Development of a Graft Weight Prediction Model Using Preoperative CT Volumetric Measurement for Living Donor Liver Transplantation

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Introduction

Background

- Estimation of **graft weight** (GW) is important to both donor and recipient for **safe** and **successful** liver surgery

Recipient	Donor
Too **small graft** ⇒ Posttransplant **complications** such as small-for-size syndrome	Too **much loss** of liver **tissue** ⇒ High risk of postoperative **liver failure**

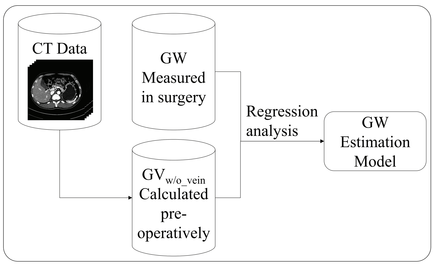
- Existing **regression models** for GW estimation from preoperatively calculated **graft volume with vein** (GV_{w_vein})

Authors	Regression Models	Adjusted R^2	Sample		
			Nationality	Size	Age
Lemke et al . (2006)	GW = 143.704 + 0.678 × GV_{w_vein}	0.76	Germany	16	45.4 ±14.1
Yoneyama et al. (2011)	GW = 0.84 × GV_{w_vein}	0.52	Japan	39	N.A.

- **Limitations** of the existing models
  1. Using GV **with vein** to estimate GW **without vein**
  2. **Small sample size** (16) of Lemke et al.'s model
  3. **Low adjusted R^2 value** (0.52) of Yoneyama et al.'s model
  4. **Not** validated
  5. **Not** for Korean population

Objectives of the Study

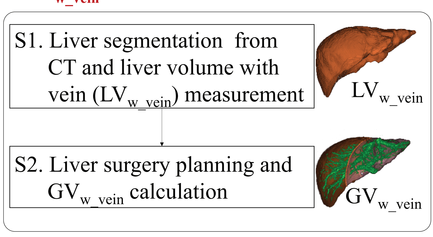
1. Develop a **regression model** using **graft volume without vein** (GV_{w/o_vein}) for **GW estimation**
2. Cross **validate** the proposed model



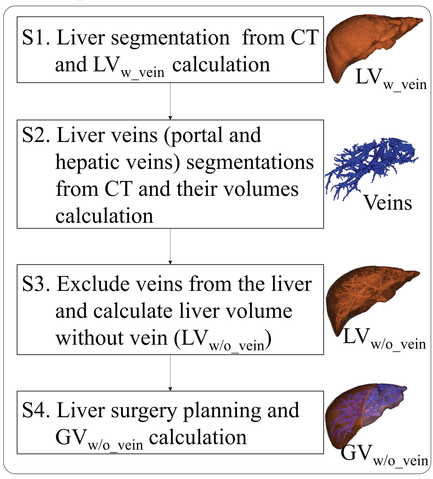
Materials & Methods

Approach

- Preoperative **GV** measurement by **Dr. Liver** (Humanopia, Inc., South Korea)
  1. **GV_{w_vein}** measurement



  2. **GV_{w/o_vein}** measurement



Data & Software for Regression

- **40 cases** (age: 29.7 ± 10.6 years) with **CT images** and **GW measured in surgery** provided by Pusan National University Yangsan Hospital (PNUYH)
- **Statistical software**: **Minitab** version 14 (Minitab, Inc., USA)

Results

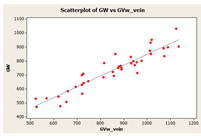
Regression Models

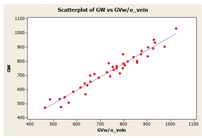
1. Proposed by **GV_{w_vein}**

$$GW = 74.7 + 0.773 \times GV_{w\_vein} \text{ (Adj. } R^2 = 0.87)$$

2. Proposed by **GV_{w/o_vein}**

$$GW = 29.1 + 0.943 \times GV_{w/o\_vein} \text{ (Adj. } R^2 = 0.94)$$

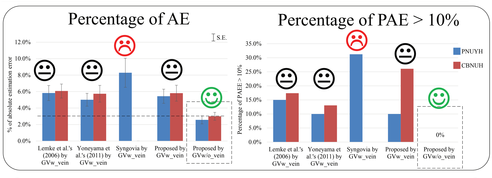


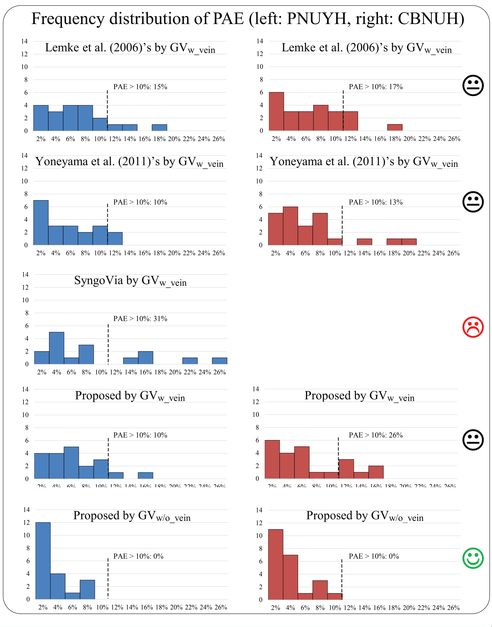


Cross Validation

- Data
  1. **20 cases** (age: 24.1 ± 6.9 years) with CT images and GW measured in surgery provided by **PNUYH**
  2. **23 cases** (age: 29.6 ± 10.8 years) provided by Chonbuk National University Hospital (**CBNUH**)
- Comparison to **Lemke et al.'s** and **Yoneyama et al.'s** models and **SyngoVia** method (GW = 0.9 × GV_{w_vein} manually measured by SyngoVia: Siemens Co., Germany)
- Validation **results**

Methods	PNUYH Data (n = 20)					CBNUH Data (n =23)				
	Absolute Error (AE; g)		Percentage of AE (PAE)		Percentage of PAE > 10%	AE (g)		PAE		Percentage of PAE > 10%
	Mean (SD)	SE	Mean (SD)	SE		Mean (SD)	SE	Mean (SD)	SE	
Lemke et al. (2006) by GV_{w_vein}	36.6 (22.5)	5.0	5.8% (4.1%)	0.9%	15.0%	45.5 (32.9)	6.9	6.1% (4.1%)	0.9%	17.4%
Yoneyama et al. (2011) by GV_{w_vein}	34.2 (26.4)	5.9	5.0% (3.5%)	0.8%	10.0%	42.0 (36.8)	7.7	5.7% (4.9%)	1.0%	13.0%
SyngoVia	52.5 (49.7)	12.4	8.3% (7.1%)	1.8%	31.3%	-	-	-	-	-
Proposed by GV_{w_vein}	35.0 (25.1)	5.6	5.4% (3.9%)	0.9%	10.0%	41.8 (33.9)	7.1	5.8% (4.6%)	1.0%	26.1%
Proposed by GV_{w/o_vein}	16.3 (12.6)	2.8	2.6% (2.2%)	0.5%	0.0%	21.5 (16.5)	3.4	3.0% (2.3%)	0.5%	0.0%





Discussion

- The **proposed** regression **model** by GV_{w/o_vein} showed **superior to existing models** in **accuracy**
- Surgeons need to spend 2~3 minutes more on GW estimation using the proposed model than existing models due to veins extraction.
- Further validation using data from more medical centers is needed.