The Seoul Journal of Medicine
Vol. 27, No. 1:39-46, March 1986

A Human Embryo of Streeter Age Group XV

Je G. Chi and Hyun K. Chee

Department of Pathology, College of Medicine, Seoul National University, Seoul 110, Korea

= Abstract =A human embryo was sectioned serially and studied microscopically in order to determine its proper age group based on the developmental status of the internal organs in terms of selected definable characteristics. The embryo obtained incidentally from an hysterectomy specimen had an ovulation age of 33 days and a crown-rump length of 7.4 mm.

Discernible morphological features of the embryo included closure of the lens vesicle, separation of the otocyst from skin ectoderm and endolymphatic duct, a cervical sinus, a narrow atrio-ventricular canal with an incompletely formed interventicular septum, bronchi in the primary stage, and dorsal and ventral pancreatic buds.

The above observations strongly suggested that this embryo should be classed in the age group XV of Streeter's developmental horizon.

Key Words: ***Embryo, Streeter age group***

INTRODUCTION

Presently the study of human embryos is based primarily on microscopic examination of serial sections of the embryo. To further describe and classify the estimated age of embryos it was necessary to include measurement of the crown-rump (CR) length and the last menstrual period (LMP).

The length of an embryo is only one criterion for establishing age of the embryo. In 1948 Streeter at the Carnegie Institute discovered a more reliable method of measuring gestational age based on the strong relationship that exists between the embryonic age, size of the embryo and the developmental status of main internal organs.

Based on his observations he formulated and introduced the concept of the "Developmental Horizon" or "age group" by dividing the embryological stages into age groups numbering I to XXIII with an interval of 2 to 3 days.

In this study a human embryo was sectioned serially, observed microscopically, and its major organ systems reconstructed. The embryo was placed in Streeter age group XV based on advancing morphological characteristics observed in the progressive development of major organs.

CASE REPORT

An embryo (ESR # 60) obtained incidentally from a hysterectomy specimen was fixed in 10 % formalin solution, embedded in paraffin, and serially sectioned in the sagittal plane from left to right in 7 micrometer thicknesses. A total of 198 sections stained in hematoxylin-eosin were obtained.

External Appearance: There was a loss of the neck region and of part of the upper jaw, presumably due to detachment of the head portion during the preparatory embedding process. Taking this into consideration, the embryo was reconstructed as shown in Fig. 1A. C-shaped embryo was structured with a marked caudal flexion. However the cephalic flexion could only be deduced. Other features characterizing the external form of this embryo included a clearly visible cervical sinus, well-formed branchial arches, and prominent upper limbs. The heart was prominent in the ventral thoracic wall and the liver at the lower margin of the heart. The CR length of embryos of Streeter's horizon XV collection range from 6.5 mm to 8.5 mm; this embryo under study measured 7.4 mm.

Central Nervous System and Sensory Organs: Due to the loss of the neck region, the

