Macroscopic study of the collection of human fetuses from Granada University

Kevin Doello[1,3,4], Cristina Mesas[2,3,4], Francisco Quiñonero[2,3,4], Gloria Perazzoli[2,3,4], Consolación Melguizo[2,3,4], Miguel Guirao[2], Jose Prados[2,3,4]

[1] Medical Oncology Service, Virgen de las Nieves Hospital, 18014 Granada, Spain

[2] Department of Anatomy and Embryology, University of Granada, Granada 18071, Spain

[3] Institute of Biopathology and Regenerative Medicine (IBIMER), Biomedical Research Center (CIBM), Granada 18100, Spain

[4] Instituto Biosanitario de Granada, (ibs.GRANADA), SAS-Universidad de Granada, Granada 18012, Spain

SUMMARY

The anatomical collections of fetuses are a valuable element of study and research in universities. At the University of Granada, the Department of Human Anatomy and Embryology has a collection of 283 fetuses. The purpose of this article has been to carry out an exhaustive study on these fetuses to present data related to the malformations they presented. Regarding the results, it is worth noting the presence of a higher frequency of aborted fetuses between 4.5 and 6 months of development and the presence of macroscopically evident malformations in 56% of them. In conclusion, this study assesses the usefulness for teaching and research of this anatomical material and the results provide data of interest on fetal development and the etiology of spontaneous abortions.

Key words: Fetuses – Abortions – Malformations – Anatomical collections

INTRODUCTION

Fetal development is a complex process that could be divided into three periods (trimesters), each with distinct developmental milestones. During the first trimester, the fertilized egg undergoes rapid cell division and differentiation, leading to the formation of the major organs and systems of the body. By the end of the first trimester, the fetus is about 3 inches long and weighs around 1 ounce. In the second and third trimesters, the fetus undergoes further growth and development. The skeleton begins to harden, and the nervous system becomes more advanced. During the third trimester, the fetus gains the most weight and continues to develop its organ systems. By the time of birth, the average fetus is about 20 inches long and weighs around 7.5 pounds. Fetal development is a critical period that lays the foundation for a person's health and well-being throughout their life (Blencowe et al., 2012; Filippi et al., 2023; O'Rahilly and Müller, 2010).

To study fetal development, anatomical collections of human fetuses have been created in many medical schools and faculties around the world. These collections provide invaluable resources for researchers, educators, and medical professionals who seek to better understand human development and improve patient care. The value of

Corresponding author:
José Prados. Institute of Biopathology and Regenerative Medicine (IBIMER), Biomedical Research Centre (CIBM), University of Granada, Spain. Phone: +34-958249322; Fax: +34-958246296. E-mail: jcprados@ugr.es

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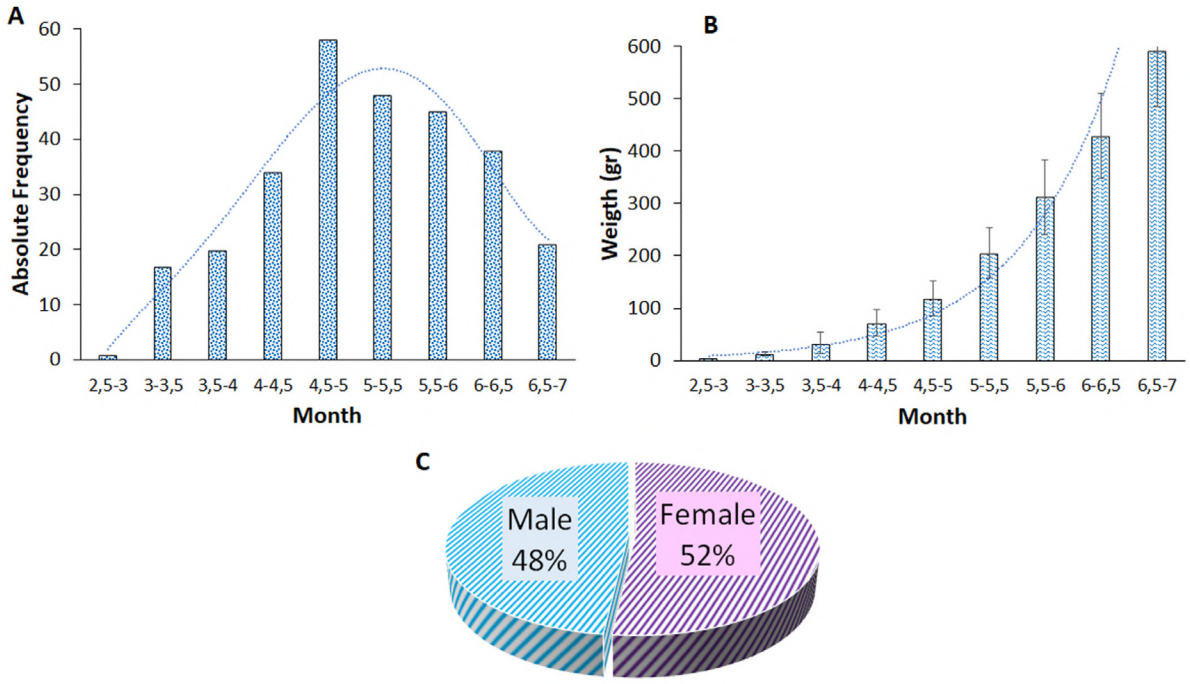

