0	7.0	60	14.79	4	**1**
10.0	7.0	45	15.74	4	**1**
10.0	7.0	30	16.43	4	**1**
11.0	7.0	90	13.03	5	**0**
11.0	7.0	75	14.48	5	**1**
11.0	7.0	60	15.71	5	**1**
11.0	7.0	45	16.70	5	**1**
11.0	7.0	30	17.41	5	**1**
12.0	7.0	90	13.89	6	**0**
12.0	7.0	75	15.37	6	**1**
12.0	7.0	60	16.64	6	**1**
12.0	7.0	45	17.65	6	**1**
12.0	7.0	30	18.39	6	**1**

3.1. Statistical Analysis Result

The two factor variables were tested for normality and as shown in the following table (**Appendix II**, Table A1), it was found that after performing the Kolmogorov-Smirnov(K-S) test, both independent variables that are final speed and number of layers of fat deposits satisfy the test for normality [7] and their distributions are normal. Therefore, the subsequent test is correlation analysis using Pearson's correlation tests [8] for the two pairs of variables (Number of layers of fat deposits and fat destroyed; and final speed of saline solution and fat destroyed).

From Table A2 (see **Appendix II**), it is clearly shown that there is a positive significant relationship (as statistical probability p is much less than 0.05) between final speed of the saline solution and whether the fat is destroyed or not (R = 0.399, p = 0.029, statistically significant). This means as the speed of the saline solution is increased, there is the tendency that the fat deposit will be destroyed.

Moreover, from Table A3 (see **Appendix II**), it is shown clearly that there is no statistically significant relationship between the dichotomous variable fat destroyed (yes/no) and the number of layers of fat pasted on the inside of the vein's wall. One observation is that as the number of layers of fat is increased, it is hard for the fat to be destroyed as the Pearson correlation between these two variables are negative (R = −0.131).

3.2. Linear Regression Analysis Result

The final analysis consists of regression analysis using number of layers of fat deposits and final speed as independent variables and fat destroyed as the dependent variable. From the model summary (**Appendix II,** Table A4), it was found that these two independent variables account for 48.9% of the variation in the dependent variable. Table A5 (see **Appendix II**) shows ANOVA results which confirm that the model is fit and these changes are significant [9] [10]. Table A6 (**Appendix II**) demonstrates the relationship between the dependent variable (Fat destroyed) and the independent variables (Number of layers of fat deposits and final speed) are statistically significant at 1%. The linear regression is shown below (Equation (2)) and this can be used to predict whether fat will be destroyed based on the number of layers of fat deposits placed onto the inside of the vein's vessels, and the final speed of the saline solution upon impact on those fat deposits.

$$\text{Fatdestroyed} = -0.190 * \text{NoOfLayersofFatdeposits} + 0.180 * \text{FinalSpeed} - 1.049 \quad (2)$$

4. Discussion and Conclusions

This work has successfully attempted to simulate the flow of blood through vein using saline solution as a medium [11] [12] [13] [14] and the phlebotomy vein kit has helped us to do so without affecting any human health [15]. Moreover, the speed of saline fluid particles emanating from a 21-gauge syringe needle was

varied just before entering inside the vein's vessel. The idea of varying the speeds of the saline particles really has positive effects on fat deposits degradation. Moreover, two different pumps governed the speed of flow of the saline solution inside the vein, and also the speed of the particles through the needle.

A microcontroller was used to control these pumps and also display the speed of flow of the saline fluid particles on a LCD for monitoring purposes. The statistical analysis demonstrated that there is a positive relationship between the speed of the accelerated saline fluid particles onto the fat deposits, and the successful elimination of the fat or not. The speed of impact of those fluid particles disintegrates the fat deposits which then promotes the destruction of fats. Moreover, regression analysis showed that both independent variables (final speed of saline solutions and number of layers of fat deposits) are important in predicting the dichotomous dependent variable (fat destroyed [yes/no]).