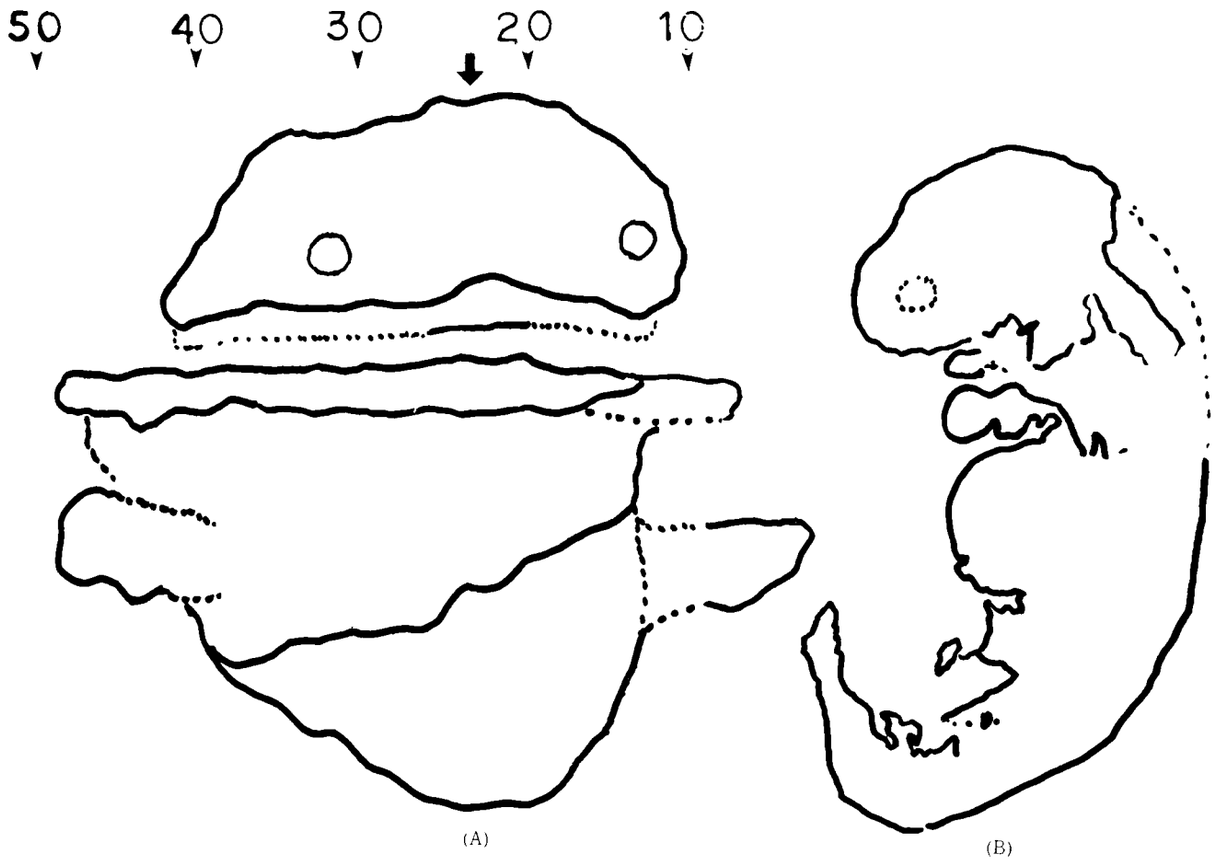


Fig. 1. A. Schematic reconstruction of the embryo in this report. Number represents the number of sectional slide. B. Mid sagittal plane (arrow in Fig. 1-A).

available slides showed only a part of the fourth ventricle and a portion of the prosencephalon. Single-layered cells lined the roof of the fourth ventricle. The Rathke's pouch having arisen from the pharyngeal epithelium was growing toward the ventral aspect of the prosencephalon (Plate 3) to form the primordial anterior lobe; the neural lobe had not developed. In the eye the edges of fovea lentis had approached each other and fused to form a spherical lens vesicle, which was separated from the surface ectoderm (Fig. 2 & Plate 4). No pigment granules were seen in the outer layer of the retina. The ear vesicle showed an elongated endolymphatic appendage (Fig. 2). Nearby the vicinity of the ear vesicle, otic ganglion was observed (Plate 6). Although sections containing the olfactory placode were lost, all of the slides showing the four pharyngeal arches were preserved in good condition (Plate 1). Dorsal root ganglia originated from the neural crest and were located along the length of the neural tube. The cervical sinus was dorsal to the hyoid arch.

Respiratory System: The ventral portion of the foregut that had become the laryngotracheal tube was separated from its dorsal portion that had become the esophagus (Plate 9). The primary bronchi extending dorsally beside the esophagus had not yet subdivided into secondary bronchi (Fig. 3). The endodermal lining of the laryngotracheal tube was different from the surrounding splanchnic mesenchymal tissue. The lumen of bronchus was identified dorsal to the lumen of the esophagus.