Fig. 1.- Abortive fetuses of the Granada University. **A**. Distribution of abortive fetuses by week of gestation. **B.** Evolution of weight (gr) in abortive fetuses by week of gestation. **C.** Sex distribution in abortive fetuses by week of gestation.

fetal anatomical collections lies in their ability to provide a comprehensive view of human development, from the early embryonic stages to full-term fetuses. By examining these specimens, researchers and educators can identify the normal and abnormal features of fetal anatomy and understand the complex interactions that occur during development. Additionally, these collections serve as a valuable resource for training future medical professionals, allowing them to gain hands-on experience in human anatomy and pathology (Knoeff, 2015; Kosenko et al., 2022). Among the most rep-

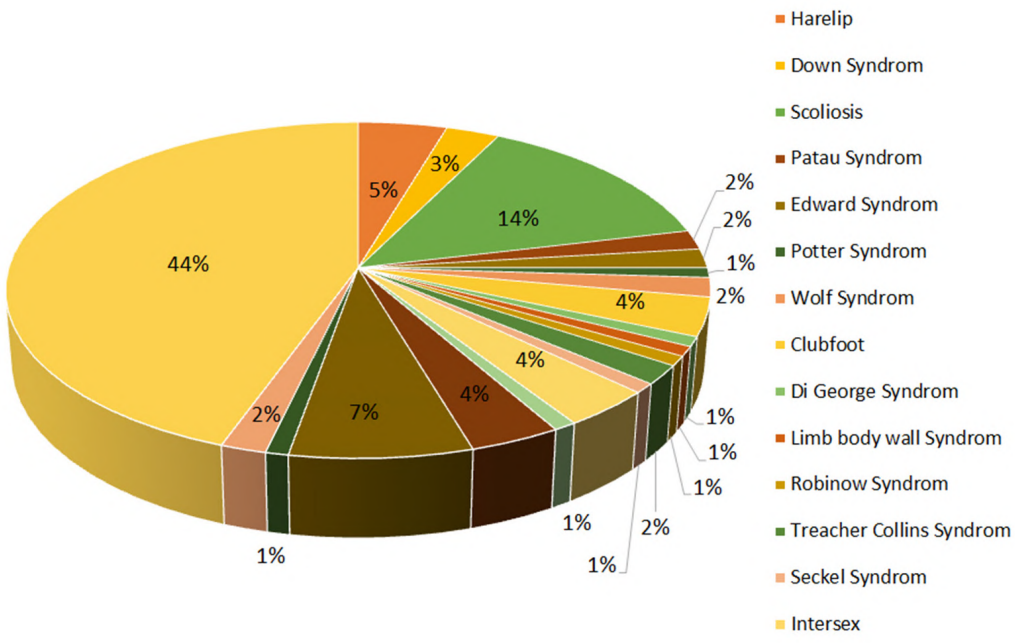

Fig. 2.- Description of the malformation in the collection of fetuses from the University of Granada.

resentative collections are the Carnegie Collection (Carnegie Institution) of Washington, which includes more than 15,000 specimens from early embryos to term fetuses, and the Kyoto Collection, which contains more than 6,000 specimens and is known for its extensive documentation of abnormal fetuses (Brown, 1987; Spradling, 1997; Tanaka et al., 2020; Yamaguchi and Yamada, 2018).

Our main was to carry out a descriptive study of the collection of human fetuses from the Department of Anatomy and Embryology of the Granada University.

MATERIALS AND METHODS

Human Fetuses (n=283) from the collection of the Department of Human Anatomy and Embryology of the University of Granada were classified by weight at the time of acquisition, apex-coccyx (CV) distance, and apex-tail distance. From the VC distance we determine the approximate gestational age. Likewise, the existence of malformative macroscopic features was analyzed. With all these data, a descriptive statistical study was carried out. This research has been approved by the ethics committee of the Faculty of Medicine of Granada (3440/CEIH/2023).