This work provides a platform for future research to conduct analyses on animals (such as wistar rats) to find out if this technique is medically feasible for human beings. If this research is extrapolated to animal research, the pumps should be customized in such a way that one pump will be used to work with blood whose density differs from the density of saline solutions that were employed in our model, and also the speeds of the fluid particles in the syringe should be customized and assessed to investigate whether they can really disintegrate fat deposits and the *duration* of destroying these fat deposits should be monitored as well. The size of the fat deposits, the strength of adhesion of these fat deposits bound to the inside of the vein's wall should be assessed and investigated.

This research will help future research to concentrate their effort in analyzing an ideal saline solution which when accelerated can in fact break fat deposits onto the veins' walls. These findings will help humanity in the long run to combat heart attacks or brain strokes owing to blockages of arteries or veins.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Ashorobi, D., Ameer, M.A., Fernandez, R. (2021) Thrombosis. StatPearls Publishing, Treasure Island. https://www.ncbi.nlm.nih.gov/books/NBK538430

[2] Mackman, N. (2008) Triggers, Targets and Treatments for Thrombosis. *Nature*, **451**, 914-918. https://doi.org/10.1038/nature06797

[3] Johnson, J. (2018) Is It Possible to Unclog Your Arteries? Newsletter. Medically Reviewed by Gerhard Whitworth. https://www.medicalnewstoday.com/articles/321238

[4] Stewart, S. and Chuckravanen, D. (2021) Novel Method Employing Accelerated-Oscillated Wave Saline Solutions to Unblock Blood Vessels—Physics and Fluid Dynamics Perspectives and Simulations. *Open Journal of Biophysics*, **11**, 415-424. https://doi.org/10.4236/ojbiphy.2021.114018

[5] Teeny Tiny Little Brushes for Teeny Tiny Little Lines. https://www.sweetsugarbelle.com/2012/12/teeny-tiny-little-brushes-for-teeny-tiny-little-lines

[6] Wahyuni, R., Sentana, J.T., Muhardi and Irawan, Y. (2021) Water Level Control Monitoring Based on Arduino Uno R3 ATMega 238p Using Lm016l LCD at STMIK Hang Tuah Pekanbaru. *Journal of Robotics and Control*, **2**, 265-269. https://doi.org/10.18196/jrc.2489

[7] Saporta, G. (2006) Probability, Data Analysis and Statistics. Editions Technip, Paris, 359-370.

[8] Davey, C.E., Grayden, D.B., Egan, G.F. and Johnston, L.A. (2013) Filtering Induces Correlation in fMRI Resting State Data. *NeuroImage*, **64**, 728-740. https://doi.org/10.1016/j.neuroimage.2012.08.022

[9] James, G., Witten, D., Hastie, T. and Tibshirani, R. (2013) An Introduction to Statistical Learning. Springer Texts in Statistics, Springer Verlag, Berlin. https://doi.org/10.1007/978-1-4614-7138-7

[10] Altman, N. and Krzywinski, M. (2015) Simple Linear Regression. *Nature Methods*, **12**, 999-1000. https://doi.org/10.1038/nmeth.3627

[11] Ziyaeifard, M., Alizadehasl, A., Aghdaii, N., Sadeghi, A., Azarfarin, R., Masoumi, G. and Golbargian, G. (2015) Heparinized and Saline Solutions in the Maintenance of Arterial and Central Venous Catheters after Cardiac Surgery. *Anesthesiology and Pain Medicine*, **5**, e28056. https://doi.org/10.5812/aapm28056

[12] Bertoglio, S., Solari, N., Meszaros, P., Vassallo, F., Bonvento, M., Pastorino, S., *et al.* (2012) Efficacy of Normal Saline versus Heparinized Saline Solution for Locking Catheters of Totally Implantable Long-Term Central Vascular Access Devices in Adult Cancer Patients. *Cancer Nursing*, **35**, E35-E42. https://doi.org/10.1097/NCC.0b013e31823312b1

[13] Kulkarni, M., Elsner, C., Ouellet, D. and Zeldin, R. (1994) Heparinized Saline versus Normal Saline in Maintaining Patency of the Radial Artery Catheter. *Canadian Journal of Surgery*, **37**, 37-42.