Gastrointestinal System: The stomodeum contained a well-formed tongue in which the foramen cecum was continuous caudally with a short thyroglossal duct connecting to the thyroid gland that still persisted in the floor of the pharynx (Plate 8). Although the foregut was preserved (Plate 11), the midgut, the hindgut, and the umbilical cord were unfortunately lost during the preparatory process of the specimen. The epithelium of the foregut was surrounded throughout its length by a zone of condensed visceral mesenchyme. Fig. 3 shows that the endodermal cells have arisen from the most caudal part of the foregut. They have proliferated and expanded to form the gallbladder, ventral and

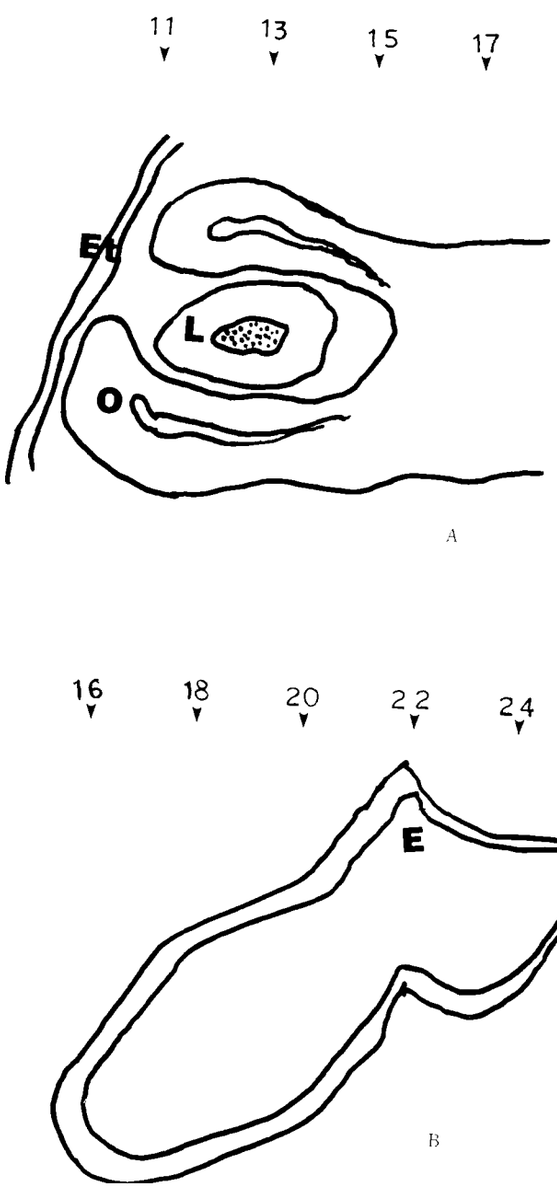


Fig. 2. A. Schematic reconstruction of eye.
B. Schematic reconstruction of ear vesicle.
Et:Skin ectoderm
L :Lens vesicle
O :Optic vesicle
E :Endolymphatic appendage