RESULTS

Regarding the distribution of abortive fetuses, it should be noted that their highest frequency was concentrated between 4.5 and 6 months of gestation (18 and 24 weeks), decreasing slowly and following an inverse gamma distribution (Fig. 1A). Weight, as expected, evolved exponentially with increasing gestational age (Fig. 1 B). Slightly more female (52%) than male fetuses were observed, although these differences were likely due to sample-specific variability (Fig. 1C). According to the detected malformations, the most frequent was to find fetuses with hypertelorism and micrognathia not associated with any specific syndrome and scoliosis. Malformations compatible with some chromosomal syndromes and other congenital malformations such as Down syndrome, Patau, Edwards, Wolf, Potter, Di George, Robinow, Treacher-Collins syndrome or intersex anomalies were detected. A large proportion of fetuses (44%) did not present clear macroscopic malformations (Figs. 2 and 3).

Fig. 3.- Examples of congenital malformations found in the collection of human fetuses from the University of Granada. **A**. Wolf-Hirschorn syndrome (head in Greek helmet). **B**. Patau syndrome (cleft lip, genital malformations, short sternum). **C**. Potter syndrome (periorbital edema, mycorgnathia, and low-set malformed ears). **D**. VACTERL (anal atresia and genital malformations). **E**. Down syndrome (broad nasal root, hypertelorism, and macroglossia). **F**. Robinow syndrome (achondroplasic cranial changes, hypertelorism, and characteristic nose). **G**. Scoliosis. **H**. Anophthalmia. **I**. Edwards syndrome (rocking chair feet, hypertelosimus, retrognathia, and auricular malformations). **J**. Limb body Wall syndrome (scoliosis and gastroschisis). **K**. Dolichocephaly. **L**. Treacher Collins syndrome (characteristic fascia with large oral cleft).

DISCUSSION

The most frequent malformations found in human fetuses aborted between 3 and 6 months of development include central nervous system defects, such as anencephaly and hydrocephalus, and chromosomal abnormalities, such as Down syndrome. Other malformations found in fetuses at this stage include heart defects, skeletal abnormalities, and gastrointestinal defects (Naeye, 1983; Roets et al., 2023). In our collection, the most frequently malformations were fetuses with characteristics of hypertelorism and micrognathia not attributable to specific syndromes and scoliosis. In addition, to a lesser extent, fetuses with anomalies such as Down syndrome, Patau, Edwards, Wolf, Potter, Di George, Robinow, Treacher-Collins syndrome, or intersex anomalies were observed. Mora-Alferez et al., (2016) in a study on abortive human fetuses and chromosomal malformations, indicated that the most frequent chromosomal anomalies in spontaneously aborted fetuses were trisomies 16, 22 and 9. These are anomalies mostly in internal organs and without clear distinctive macroscopic features. Thus, they probably correspond to fetuses that have been classified as hypertelorism and micrognathia without a clear syndromic correspondence. In addition, these malformations have been determined in fetuses older than six months, so it would be very likely to find younger fetuses with the chromosomal alterations described by Mora-Alferez et al., (2016). However, this study was very difficult at the macroscopic level with fetuses under six months.

On the other hand, no human fetuses younger than 3 months were found in our collection, probably because abortions at this stage are usually spontaneous and the embryos are extracted undetectable or by curettage. Almost 70% of spontaneous abortions occur before 8 weeks of gestation (Alves and Rapp, 2023). In our case, the human fetuses showed a curious distribution as spontaneous fetal abortions increased towards week 18, being higher between weeks 18 and 24. Interestingly, they followed an inverse gamma distribution. This distribution is similar to that described in infectious disease susceptibility, suggesting the infection as the cause of the abortion at this stage. In addition, 56% of the fetuses also had signs of malformations that would make them more susceptible to these infectious factors. It is known that infections can occur at any stage of fetal development, but the highest incidence occurs at the first and second trimesters. During this period, the fetus is particularly susceptible to infection due to the immaturity of its immune system and the high rate of cell division and differentiation (Kollmann et al., 2017; Limperopoulos et al., 2002; Marbán-Castro et al., 2021; Plourde and Bloch, 2016). Several factors can increase the risk of infections, including maternal age, maternal immune status, and exposure to environmental pathogens. Maternal infections, such as urinary tract infections, can also increase this risk. In addition, certain lifestyle factors, such as smoking and alcohol consumption, may also increase the risk of infections (Pascoal et al., 2023; Wiegersma et al., 2023). In addition, malformed human fetuses are at increased risk of developing infections due to their weakened immune systems and compromised barrier function. Studies have shown that fetuses with malformations have a higher incidence of infections such as cytomegalovirus, rubella, toxoplasmosis, and syphilis. Furthermore, human fetuses with chromosomal abnormalities are also at increased risk of infections, as their immune systems are not fully developed (Fitzpatrick et al., 2022; Marbán-Castro et al., 2021; Wang et al., 2019).

CONCLUSION

In conclusion, this study highlights the interest of human fetus material for teaching and research purposes, and provides new data regarding fetal development and the etiology of abortions in the fetal stage, highlighting the absolute frequency per week, the possible etiologies, and the presence of macroscopic malformative anomalies in 56% of them.

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