[14] Cruzeiro, P.C., Camargos, P.A., Tatsuo, E.S., Picarro, C., Campos, B.A., Paixao, R.M., *et al.* (2012) Percutaneous Central Venous Catheterization through the External Jugular Vein in Children: Is Inserting the Guide Wire into the Superior Vena Cava Essential for Successful Catheterization? *Journal of Pediatric Surgery*, **47**, 1742-1747. https://doi.org/10.1016/j.jpedsurg.2012.04.018

[15] Ialongo, C. and Bernardini, S. (2016) Phlebotomy, a Bridge between Laboratory and Patient. *Biochemia Medica*, **26**, 17-33. https://doi.org/10.11613/BM.2016.002

Appendix 1

(Microcontroller codes to control the pumps which control the speed of flow of the saline solutions).

Pump_Uno1

```
#include <LiquidCrystal.h>
int motor1_ena=3;
int motor1_in1=4;
int motor1_in2=5;

int motor2_enb=6;
int motor2_in1=7;
int motor2_in2=8;
int speedAll;


const int rs = 4, en = 5, d4 = 11, d5 = 12, d6 = 13, d7 = 14; //modify for uno entries
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup() {
  // put your setup code here, to run once:

  lcd.begin (16,2);
  lcd.home ();
  lcd.setCursor(0,0);
  lcd.print(" Start .....");
  pinMode(motor1_ena,OUTPUT);
  pinMode(motor1_in1,OUTPUT);
  pinMode(motor1_in2,OUTPUT);


}
void loop() {
  // put your main code here, to run repeatedly:
  digitalWrite(motor1_in1,HIGH);
  digitalWrite(motor1_in2, LOW);

  digitalWrite(motor2_in1,HIGH);
  digitalWrite(motor2_in2, LOW);

  speedAll=analogRead(A0);
  speedAll=speedAll*0.2492668622;

  analogWrite(motor1_ena,speedAll);
  analogWrite(motor2_enb,speedAll);


  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("  Speed : ");
  lcd.print(speedAll);
}
```

Appendix 2 (Statistical Tests)

Table A1. Kolmogorov-Smirnov Test.

		Final Speed	No of Layers of Fat deposits
N		30	30
Normal Parameters[a,b]	Mean	14.1243	3.5000
	Std. Deviation	2.16024	1.73702
Most Extreme Differences	Absolute	0.077	0.139
	Positive	0.077	0.139
	Negative	−0.057	−0.139
Test Statistic		0.077	0.139
Asymp. Sig. (2-tailed)		0.200[c,d]	0.142[c]

a. Test distribution is Normal. b. Calculated from data. c. Lilliefors Significance Correction. d. This is a lower bound of the true significance.

Table A2. Correlation between final speed and fat destroyed (yes/no).

		Final Speed	Fat destroyed
Final Speed	Pearson Correlation	1	0.399*
	Sig. (2-tailed)		0.029
	N	30	30
Fat destroyed	Pearson Correlation	0.399*	1
	Sig. (2-tailed)	0.029	
	N	30	30

*. Correlation is significant at the 0.05 level (2-tailed).

Table A3. Correlation between number of layers of fat.

		Fat destroyed	No of Layers of Fat deposits
Fat destroyed	Pearson Correlation	1	−0.131
	Sig. (2-tailed)		0.490
	N	30	30
No of Layers of Fat deposits	Pearson Correlation	−0.131	1
	Sig. (2-tailed)	0.490	
	N	30	30

Table A4. Model summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.724[a]	0.524	0.489	0.27089

a. Predictors: (Constant), Final Speed, No of Layers of Fat deposits.

Table A5. ANOVATests.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.185	2	1.093	14.890	0.000[b]
	Residual	1.981	27	0.073		
	Total	4.167	29			

a. Dependent Variable: Fat destroyed. b. Predictors: (Constant), Final Speed, No of Layers of Fat deposits.

Table A6. Coefficients[a].

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	−1.049	0.386		−2.716	0.011
	No of Layers of Fat deposits	−0.190	0.042	−0.873	−4.555	0.000
	Final Speed	0.180	0.034	1.028	5.367	0.000

a. Dependent Variable: Fat destroyed.