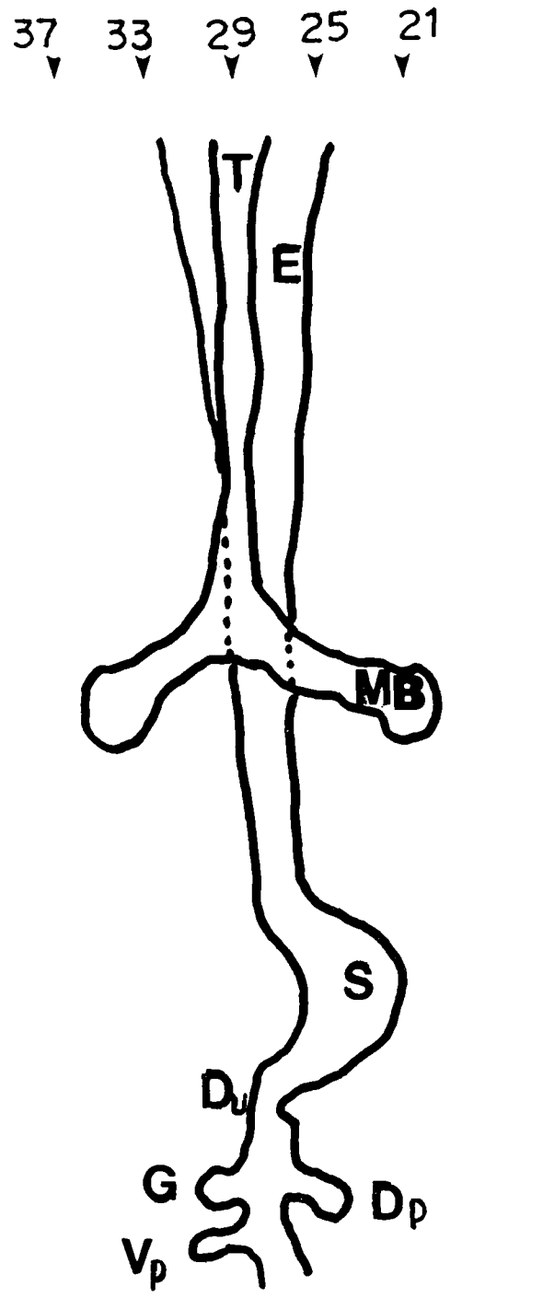


Fig. 3. Schematic reconstruction of the digestive system and respiratory system.
T :trachea
E :esophagus
MB:main bronchus
S :stomach
Du:duodenum
G :gallbladder
Dp:dorsal pancreas
Vp:ventral pancreas

dorsal pancreatic buds (Plate 12). Since the duodenum still remains to be rotated to the right, the ventral pancreatic bud has not yet fused with the dorsal bud. The liver showed interlacing hepatic cords in anastomosis with endothelium-lined hepatic sinusoids and was active with diffuse hemopoiesis.

Cardiovascular System: The primary heart showed development of the chambers with further subdivision into two atria and two ventricles. The atrioventricular endocardial cushions were bulging on the dorsal and ventral walls of the atrio-ventricular canal. They had actively grown, but had not approached each other or fused to form the septum of the atrioventricular canal (Fig. 4).

Other morphological developments observed

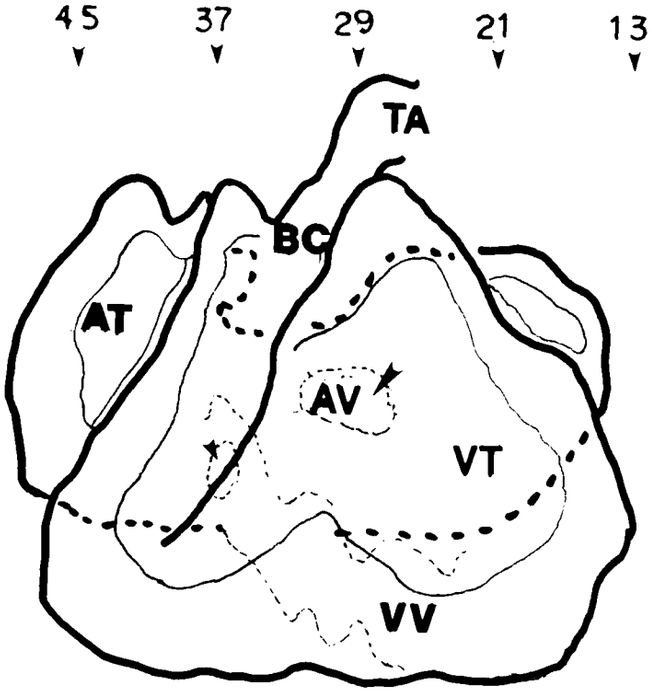


Fig. 4. Schematic reconstruction of the heart of the embryo.
TA:truncus arteriosus
BC:bulbus cordis
AT:atrium
VT:ventricle
AV:atrioventricular canal
VV:vitelline vein

were the sinus venous, vitelline vein, right and left atria, septum primum, bulbus cordis, truncus arteriosus, aortic sac and dorsal aorta (Plate 13-Plate 16). The vitelline vein was in communication with the hepatic sinusoids. The heart was enclosed in layer of cardiac jelly, also referred to as the gelatinous reticulum, which filled the myoendocardial space throughout its entire area. Cross striations and multilayered myocardial cells with centrally located nuclei were observed in the myocardial layer.

DISCUSSION

Although the loss of the neck portion of this embryo made it difficult to measure the exact CR length, its length was estimated to be about 7.4 mm. Since the CR measurement of embryos of Streeter's horizon XV range from 6.5 mm to 8.5 mm in 82 %, and 7.0 mm to 7.8 mm in 42 %, this embryo seemed to belong to horizon XV. Streeter described five main distinguishing external characteristics in this age group: closure of the lens vesicle, formation of the olfactory placode, appearance of 2 segmented hyoid bars, development of the arm buds, and elevation of the ectoderm caused by somite formation and underlying spinal ganglia. Since a photograph of the gross specimen was not available the formation of the olfactory placode and arm buds and the elevation of the skin ectoderm could not be confirmed. However, reconstruction showed that the closure of the lens vesicle had occurred, agreeing with the structural character for the lens typical of age group XV.

The absence of pigmentation in the outer layer of the retina and the lack of the neural lobe of the hypophysis ruled out age group XVI. The observation of a narrow atrio-ventricular canal with an incompletely formed interventricular septum met Streeter's description of the advancing characteristics of the heart for group XV. Additionally the developmental status of the lung was within the group XV. Since the primary bronchi had not subdivided into secondary bronchi.

Overall, based solely on the aforementioned characteristics it was quite difficult to classify the age group of this embryo due to insufficient evidence as a result of unavailable slides and a photograph of the gross specimen. Although one could claim that the appearance of the limb bud was that of the age group XIV, other features suggestive of group XIV were not found (Chi *et al.* 1983). Therefore, the embryo was classified as a member of age group XV based on the findings of the closed lens vesicle, no subdivision of the primary bronchi into secondary bronchi, and the endolymphatic appendage being distinct and elongated.

REFERENCES

Chi JG, Choi MR, Lee HK. A human embryo of Streeter age group XIV. Seoul J. Med. 1983, 24:329-336

Streeter GL. Developmental horizons in human embryos. Description of age groups XV, XVI, XVII and XVIII, being the third issue of a survey of the Carnegie collection. Contrib. to Embryol. 1948, 32:113-203

Streeter GL. Developmental horizons in human embryos. Description of age group XIX, XX, XXI, XXII and XXIII, being the fifth issue of a survey of the Carnegie collection. Contrib. to Embryol. 1951, 34:165-196

LEGENDS FOR PLATES

Plate 1. The pharyngeal arches. Arrows indicate the 5 pharyngeal pouches. X40 (#23)
Plate 2. The pharyngeal arches and cervical sinus are exhibited behind the hyoid arch. X100 (#24)
Plate 3. Central nervous system and its flexion(arrow). R: Rathke's pouch X40 (#23)
Plate 4. The eye. The lens vesicle is closed. The otic vesicle is separated from the skin ectoderm. X100 (#32)
Plate 5. Central nervous system. Low portion is 4th ventricle. X40 (#23)
Plate 6. The ear vesicle and the otic ganglion. X100 (#46)
Plate 7. The limb bud (left). X100 (#14)
Plate 8. The thyroid gland. X100 (#25)
Plate 9. The esophagus and the trachea. T: trachea, B: bronchus, E: esophagus S: somites X40 (#27)
Plate 10. The mesonephros. X100 (#23)
Plate 11. Digestive system. S: stomach, L: liver, HD: hepatic duct, G: gallbladder, I: intestine X40 (#26)
Plate 12. Digestive system. S: stomach, DP: dorsal pancreas, I: intestine X40 (#32)
Plate 13. The heart (left). AS: aortic sac, A: atrium, V: ventricle X40 (#28)
Plate 14. The heart (right) X40 (#38)
Plate 15. The endocardial cushion (arrow)., X100* (#28)
Plate 16. The sinus venosus (arrow). Ra: right atrium, Rv: right ventricle X100 (#38)

= 국문초록 =

사람배아(Streeter 연령군 XV)의 1예

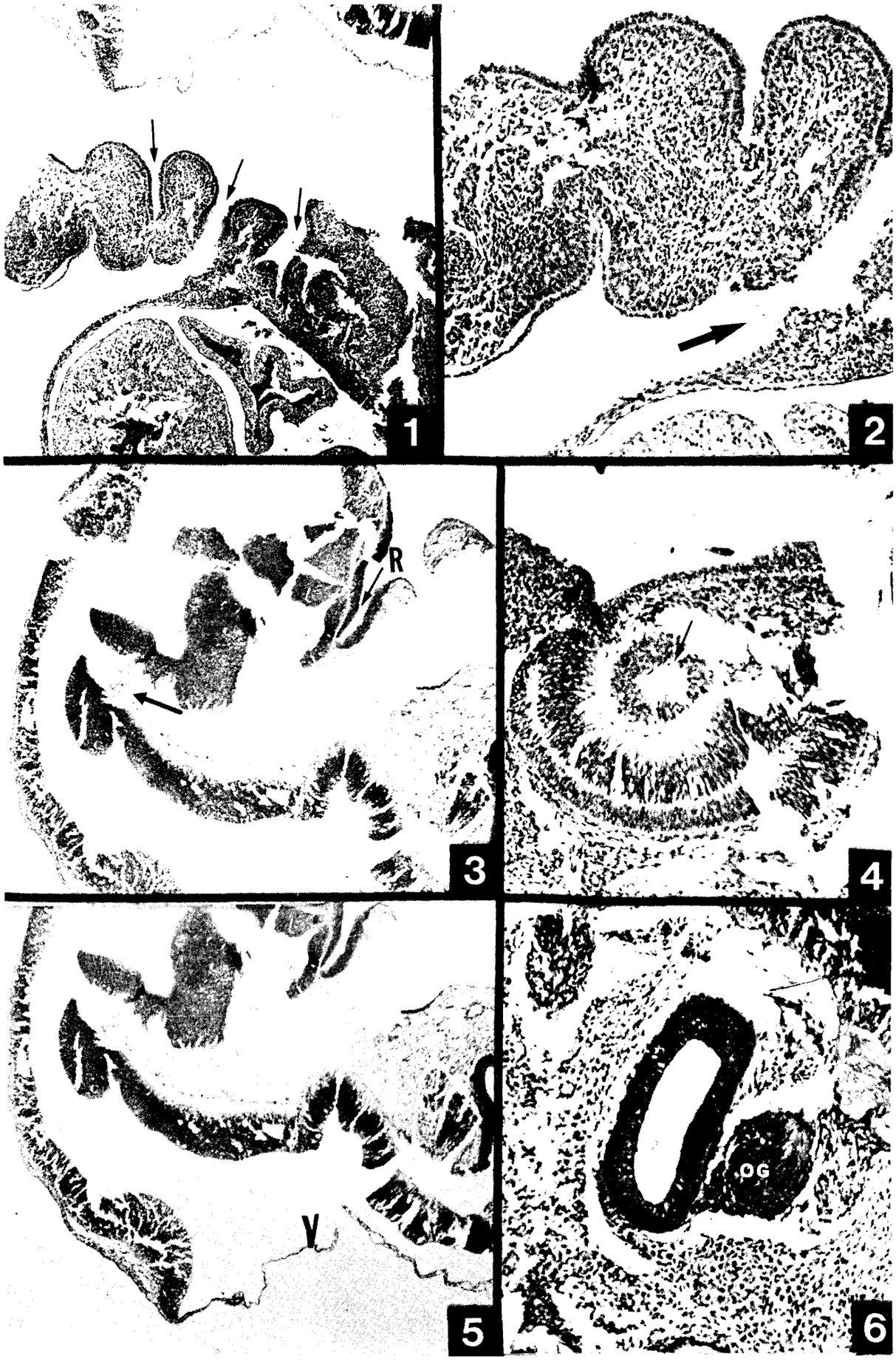
서울대학교 의과대학 병리학 교실

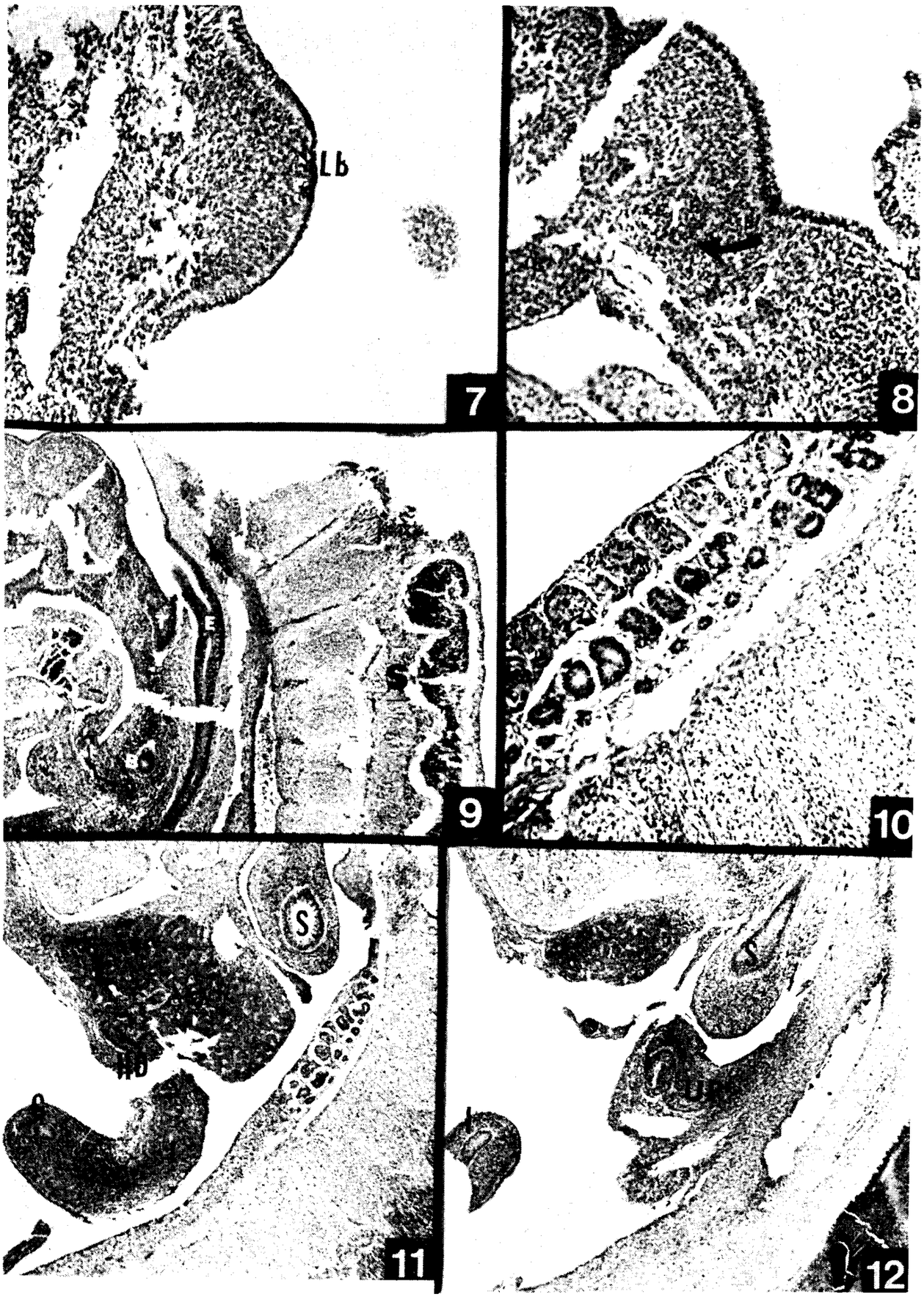
지제근 · 지현근

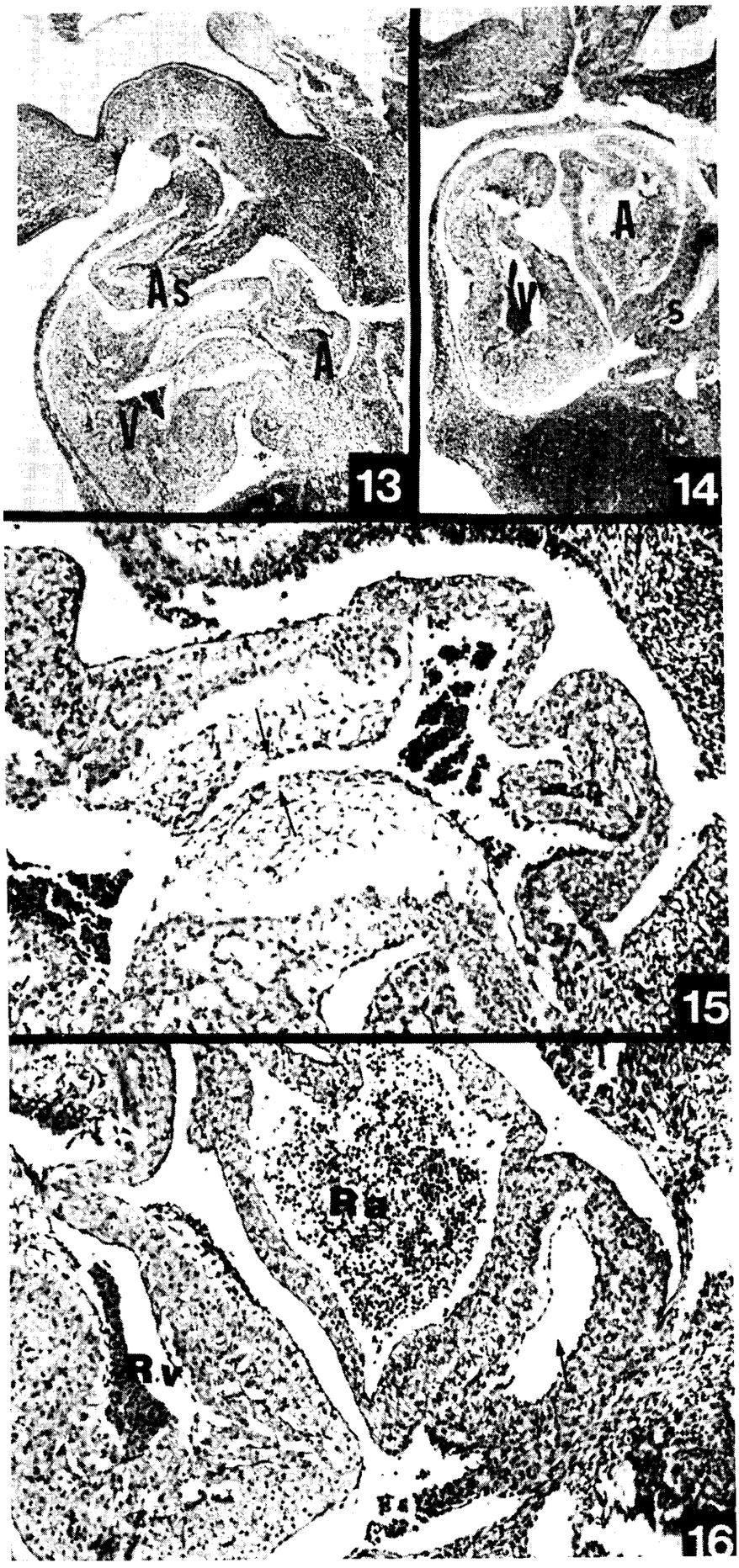
자궁적출술로 절제된 자궁에서 얻은 7.4 mm 크기의 사람배아를 연속절편하고 이를 현미경으로 관찰하고 재구축하여 그 발생학적 특징을 기술하였다.

본 배아는 표본제작 과정에서 목부위가 소실되었으나 발생학적으로 정상 발육을 하고 있다고 판단되었으며 형태학적으로 렌즈소포의 폐쇄, olfactory placode의 형성, 이분절의 hyoid bar 출현, arm bud의 형성 및 외배엽의 융기등이 특징이었다.

이상의 소견을 종합하여 이 재료는 정상발육의 배아이었고 연령군은 Streeter의 제15군에 속하는 것이라고 판단되었다.


1
2
R
3
4
V
5
OG
6


Lb
7
8
E
9
10
S
WD
11
12


As
A
V
13
A
V
S
14
15
Rs
Rv
16